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COMMITMENT TO TRAINING
WHY YOUR SHOP SHOULD BE BLOGGING 36

UBM
NOVEMBER 2017
VOL. 136, NO. 11 MOTORAGE.COM


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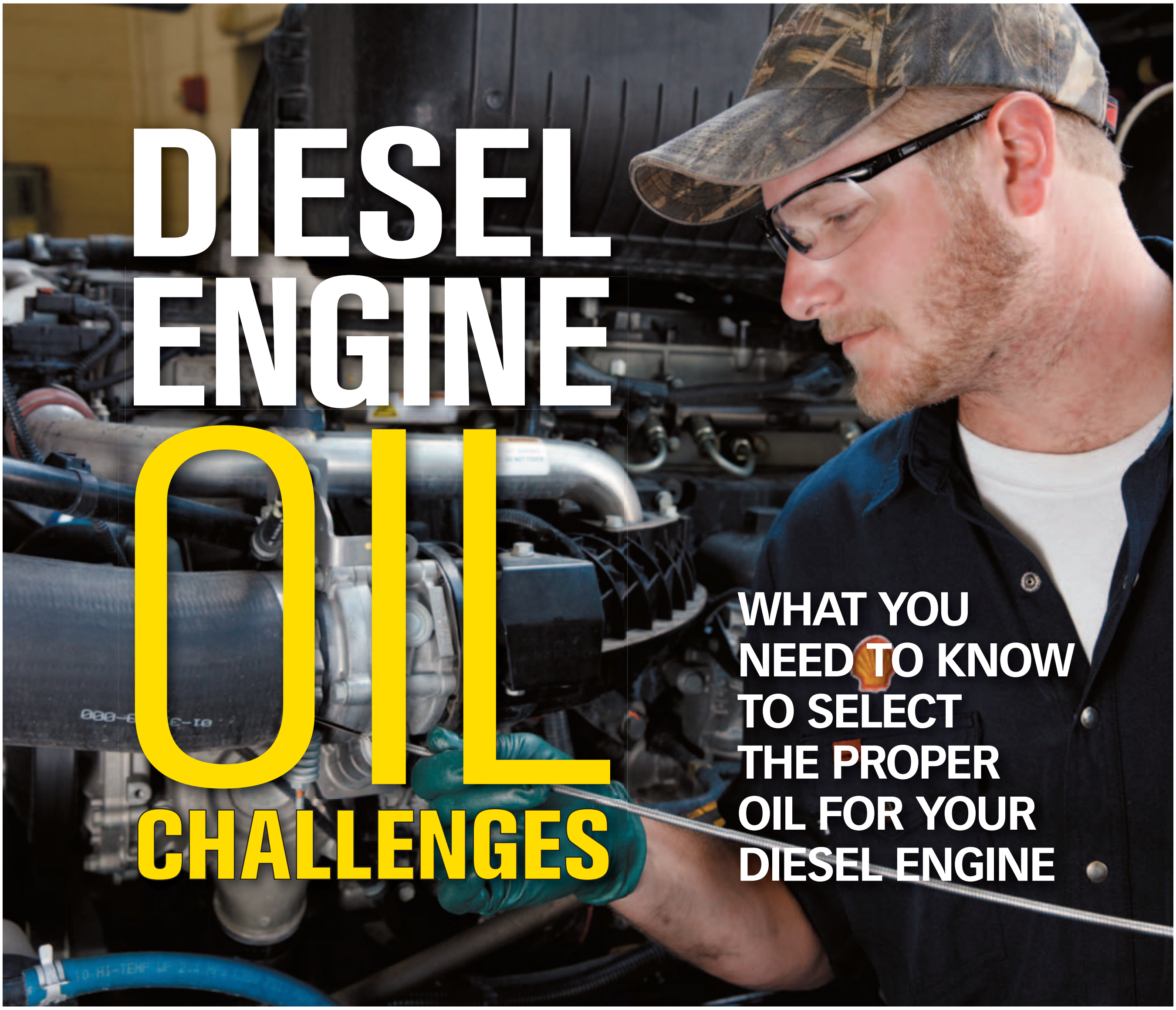

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AUTOPRO WORKSHOP

NOVEMBER 2017

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OPERATIONS

TECHNICAL

IN EVERY ISSUE

SPECIAL SUPPLEMENT

KIA QUALITY CONNECTION

Take a look at the Fall Kia Quality Connection, which is included with this month's issue of *Motor Age*.

WEB EXCLUSIVES // MOTORAGE.COM

FINDING THE RIGHT SHOP MANAGEMENT SYSTEM

What do you expect from your shop management software? From utilizing robust tools to improve your shop performance to marketing, financial assistance, estimating and repair orders, your shop management system significantly impacts your business. Joining the latest episode of the NAPA AutoCare Center Podcast are three experts with intimate knowledge of how shop management systems work from all angles. Jon Luttrell, director of sales with NAPA TRACS, moderates. Joining him are Ben Dexter, national training manager with NAPA TRACS, and Steve Manning, general manager with Woodie's Auto Service in North Carolina. Ben and Steve share personal experiences from using shop management software that will give you insight into what you should be looking for in a system.

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INDUSTRY NEWS

PHOTO: TENNECO

TENNECO LEARNING PROGRAM HELPS SHOPS SUSTAIN GROWTH

The Tenneco Service Solutions team is helping automotive service providers achieve and sustain impressive gains in ride control replacement and other services through a multi-faceted training program that includes dozens of free eLearning courses. The expanded set of eLearning modules, available at www.ExpertsLearningCenter.com, is helping tire dealers, general repair shops and other businesses enhance employee training opportunities with access to best practices shared through the Service Solutions team's instructor-led workshops and other activities.

"Service Solutions takes a holistic approach to helping Tenneco customers increase their ride control and other service volume over the long-term," said Ethan Bregger, Tenneco's aftermarket training manager, North America. "We have found that this approach is far more effective than individual training events, which will often produce only a temporary increase in business. Our eLearning modules help employees contribute to a sustained improvement in the way their shops approach ride control replacement and other service opportunities."

The Service Solutions eLearning curriculum includes more than 25 interactive courses focused on vehicle inspection and diagnostic techniques as well as customer communication skills. Available courses cover the ride

>> CONTINUES ON PAGE 10

BREAKING NEWS

NEWS EYEBROW

HOW SHOPS SHOULD COMMUNICATE WITH THEIR CUSTOMERS

JON EYRE // Contributing Editor

The way that consumers research, find and engage with car shops has changed significantly in recent years. In the past, managers would buy newspaper and radio ads, put up a billboard, get listed in the Yellow Pages and wait for customers to call or show up to their shop.

Now, the process is much more detached. While traditional advertising and marketing are important to create awareness, they are no longer the primary sources consumers turn to when deciding which shop to choose. Online searches are now king. Today's consumer typically searches for shops near them, reads reviews, maybe looks at your website, and then calls or messages you directly from your listing.

The option for customers to message businesses is a new

>> CONTINUES ON PAGE 6

TRENDING

THE GROUP TRAINING ACADEMY PROVIDES ONLINE TRAINING

The Group Training Academy gives automotive professionals the opportunity to train online as often as they like and when it is convenient for them.

MOTORAGE.COM/GROUP

TIMKEN OFFERS TRAINING VIDEOS ON BEARING SERVICE

The Timken Company created two new training videos that guide techs through replacing press-in style wheel bearings as well as proper lubrication of Ford truck wheel hubs.

MOTORAGE.COM/BEARING

OPENBAY ONLINE SERVICE HELPS SHOPS SERVE CONSUMERS

Openbay Profile is a robust online presence for the automotive care business that allows consumers to interact and exchange information for service and repair.

MOTORAGE.COM/OPENBAY

MAHLE INTRODUCES SHOPPRO JACKS, LIFTING EQUIPMENT

MAHLE Service Solutions has partnered with Gray Manufacturing to offer ShopPRO, a line of high-quality hydraulic and pneumatic equipment for commercial vehicles.

MOTORAGE.COM/SHOPPRO

WOMEN IN AUTO CARE ANNOUNCE 2017 WOMEN OF THE YEAR

Women in Auto Care announced the recipients of the Auto Care Woman of the Year; Auto Care Woman of Excellence and Female Shop Owner of the Year awards.

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addition. Google recognized that more and more customers would prefer to message a business as opposed to placing a call. In fact, 90 percent of consumers want to use messaging to interact with a business — with 50 percent preferring to message via SMS text.

The problem is only 48 percent of businesses are capable of messaging with their customers. There are a number of reasons that businesses cite for not wanting to implement a messaging strategy with their customers including:

- Too time consuming
- Resource intensive
- Cost prohibitive

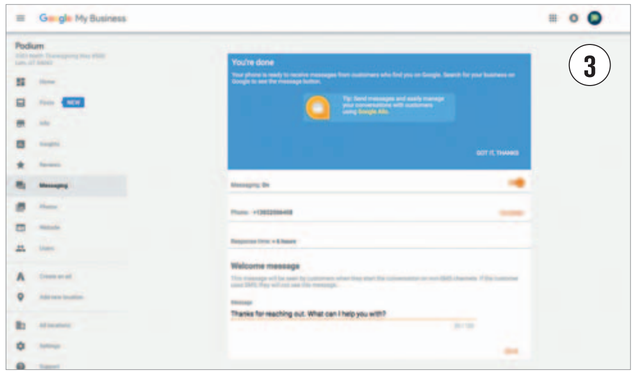
In the past, those concerns might have been valid, but that is no longer the case. In fact, messaging with your customers will save you time and money rather than eating up resources. Businesses using Podium Messenger have been able to see a 15 percent reduction in inbound call volume, while also seeing a 26 percent increase in their Net Promoter Scores. Because business text messaging is so vital, we want to walk you through the process of setting up your business with Google's Click-to-Message feature.

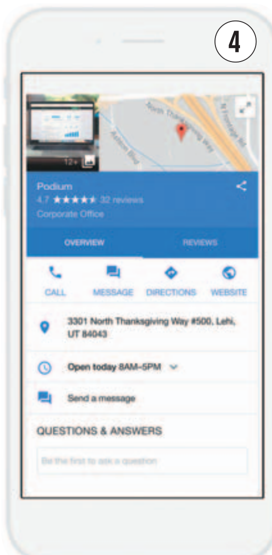
Setting up Google Click-To-Message

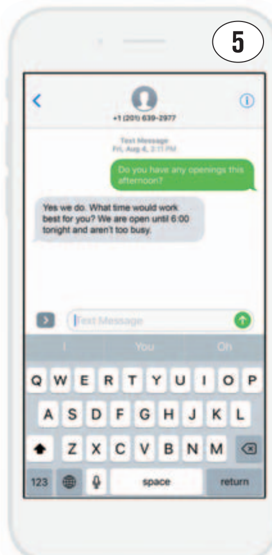
1. Login to your Google My Business Page (Figure 1).
2. Select "Messaging" in the left menu and add phone number (Figure 2).
3. Verify that number with a code sent from Google (Figure 3).
4. Now searchers can message your shop (Figures 4, 5).

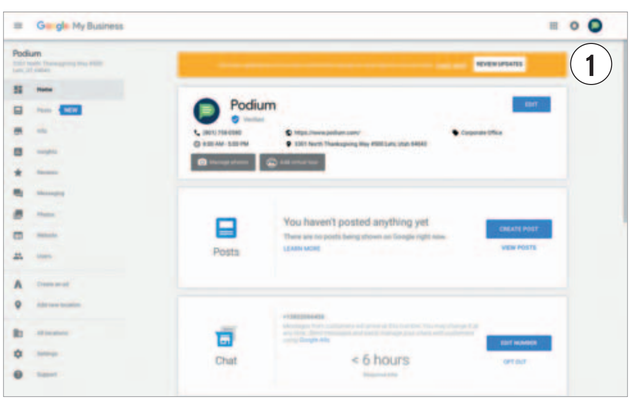
When you should message your customers

Because texting with your customers is such a new phenomenon, it might be difficult to know when you should text with your customers. Customers typically will reach out to you via text when they are experiencing what Google refers to as a "micro-moments." A micro-moment is a time on the customer journey when customers want to know, want to









go, or want to buy something.

A lot of times, consumers won't want to make a call when they are having these micro-moments because calls are often perceived as time consuming and inconvenient. Businesses that give consumers the option to message with them will likely see an uptick in business. Some other times when consumers want to engage your business via text include:

Answer simple questions: Customers may just want to know something simple like what your hours are or whether you perform a specific service. Having the ability to answer

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those questions via text will make life easier for not only your customers but your employees as well.

Make appointments: Today's consumer wants it to be simple and easy to engage with a business and that includes making appointments. Being able to make an appointment and send appointment reminders via text will increase customer satisfaction and help you drive loyalty.

Resolve problems: Unfortunately, not every interaction with your customers is going to go as smoothly as you would like. Giving customers the option to reach out to report issues via text will help you significantly improve your response time and help you prevent small problems from becoming larger.

Tips for interacting with customers via text

Now that your shop is all set up to take incoming texts and are familiar with instances where customers want to text you, let's review some tips that will help you successfully interact with your customers.

Be responsive. Oftentimes when consumers are conducting an online search on their mobile device, they want their questions answered immediately. This is because, as previously discussed, they are likely experiencing micro-moments. If your online presence isn't able to quickly answer their questions, they will probably move on to your competition.

One of the main reasons that online searchers want to connect with you via text is they feel like it is a quicker, more efficient method of communication. But that's only true if the shop is placing an emphasis on quick response times.

To ensure this happens, shop owners and managers should make sure their team is well equipped to offer quick responses to customers. If you don't consistently respond to messages in a timely manner, customers will know because over time Google will post typical response times on your listing.

Don't ask for sensitive information via text. This might seem obvious, but it bears repeating. Businesses should never ask for sensitive information like credit cards, banking information, or social security numbers over text. While text messages seem secure, the information isn't encrypted so the data could be vulnerable.

Ask for customer feedback. Another valuable way to utilize text messaging in your customer interactions is asking for feedback. A lot of times customers don't want to take the time to fill out a lengthy customer satisfaction survey, but they would be willing to answer a few questions via text. That is because asking questions via text comes across as more personal and less intrusive than a survey.

One way to approach this is by asking your customers after a transaction is complete, "On a scale of 1 to 10, how likely would you be to recommend this business to a family or friend?" And then follow that up with one or two questions about the service your business delivers. Our research has shown that approaching customer feedback this way results in significantly higher open and response rates than traditional CSAT surveys.

Invite customers to review your business. Text messaging is also a good method for collecting public-facing customer feedback on your Google My Business listing. One of the biggest reasons to use text messaging to do this is many people are already signed into their Google account on their smartphone, so it's much easier to connect them directly to your Google reviews page.

Encourage customers to add you to their contacts. Texting with your customers will help you build stronger, more loyal customers. To help you reinforce that loyalty, try texting them a vCard with your contact information on it. If customers have access to your phone number in their contacts, it removes one of the steps in the car buying journey. It will help you evolve from being just a shop to being their shop. MA

>> CONTINUED FROM PAGE 4

control, emissions control and performance categories, and many are offered in English, French and Spanish. More than 25,000 course sessions have been completed through the www.ExpertsLearningCenter.com training portal, while thousands more are completed each year through learning management systems sponsored by leading Tenneco channel partners.

In addition to eLearning courses, the Tenneco Service Solutions program includes classroom training led by the company's ASE-certified Master Trainers; the Tenneco Technical Resource Center, which includes technical, warranty, catalog and other support delivered via telephone, email and the company's Tech Talk web forums; the Tenneco Experience mobile product and technology trailer; and marketing services, through which the team creates and executes custom training programs, on-the-job learning tools and other resources.

"We are collaborating with a growing range of distribution networks, service chains and other customers in developing and delivering custom technical and business training that drives positive results at the service dealer level," Bregger said. "We also encourage any shop owner, service writer or technician to access any of the free eLearning courses offered online at www.Experts-LearningCenter.com." MA

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MANAGEMENT SUCCESS FALL CONVENTION FOCUSED ON SUCCESSION PLANNING, MARKETING TECHNIQUES

MOTOR AGE WIRE REPORTS

The Management Success fall convention attracted hundreds of independently owned repair shops from the United States and Canada to the Pomona Fairplex in Pomona, Calif., Sept. 22-24.

The event kicked off on Friday morning with a welcoming speech by Robert Spitz, senior vice president of business development, which included a presentation about the emergence of autonomous and electric vehicle technology. A series of informative workshops and seminars then followed for more than 300 attendees in the heavy duty truck, collision and automotive repair industries.

"With its focus on financial management and succession planning, the educational content is designed to help shop owners elevate their business," Spitz says.

Friday's buzz circulated around a seminar called "Working with Millennials: Keys to Understanding and Employing the Next Generation," which discussed common personality traits and career goals of this growing demographic in the workplace. "Since they were born during the technology boom, millennials — or Generation Y, as they prefer to be called — adapt to change quickly," says presenter Mandee Bradshaw, vice president of professional services. "Create an environment where Generation Y employees feel supported and valued and you'll notice increased productivity."

Later that evening, Management Success bestowed 23 trophies to owners who attained significant milestones in their business' development. Multiple shop owner Kate Jonasse of K-Tech Auto and Pauline's Automotive in Sebastopol, Calif., received the distinguished Master Elite of Shop Management award. This honor recognizes operators who have demonstrated effective management tools and financial and organizational stability.

"Envision what success looks and feels like to you and hold on to that thought," said Kate in her sentimental acceptance speech. "If you want it enough, you can have it as long as you focus on it and you never give up."

Activities on Saturday morning began with a high-energy interactive workshop on communication and workflow presented by Wes Severi, senior service consultant. Shop owners practiced communication techniques designed to help them improve workflow in their shops.

Pomona Fairplex, home to one of the world's largest and most renowned fairs, set the tone for Saturday evening's country-themed barbecue dinner. With a green-screened photo booth, mechanical bull, live band and line dancing, Management Success clients, vendors and employees dressed in lively western attire.

Wrapping up the weekend with Sunday morning super sessions on "Modern Marketing Techniques that Work," Management Success staff and special guest speakers touched on hot-button topics. They included social media, digital marketing, advertising and public relations. Plus, an expert-level masters panel answered shop owners' questions on various marketing strategies and provided a checklist of action items that could be easily implemented into their businesses.

"You need to come to a convention — it's just that simple," said TJ Cleveland at Durango Muffler in Durango, Colo., when asked about the value that Management Success conventions offer to shop owners. "When you listen to the succession stories and meet the masters, it reenergizes you to keep making your business better."

The next convention will be held in Montgomery, Texas from April 13 – 15, 2018. For more information, please visit www.managementsuccess.com.

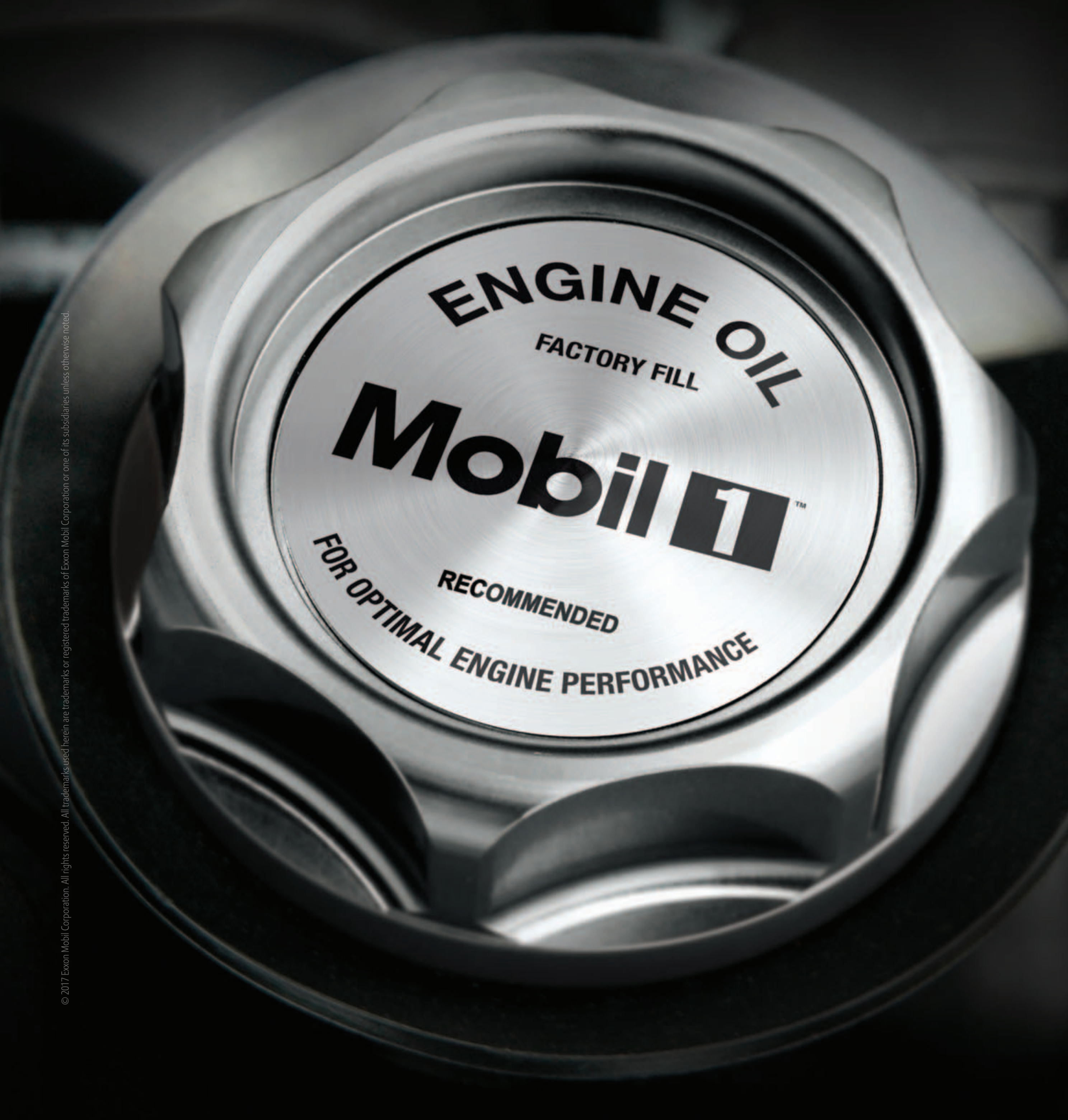
ALI MOVES INTO LARGER HEADQUARTERS, OPENS LIFTLAB

The Automotive Lift Institute (ALI) opened its new headquarters and LiftLab in Cortland, New York, last month.

Growth of ALI lift safety initiatives like the ALI Lift Inspector Certification Program drove the need for a larger multipurpose facility.

The new 8,500-square-foot headquarters includes renovated office and conference space, as well as a modern classroom that complies with nationally recognized examination requirements for up to 20 participants.

ALI member manufacturers have provided and installed 12 vehicle lifts in the expansive LiftLab area. They range from the smallest motorcycle lift to the most common two-post style, all the way up to heavy-duty inground and mobile column lifts. This is the only facility in North America that brings together such a wide range of operational lifts from various manufacturers and makes them available for hands-on industry training.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MANNING THE BOOKS

Hire and manage a bookkeeper with a single focus and clear communication

TERRY KELLER // Contributing Editor

I've made a lot of mistakes running a shop since I first opened my doors in 1974. In that time, I've spent my own time and money learning the exact wrong way to advertise, hire, fire and incentivize. I've filed 102 W2s in a single year hiring the wrong people, and I've spent hundreds of thousands of dollars on a single, failed marketing campaign.

As damaging as these things are, there's probably nothing I've done that has been more damaging to my business, bank account and health than hiring the wrong bookkeeper.

A bookkeeper is a vital part of running a successful repair shop, and I absolutely don't recommend trying to operate without one. But I'd wager that 95 percent of the shop owners I know and have worked with struggle to hire, train, manage and hold their bookkeepers accountable.

This position doesn't have to be a source of constant frustration and disappointment, especially with how critical it can be to your business. Start with learning how to hire a quality bookkeeper, how to manage him/her and lastly, how to best utilize this person.

Knowledge barrier

In the shop, we use service advisors or a related role to turn the technician's knowledge and specialized lingo into language the customer can understand. This relationship makes sense. A technician's highest and best use is under a car, doing inspections and turning wrenches, so we trust the service advisor to translate and clearly communicate.

A bookkeeper is every bit as specialized and deals in as much technical lingo as a technician but doesn't have anybody to translate for them. Which means we must approach this from both sides. We must spend some time

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learning basic accounting concepts, and we must expect them to translate for us.

When a conversation has gotten too technical for me — with a bookkeeper or any other position — I stop the discussion right there and ask one of two questions.

If I think I have a pretty good understanding, but don't want to assume, I start by saying, "So, what you're telling me is…" and repeat back their words in my own language.

And if I have no idea what they're trying to communicate, there's no point in me pretending, so I say, "Teach me what you mean by that."

I know that probably seems like a strange place to start — how to ask your bookkeeper to explain what they mean — but honestly, it's impossible to hire, train and manage a bookkeeper if you can't communicate clearly with them. If we're not willing to ask for an explanation, we're going to stay stuck in the same cycle of distrust and frustration that plagues most shop owners and their relationship with their bookkeeper.

Setting expectations

Once you're ready to openly communicate with your bookkeeper, the next critical step is to set clear expectations for what they need to do every day, week and month. These shouldn't be poorly-defined concepts, but explicitly-defined tasks. What report to send, by what time, to whom.

In other words, a checklist.

At the expense of cutting a critical section short, you can download our Daily Bookkeeping Checklist for free at autoprofitmasters.com/checklist.

Who to hire

My biggest failure in the bookkeeping department has been seeking the right personality. All the processes and checklists in the world can't make the wrong fit a good bookkeeper.

For example:

I've hired empire builders, who wanted to take control of more and more responsibilities — which seems great until they walk and you're left to figure out how to get five jobs done again.

I've hired pushovers who were nice but unable to get even basic job responsibilities done.

I've hired overqualified bookkeepers who came in and wanted to change how my books were done.

I've been doing this since 1974. I've hired a lot of bookkeepers.

And if there's a consistent lesson, it's this: Look for a bookkeeper with a personality in the middle, who is willing to fit into your system instead of taking over yours. Stick to core responsibilities — don't let them control everything — and remember that bookkeepers are not managers or customer service people.

Does that last point sound crazy? Your bookkeeper already knows more about your business than probably anybody in it – maybe even more than you. Do you want the person who does your payroll and bank statements to communicate with your customers and employees? Because they're doing so through that lens: "This person makes this much? I do more than them." And, "This person owes how much? They don't deserve excellent customer service."

Bookkeeping has a natural tendency to produce feelings of jealousy and underappreciation. Combining that with the responsibility to lead other employees or talk with customers is a toxic combination.

Which leads to perhaps my most important point in this article: Not only should bookkeepers not be involved in managing employees or providing cus-

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tomer service, they are also singularly unqualified for helping you make business decisions.

It's not about whether they're smart, it's that they view every decision through the lens of how to pay for it. They don't know how to increase the efficiency of your team. They don't know how to attract quality customers with marketing. They don't know how to increase your profitability. They don't know how to properly incentivize your team.

Trusting them in the decision-making process for growing your business is foolish, and you'll end up stuck in mediocrity simply because it comes with fewer upfront costs.

Holding bookkeepers accountable

On this point, I'll admit to being lax at times, and each and every time it comes with consequences. You must trust somebody outside of the business to review your books regularly.

This isn't about not trusting your bookkeeper. You don't have to suspect that they're embezzling money from you. This is about making sure that there aren't long-term issues happening in your books.

If you hire a bookkeeper today, and you don't discover they're misclassifying an income or expense until your CPA finds it next April, how much time is it going to take to walk back all those mistakes? You've lost time and money with the CPA, and you've lost a lot of time and money with your bookkeeper — all of which could be stopped with a routine audit by the CPA.

Talk to your CPA about doing a monthly, quarterly and annual review of your books. Keep a hard line of separation between the CPA and the bookkeeper — they should never speak, become cozy, or want to cover for each other. Have your bookkeeper send you the reports, and then send them yourself to the CPA.

Set the example

By "set the example" I mean "never be dishonest."

Even the smallest moment of dishonesty in front of your bookkeeper gives them the license to be dishonest with you. This is true of any position in your business but especially with the bookkeeper.

They know your books. They know what you pay attention to and where they can hide things from you. They can hurt you in spectacular ways, even putting you out of business.

Ultimately, much of this article could go under the headline, "Don't let your bookkeeper own you," and this point is no different. From their personality, to their responsibilities, to the way you manage the position and hold it accountable, a bookkeeper can hold you and your business hostage.

And yet, the bookkeeper is a valuable part of your shop. They can keep you out of trouble, give you the knowledge you need to run your business effectively, and be a crucial part of your shop's success.

The key is to put them in a box to start, and take away the tools they might otherwise use to own you.

Good luck with your bookkeeping hire. I hope it doesn't take you the 30-plus years to find the right combination of skills, personality and tools that it took me! MA

TERRY KELLER is a shop owner, service writer and AMi-approved trainer for auto repair shops. He is also the CEO of Auto Profit Masters and creator of the RPM ToolKit™.
contact@autoprofitmasters.com

OPERATIONS

IMPLEMENTING PRICE INCREASES

Gauge customer response with small, incremental increases

BOB COOPER // Contributing Editor

Over the years I have seen hundreds, if not thousands of shop owners do irreparable damage to their businesses. This damage occurs when they are mesmerized by the management trainers or consultants who tell them that they can solve all of their problems by raising their prices. At first they are pleasantly surprised to hear that their services are worth more than they are presently charging, because it plays to their ego. They are also told that they have nothing to worry about, because none of their customers will complain. They then jack up their prices and are pleasantly surprised when they discover, as they were told, that not one of their customers objected to the new pricing.

Over the next few months profits typically swell, and the shop owners smile all the way to the bank. Then, unfortunately, in far more cases than you would imagine, 9 to 12 months later these shop owners find that all of their good customers are gone, and the reason is pretty simple: Rather than complain, their good customers just take their business elsewhere. So before you listen to the pied pipers who tell you that you can solve all of your problems by jacking up your prices, I wanted to share a different strategy with you. It's one that I used to grow some really great shops, so I know it will work wonders for you, too.

First of all, any price increase should be small and incremental. You will find that small increases will not only be considered acceptable by most of your good customers, but they will allow you to monitor your customer's acceptance. When you move forward with this approach, you need to monitor your lost sales at the point of sale to ensure there is no appreciable increase.

Secondly, you will need to perform your customer follow-up calls to keep your finger on the pulse of your customers and to enable you to detect any early signs of price resistance.

Lastly, you need to monitor your percentages of repeat customers and referrals. I have discovered over the years that there is only one true judge of pricing, and it's our customers, so if a customer continues to return to your shop, and if they continue to recommend their family and friends to you, then it's safe to say that they are comfortable with your pricing.

How often you revisit your pricing is subjective, too, but I would encourage you to do it at least two times a year. Another benefit of small incremental price increases is that they will allow your advisors to feel comfortable with the new pricing. This is critical to your success as a business owner, because as we all know, if your advisors feel uncomfortable with your pricing, it will be hard for them to put their hearts into

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GASKETS

PRICING, ETHICS AND THE REPUTATION OF YOUR BUSINESS

Once someone comes into your shop, you should do everything you can to generate a happy customer and make a fair profit. Unfortunately, some customers will put you to the test when it comes to the prices you charge. They'll tell you they can't afford the recommended services, they'll tell you they can get the same service done down the street for less, or they'll just need you to knock a few bucks off the price. This is when you typically tell yourself that you've already invested a good amount of time and money to get the customer to this point in the sale, so rather than letting the customer walk, you drop your price a few bucks, and in your mind, you just saved a job. Unfortunately, what you just lost was your integrity and the integrity of your pricing.

One of the things we teach in our sales courses is that there are a number of reasons a customer will ask you for a discount. They may very well be in a cash crunch, and as we all know, many cultures believe that you're foolish if you don't haggle over the price. But there's yet another reason why people will ask you for a discount, and ironically it's the one most shop owners, and service advisors, completely overlook. What those customers are doing is testing your integrity. Look at it like this: You hire a plumber to do a job at your house, and they quote you at $800. You then ask them if that's their best price, and within a few minutes they're telling you they'll knock $50 off the price. Regardless of whether or not you authorize the job, you'll more than likely tell yourself that if you wouldn't have asked, one thing is for certain: you would have paid $50 too much. You probably wouldn't feel too good about that, would you?

And then ask yourself this question: would you call that same plumber again? And if you did, what thought would pass through your mind when he gave you a quote on the next job he did for you? I think it's safe to say that your confidence in the plumber, and the integrity of his pricing, would be gone. We also know many shop owners will inflate their prices when knowing they are dealing with a negotiator, and then will provide those customers with a supposed "discount." So do this… rather than playing a shell game with your customers that will put you out of business, apply these powerful tips:

#1. Embrace the fact that it's perfectly OK to offer legitimate discounts, such as senior discounts, police and fire department discounts, military discounts and promotional discounts.

#2. When a customer asks for a discount, look at their request as a buying signal. They are already sold on you and the recommended services! They are now either simply testing you for price integrity, or they are negotiators looking to get the best deal. Since they're already sold on you, rather than lowering your price, look at their request as an opportunity for you to build even more interest and value in your recommended service, and to resell yourself at the same time.

#3. Rather than reducing your price, offer your customer something that brings an added value. For example, rather than lowering your price from $800 to $750, tell the customer that if they authorize the service, you'll provide them with a voucher they can use for a complimentary oil service during their next visit. This way you don't cheapen the value of your existing recommendation.

#4. If you feel for whatever reason you have to provide a concession in price, you should always take something off the table in return for the price reduction. Examples would be reducing the warranty on the repair, having your tech work on the vehicle when you are not as busy, etc. In all cases, if the customer pays less, they should get less. It's called ethics.

every sale as they should.

In the coming years you will need to make some decisions regarding the gross profit margins you make in both your part sales and your labor sales. With today's technology, and your customers' access to information, customers are going to be quick to compare prices. Given the choice of the two, I would much rather defend a higher labor rate than a high part price, and here's why: Regardless of how skilled your advisors are, when they are trying to defend why they charged a higher price for that alternator than the price the customer found online, it's going to be a tough sale, because in the customer's mind, a part is a part. Yet if your labor rate is the highest in town, that's something your advisors should be able to easily defend because your technicians aren't just technicians; your technicians are superstars.

If you just listen to the pied pipers, they will scare off your customers and put you out of business. On the other hand, if you implement small and incremental increases, and if you monitor and measure customer acceptance, then you will be on the road to building a more profitable, successful business. MA

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BE OPEN TO EDUCATION

Reap the benefits of engaging, learning from others

JEFF PEEVY // Contributing Editor

My final article this year on business culture speaks to the bottom line of what really matters. As has been mentioned in each article in this series ("Culture conversations," September; "Holding staff accountable," July; and "Culture: The soul of your business," May): the simple point that the cultures we establish and live in are based on patterns of learned assumptions. The less input we receive, the less likely our assumptions are the best, most productive approaches possible. The possibilities are limited because our perspective is limited.

We should do everything possible to create an environment that makes everyone around us feel comfortable in providing their thoughts, experiences and perspectives. This doesn't mean we should accept and follow every suggestion we receive but develop a pool of information from which we pull from. The larger the area and diversity of input, the greater feedback we have to develop our own thoughts and ultimately influences the culture we establish around us.

The ability and willingness to learn is the absolute key to success today. If we believe we have seen and experienced everything, we are wrong. A quote from American author Eric Hoffer says it all. "In times of change, learners inherit the earth, while the learned find themselves beautifully equipped to deal with a world that no longer exists." In our industry, we are living in times of extreme change, and the ability and willingness to learn reigns supreme as the only resource of an ongoing competitive advantage. The longer we are in the industry, the easier it is for us to believe we have accumulated enough knowledge to become over-confident and stop being open to learning. We spend more time sharing our past experiences and less on listening to new information.

As I travel and attend industry conferences and training sessions, I am always disappointed to see so few take advantage of the opportunity. The more

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we can expose ourselves to others in the industry, the bigger and clearer the picture gets for us and the decisions and evidential culture we influence is built upon a more informed pattern of learned assumptions. The principle that we learn more by being around others is not just a human trait, but a universal one. The following is an example.

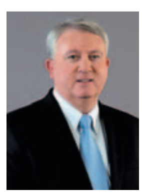
In the United Kingdom, at the beginning of the last century, milk was delivered to doorsteps in lidless glass bottles. The cream would rise to the top and seal off the fresh milk. However, because the cream was exposed and easily smelled and accessed, the robin and titmice species of birds began to find the cream and eat it. The richness of the cream and the nutrients it provided caused a population explosion in both species. As the populations continued to grow, it got the attention of both researchers and milk producers. The result was a better understanding of why the population grew and the creation of aluminum lids being placed on the bottles. Once the lids were used, both bird species populations gradually went back to traditional levels.

However, within a few years the titmice population exploded again, while the robin populations stayed at traditional levels. This baffled researches until they realized that the very social nature of the two species accounted for the differences.

The lid represented a higher level of complexity and required more learning to overcome. Robins are very territorial, and though it was noted that some robins had learned to overcome the lid challenge, they never taught the new knowledge and skills to others. As a species, they never learned to access the highly nutritious cream ever again. On the other hand, the titmice, which spend most of their time in groups, learned from each other and the knowledge needed to peel back the lid to access the cream was taught to the entire species in the U.K.

There is an important lesson in this story. The more complex the challenge, the more advantage one has when others are engaged. My industry observations are consistent with this theme, and I note that shop owners and managers who attend conferences and educational events, are actively engaged in 20 groups or have coaches, are the most successful. It seems this same group actively educate their employees at a greater rate than those who stay to themselves and fail to seek feedback from others. Please keep in mind that just showing up is important, but the real value comes when one engages others and the meaningful conversations and relationships begin.

Repair businesses that have a culture that sets an expectation to learn and share knowledge, coupled with leadership and staff who are engaging others in the industry are without exception the most competitive businesses in the industry. The dynamics of this culture keeps the shop on the cutting edge of knowledge and constantly learning from each other and those outside their organization makes the difference. This is the culture created by a genuine curiosity and willingness to learn and will ultimately represent the successful businesses of the future. You can be the robin, be protective and stay to yourself, or be like the titmouse and engage and learn from others and reap the benefits. The decision is yours.



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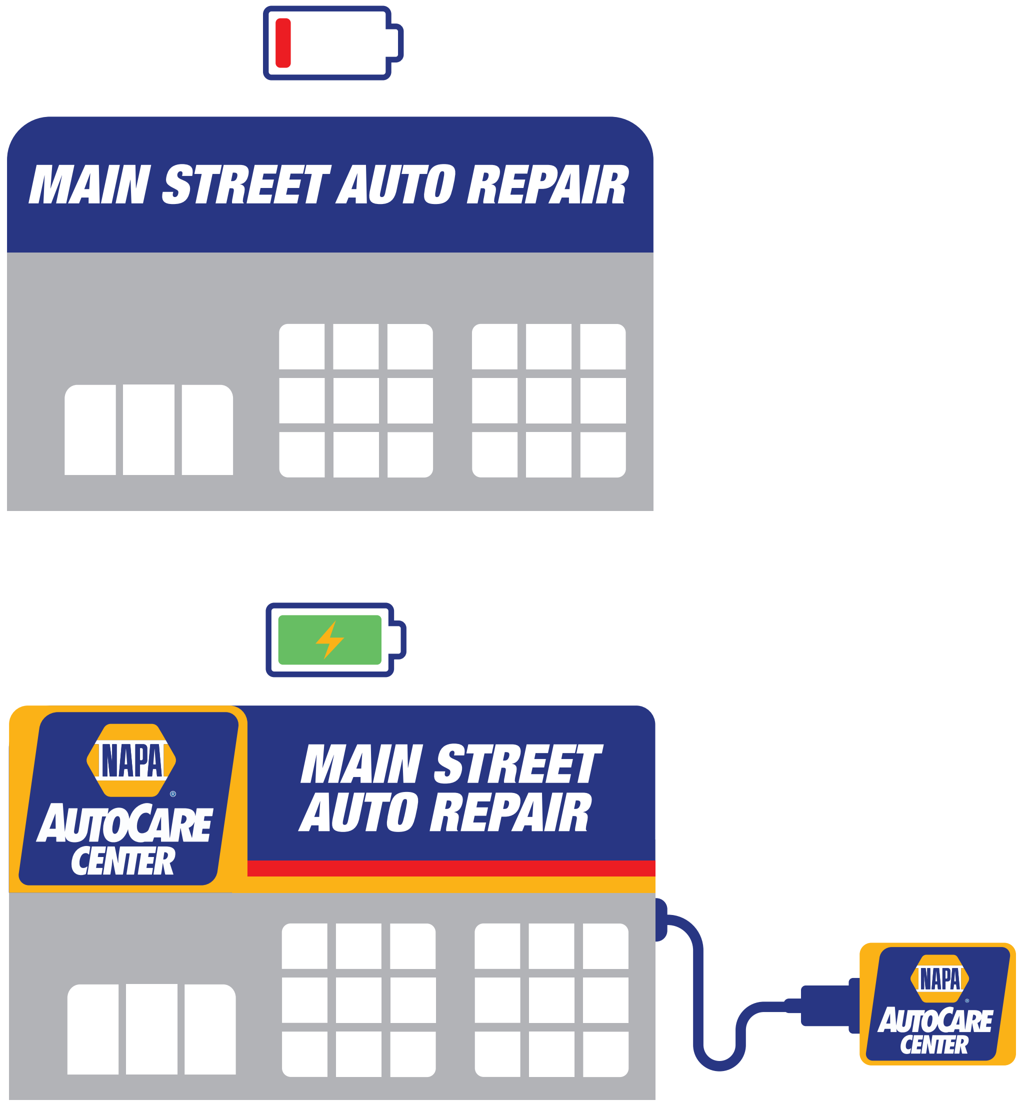

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You must start the interviewing process all over again! Meanwhile, the business starts to slip, and you stop making money, which affects your business and personal life. There must be a way to keep this from happening again and again. Let's listen to Coach Bobby Poist explain the mistakes shop owners are making.

One of the biggest mistakes you can make is to interview when someone is leaving. Statistics show that most employers are reactive when it comes to hiring. This leaves no room for growth in the company and usually happens at the most inopportune times. Most successful business owners follow the "always be hiring" mantra. This approach will help you cut the B and C players that take the space A players should have.

Build a stable of potential

Offer a referral bonus, and ask everyone who they know with talent. This will help you build a strong stable of potential employees. Signing bonuses are huge in big business and sports. Yet I hear nothing about referral bonuses from my members. The best approach is to offer a dollar amount to everyone. Put stipulations on the bonus so you can track it when people come to you for an interview. You never know where you'll find the next superstar for your business.

RECOGNIZE IF SOMEONE WILL BE A GOOD FIT FOR YOUR TEAM. PEOPLE CAN BE GREAT AT WHAT THEY DO, BUT THAT DOESN'T MEAN THEY'LL BE GREAT FOR YOU.

Do yourself a favor and interview everyone. The practice will help you master your process. Discovering the difference between a great interview and a bad interview is important. I often hear how people aren't qualified for the job before the owner meets them. It's better to form an opinion after you meet someone as opposed to before. The candidate could fit your needs in the future.

The automotive industry has a shortage of technicians. Don't wait to respond to resumes or potential contacts. These applicants are in high demand. A-players are in higher demand than ever. Each day decreases your chances of getting a response. Being proactive will increase your chances of success.

Do your homework and create an outline of the role for each position in your company. Job descriptions and checklists will help to categorize each role. You must recognize if someone will be a good fit for your team. People can be great at what they do, but that doesn't mean they'll be great for you. Having a clear vision and metrics will make a difference!

Create an interview process that works, so you have consistency. This will help you to measure your candidates. Do at least three interviews. Doing so gives you plenty of ammunition to judge your potential hires.

Do a phone interview first. Ask qualifying questions about their eligibility within your company to ensure the interview won't be a waste of time. A valid driver's license, moving violations, years of experience and tools will be indicators as to whether you can move forward. Grading them based on qualifiers will help you make an educated decision.

The first interview should be informal, yet you must own it. Don't try to sell your company to them. You should be gathering information, not giving it. Explain to the candidate how their interview will go. Give them specific guidelines so they know what to expect. Once the interview is over they will have time to ask questions. Keep the interview on task and you'll be successful.

Find out about your candidate. What are their goals, hobbies and aspirations? What are their strengths and weaknesses? How do they work with their peers? Ask probing questions about their past jobs. Use specific questions such as "What will this employer say about you when I call?" and "Tell me more." Being curious, talking less, and listening more are paramount to a successful interview.

Pay attention to their posture and eye contact. Look for enthusiasm and interest. An interested candidate will square up with you and look you in the eye. What they do with their hands is important and can be a telling sign of the candidate's interest. Pay attention to these cues during the interview to avoid issues in the future.

Introduce them to your team after the first interview. Most employees surveyed admit they weren't aware of a new employee until the day they started. Introductions to the team will help determine if the person will be a good fit. Take the proper steps to ensure your team is aware of how important it is for you to get their input. Try introducing them and then get away for a few minutes. This will open the door for them to chat a bit.

Don't hire on the first interview. You will need to process the information and talk with your team. Once you have graded the individual and measured the feedback you can set up a second interview.

The second interview is as important as the first interview

The candidate will have met you and your team. Getting them in for a second interview verifies their interest. The candidate will be comfortable. They will most likely show you their true self during this meeting.

Create a list of questions from the first interview and from team discussions. You want to know why the interviewee will be a good fit for your company, so probe and ask! Involve a third party such as your manager or your spouse. My wife is an excellent judge of character. She saved me from myself a few times in this arena. Keep that in mind, because outside input can be a much-needed resource.

Once you've completed the interview process, have them perform some type of personality profile. These tests are not a prerequisite for the job, yet they will help you from a leadership perspective. Let's face it — some people can tell you they're great at everything. The key is knowing if they just told you what you want to hear. Your success counts on it!

At this point you should have plenty of data. If you have many candidates, the data will help you to determine who is the best fit. Now you can offer the job and feel more secure that you're making the best decision. Send "thank you" responses to those who didn't qualify. Keep their resumes on file and keep the door open for future possibilities. You may have a spot for them in the future.

An employee leaving should not affect your life and business. The "always be hiring" approach will allow you to be much more successful — you'll be surrounded by A players!

Most shop owners admit they hate interviewing and state that it is one of their biggest weaknesses. Learn how to create a stable of A-player resumes and a great interview process. Always have the best on your team by downloading our "Am I Ready to Hire Checklist" by going to *www.ationlinetraining.com/2017-11* for a limited time.

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Manage client vehicle service for success

Examine your sales mix to confirm if you're doing it right

It has become critical today in shop measurement to break down your revenue and examine the type of revenue coming through your door.

Most shop owners basically just measure parts and labor, then look at their bank account balance and what they owe. That must change because it boils down to what business you are really in — it is the shop's professional responsibility to ensure that their client's vehicle is safe and reliable based on how the client uses the vehicle and their expectations with the vehicle.

To achieve that responsibility, the shop business model must move to a "service on need" model, which means the shop is managing the service intervals for the client based on how the vehicle is being used (highway, city or off-road driving) and the mileage being driven on that specific vehicle. The days of using a preventative maintenance service as a canned seasonal package are over. Everything must now be tailored directly to the individual client. That is our value offering as an independent aftermarket shop to the client and when you look at it, it is very powerful.

"We will take our professional responsibility very seriously, Mr./Ms. Client, and manage your vehicle to the service intervals recommended by the manufacturer on your vehicle based on how you use that vehicle and your expectation with the vehicle. We will not let you down."

So this now brings to the table what "type" of work is coming into the shop. First, the revenue categories that should be measured daily, weekly and monthly include: fluids, tires, aftermarket parts, dealer domestic parts, dealer foreign parts, maintenance labor, diagnostic labor and reflash labor as the minimum revenue categories. Once this is done and you can see the history of these categories, now you move to a critical examination of the "type" of services that are coming in.

The objective in the shop should be that 30 percent of the revenue is "preventative maintenance revenue," meaning the client is in the shop because their service interval recommended by the manufacturer is now due and you are looking after it. The rest of the revenue should be breakdown and repair and client/customer demand revenue. Examine each RO and see why the vehicle was in the shop.

30 PERCENT OF SHOP REVENUE SHOULD BE FROM PREVENTIVE MAINTENANCE BECAUSE THEIR SERVICE INTERVAL IS DUE AND YOU ARE HANDLING IT.

This is an intriguing measurement because it tells whether the shop is actually "managing" the vehicle on behalf of the client or only performing services requested by the client.

To achieve this level of service, the back office has to be in order because it demands proper and complete follow up and proper scheduling of the vehicle based on the mileage the client is driving. A calendar must be established with forward dates booked, as you know the vehicle mileage being driven and when the next manufacturer service level is due. Proper follow-up with the client (based on how they want to be contacted — email, text or phone call) two weeks out and one week out to confirm their next appointment must be made. Take nothing for granted. Your shop must follow up with each client.

In reality, I have found that the 30 percent figure is not being achieved — most shops I have seen are in the 5 percent to 12 percent range. This is unacceptable to management. A client hires a shop to look after their vehicle, ensure it is safe and reliable, but also to get the financial return out of it that they are looking for.

Is your shop doing it right or are you discovering there is work to be done to maximize your client relationship of trust and shop profitability? MA

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TECH
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TECH

People first, profit second

New Hampshire shop doesn't make decisions based on the bottom line

ROBERT BRAVENDER // Contributing Editor

Before Bill Gurney married his wife Charlotte in 1984, they dated six months. Then a year after the nuptials, the newlyweds opened their first repair shop. You could say Gurney works fast. "We've been married 33 years, been in business 32, and we've worked together nearly every day," he laughs.

And every day that Gurney's Automotive Repair has been operating in Nashua, NH (and eventually Milford), they've followed a bedrock business philosophy based on two tenets: honesty and integrity. No haste here; deeply religious, the Gurney's practice what they preach. Their core purposes and promises are published on their website and posted at each work station in a framed plaque.

"Part of (the employees') job description is to read those principles every day," Gurney notes. "Sure, they may not do it every day, but we go over this all the time at every meeting. The more we sew it into the fabric of the company, the more people will live it. It is part of the culture."

It's a culture best summed up by the first and last of Gurney's core purposes: "To contribute to the quality of life and the success of our customers and their families by ensuring them safe and reliable transportation…" and "to do this in a work environment that will elevate each person to their highest level of growth both personally and professionally."

Gurney maintains a "people first, profit second" rule for both customers and employees. "Treat people like you want to be treated," he shrugs. "Don't get me wrong, the profit on the job has to be there, but you can't make your decisions based on the bottom line. If someone comes in and has a problem with something you've done, it doesn't matter what it costs to fix that problem — you just need to fix it."

Their business approach has evolved over the years via books and seminars. "You have to take what everybody says and filter through what works and applies to your business," says Gurney, but notes that "our core values, our core purpose and our culture are what make us unique… From that, exceptional customer service and satisfaction became the result."

Hence the Rules of the Road. "Our Rules of the Road came out of a team-building exercise that we did off-site," recalls Gurney. "I didn't come up with those — our employees did. And I think it's genius. They're about how we're supposed to act with our customers and with each other, because we're all about

GURNEY'S AUTOMOTIVE REPAIR, INC.
Nashua, New Hampshire //
www.gurneysautomotive.com

Bill & Charlotte Gurney
Owners

5
No. of service advisors

2
No. of shops

18,300
Total square footage of shops

32
Years in business

25
No. of bays

31
No. of employees

235
No. of customer vehicles per week

13
No. of technicians

having a great [business] culture.

"Our technicians can put their heads together, think through problems, and put a strategy in play to diagnose them," proclaims Gurney. "The advantage of independents over a lot of flat-rate manufacturers and dealerships would be that our guys probably work better together than others who are worried about their own pay all the time."

From two bays and two employees, Gurney's has grown to two stores and 31 employees, with services expanding as well. "I always try to see what's coming down the road, and for years we've been talking about how cars are made better," Gurney re-

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counts. “Maintenance times are getting less, so to maintain volume we had to widen the customer base. Several years ago we realized we needed to get better at diesels because not a lot of people want to work on them. It was a good opportunity for the market because they’re usually bigger repairs.”

Case in point, Gurney’s recently hosted a hybrid training class. “Hybrids aren’t huge in New England,” says Gurney, “but we do some. It’s not something that is going to go anywhere — it will continue to be a market segment — but you have to stay on top of everything, and I think a lot of that just comes from doing it every day.”

Gurney’s secondary markets include tire sales, Leer camper shells, Bosch Service credit cards and Hiniker snow plows for pickup trucks — it’s still New England, after all. “In the winter months business falls off a little bit,” Gurney notes, “so we were looking for something to help offset that. Again, you need to look at what is going to keep your people busy so you’re not shrinking your operation.”

Meanwhile Gurney’s marketing has been aggressive on all fronts. With state inspections based on car owners’ birthdays, the company mailed reminders in the form of birthday cards. “We sent about 5,000-8,000 a month to anyone who had a birthday within a certain amount of miles from the shop or certain zip codes,” Gurney explains. “We did that for a long time without missing a month and developed a really large customer base.”

They built their first website in 1998, giving them a solid base online as well. “It’s kind of funny,” Gurney comments, “I did a four-minute video of me using this snow plow on Facebook, shot on my wife’s cellphone with no audio. I got 28,000 impressions, over 18,000 who watched for three seconds or more, and 45 people who made comments. I was amazed at the enormous reach.”

They also advertised on TV “a good 12 years or better without any interruption,” Gurney recalls. “We did a lot of cable TV, some sports channels as well, and our commercials were just kind of wacky.” This is where his iconic “are you going to finish that?” became a popular refrain whenever he encountered food.

Because as Gurney cheerfully admits, after the cars, it’s all about the food. One of the many resources Gurney’s marvelous website offers is “Charlotte’s Kitchen.” “My wife is from Louisiana and she’s a great cook,” he boasts, “so she puts recipes on there. We did it as a way to drive people to our website that might not go back very often. I don’t know how much effect it’s had, but it is fun.”

Pineapple fried rice... chicken and mushrooms in wine...zucchini crescent pie...white chocolate brownie trifle... Excuse me, but are you going to finish that? MA

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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Top 3 reasons why your shop should be blogging

USE THIS EFFECTIVE MARKETING TOOL TO DRIVE CUSTOMERS TO YOUR SHOP

MARCUS MACKELL //
Contributing Editor

Having a blog for your auto repair shop may not be at the top of your priority list, but a lot of credible data suggests that maybe it should be. One source shows that including a blog as a key component of your website and auto shop marketing strategy increases the chances that your blog will have highly indexed pages on Google — by the incredible amount of 434 percent! And the higher your pages are indexed, the greater the likelihood that your shop will come up with more favorable search results when a prospective customer is searching for auto repair shops.

Running an auto repair business in 2017 is vastly different than it was just a decade ago. It's no longer enough to simply do a great repair job, have a website and do a little advertising. There's just so much competition and significantly more options for your customers to opt for auto repair. In order to ensure you keep customers rolling into your shop, you need to do everything you can to prove you're the best at what you do.

1. Attract your audience

Arguably the top reason any company starts a blog is to better attract an audience. When customers are searching for an item or service, the first place they often turn is the internet. In fact, studies show that 47 percent of modern consumers check anywhere from three to five online sources before making a purchase. That means that nearly half of your audience is taking the time to search for answers online before ever even getting into their car. Armed with this knowledge, your blog can help to ensure that when your audience searches for answers, your shop is the solution that pops up.

Search engines love content — that much is a fact. The problem with content is that after you set up your initial company website, there isn't much room to add more content. That's where a blog comes in. A regularly updated blog gives you a platform to continuously add content to your website, letting Google and all the other search engines know that your shop has the answers people are looking for and getting your name in front of future customers.

2. Establish authority

While attracting people to your website is the first step, it's hardly the only reason to start an auto repair shop blog for your business. Bringing people to your website is great, but it's what people read on your site that really matters. Writing blogs that answer your customer's questions makes your shop an authority in auto repair. This means that when people have a problem with their vehicle, they'll begin to associate you with a solution and make you top of mind when they're ready for a repair.

Becoming an authority in your industry allows you and your shop to not only flex your knowledge muscles, but it also helps your customers form a relationship with your shop. Content marketing is all about trust, and there's no better way to build that trust with your customer base than through blogging.

3. It isn't difficult to do

The good news about blogging is that not only is it an effective marketing tool, but it isn't all that difficult to do. Many popular and intuitive website and blogging platforms such as Wordpress make including a blog on your site incredibly easy to do. While optimization can be a bit tricky, a great starting point is to put your digital pen to paper, create useful and relevant information for your readers and upload it to your blog.

If you're looking for a good way to take your auto repair business to the next level, a new company blog may be just what you need.

MARCUS MACKELL is a market manager for the Mitchell 1 SocialCRM product line. He is responsible for all support, sales and marketing initiatives for the shop marketing service.
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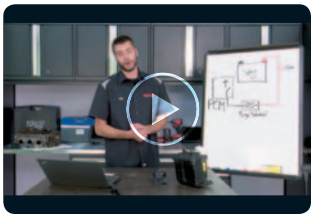

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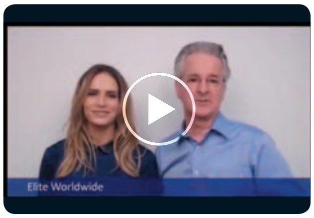
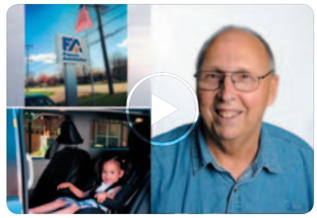


4 sales your shop should make on every call

MOTORAGE.COM/FourShopSales

Using your trigger settings on your scope

MOTORAGE.COM/TriggerSettings



Shop owner discusses ethics-based business

MOTORAGE.COM/Ethics

MECHANICAL MOMENT

SERVICE REPAIR PROBLEMS AND SOLUTIONS THAT JUST MIGHT BENEFIT YOUR SHOP TECHNICIANS

MALIBU RUNS ROUGH AND STALLS

VEHICLE: 2011 Chevrolet Malibu, L4-2.4L, Automatic Transmission

MILEAGE: 171,009

PROBLEM: The vehicle was brought to the shop because the MIL was on and the engine ran rough and stalled. The technician checked the fuel pressure and it was within factory specifications. He was unable to keep the vehicle running long enough to see any difference in the camshaft timing "actual" versus "desired" PID. He also retrieved the numerous DTCs listed below.

P0011 – Intake Camshaft Position System Performance
P0014 – Exhaust Camshaft Position System Performance
P0068 – Throttle Body Airflow Performance
P0101 – Mass Air Flow (MAF) Sensor Performance
P0106 – Manifold Absolute Pressure (MAP) Sensor Performance

DETAILS: The vehicle's engine looked poorly maintained and had high mileage on it, so the technician removed both actuator solenoids for inspection. He found massive amounts of debris and sludge on the actuator screens and in the hydraulic passages located in the cylinder head. He double checked the actuator control circuits just to make sure they were operational. They were good.

CONFIRMED REPAIR: He cleaned the passages and replaced both camshaft position actuator solenoid valves. He also changed the engine oil because it was extremely dirty. After the repairs, the technician cleared the DTCs and test-drove the vehicle. It ran well and the MIL remained off.

This tech tip and others come from ALLDATA Tech-Assist, a diagnostic hotline of ASE-Certified Master Technicians. Whatever technicians need — from creating alternative diagnostic strategies to providing step-by-step repair assistance – the Tech-Assist Team can deliver. Learn more at ***ALLDATA.com.***

TRAINING EVENTS

NOVEMBER 28
ATI: Repair Shop Mastery
Lansing, Michigan

DECEMBER 4-8
Automotive Management Institute: Advanced Selling Skills
RLO Training
Cincinnati, Ohio

DECEMBER 30
ATI: Repair Shop Mastery
Daytona Beach, Florida

FEBRUARY 14-17, 2018
MACS 2018 Training Event and Trade Show
Caribe Royal
Orlando, Florida

MARCH 1-4, 2018
2018 VISION Hi-Tech Training & Expo
Overland Park Convention Center
Overland Park, Kansas

MARCH 17, 2018
TST 2018 15th Annual Big Event
Westchester Marriott
Tarrytown, New York

MAY 9-11, 2018
Auto Care Association Spring Leadership Days
Atlanta Marriott Marquis
Atlanta, Georgia

AUGUST 8-10, 2018
NACE Automechanika 2018
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THE VEHICLE BELONGS TO YOUR CLIENT, AND IT IS THEIR CHOICE IN WHAT TO FIX

BOB COOPER // Contributing Editor

I am sure you will agree that in our industry there are a number of unwritten rules that shop owners have followed for decades. They know that they have to hire gifted technicians, stay at the forefront of vehicle technology and can never jeopardize their relationships with their customers; just to name a few. Unfortunately, there is another rule that far too many shop owners (and service advisors) have believed in for decades. It's a rule that's been passed down from one generation to the next — the one that says that whenever you have a first-time customer in your shop and you discover that their vehicle needs a lot of work, you are better off holding back on some of the recommendations.

The basis for this belief is that with first-time customers, too many recommendations will scare them off. These owners and advisors typically feel that they are better off just recommending the repairs or services that the customer brought the vehicle in for, building a relationship with the customer, and then discussing the other required services during the next visit. There is no question that these owners and advisors typically have good intentions. They believe in their hearts that since they are not trying to sell their customers something they don't need, they're not crossing any ethical lines. Unfortunately, that's the furthest from the truth.

When customers entrust you with their automobiles, they have a presumption of full disclosure and honesty. Rightfully or wrongfully, I am sure you will agree that your customers also have an expectation that every time their vehicles enter one of your service bays, your technicians will immediately pick up on everything that needs to be done.

So do this: Have a shop meeting and pull up an extra chair. Tell your entire staff that the empty chair represents the spirit of your customer, and that everything that is discussed during the meeting should be able to be said in front of the customer without hesitation. Start the meeting by reinforcing your commitment to both ethics and customer service. You should then review your vehicle inspection process. I strongly recommend using well-constructed vehicle inspection forms and taking advantage of a variety of those forms: A form for complete vehicle inspections, a safety inspection form, forms for the inspection of specific systems, etc. You should then let all of your employees know that every vehicle will be inspected in a manner that complies with your company policies, that all discoveries are to be documented, and that the inspecting technician is to sign the completed inspection form.

Once the completed form is turned over to the advisor, all of the recommended repairs and services are to be estimated, and everything is to be fully disclosed to your customers. Not only is this the professional thing to do, but equally as important, it's the ethical thing to do. Your customers have the right to know about everything that you have discovered, and they have the right to know how much the repairs and services will cost if authorized.

I am sure you will agree; when it comes to ethics, there are no exceptions. Yet many shop owners and advisors will argue that if they have a vehicle that is worth $1,000, and they discover that it needs $5,000 worth of work, then there is no sense in putting together an estimate. I adamantly disagree. The vehicles belong to your customers. It's their money, and it's their choice. Add to that — just because an advisor feels that a vehicle is not worth fixing, it doesn't mean that the customer will feel the same way.

So mandate complete and professional vehicle inspections that meet with your policies, and insist on full disclosure to all of your customers. They may not buy everything that your advisor has recommended, but a few things are for certain: Your customers will know about everything that needs to be done, you'll have detailed records, your sales and profits will go up, and you will be doing the right things for the right reasons. If you follow this advice, and if you never put money ahead of people, you can't lose. MA

BOB COOPER is the president of Elite, a company that offers coaching and training from the industry's top shop owners.
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8 important tools every service advisor needs in their toolbox

HELP YOUR STAFF TO MAXIMIZE SALES, CUSTOMER SATISFACTION AND PROFITS

BOB COOPER// Contributing Editor

As is true with the top technicians in today's automotive aftermarket industry, the top service advisors in America also need a number of tools in order to succeed.

Here's a list of important tools you can provide to the advisors in your shop that will help them maximize sales, customer satisfaction and your shop's profits.

1. Clearly defined sales goals and car count goals that are broken down into daily goals. Not only will having such goals in place help your advisors stay focused, but they will also encourage your advisors to continue to further develop their skills. If you don't have daily goals in place, how will you and your service advisors know if they were successful that day? Remember, the fact that they were busy doesn't mean that they were successful.

By having daily goals in place, not only will your advisors feel good on the days when they reach the goals, but you also will be provided with ample opportunities to congratulate them on their success.

2. Clearly defined systems and policies. As the shop owner, you need to ensure that every vehicle is properly inspected and that all discoveries are documented and then provided to the advisor. These policies need to be strictly enforced to ensure ongoing compliance.

3. The ability to make decisions. The top advisors in America are empowered by their shop owners to make many decisions on behalf of the company. Not only does this prevent you as the owner from being drawn into every customer concern, but it shows your advisors that you trust their judgement when dealing with customers and in-shop matters.

4. A budget for price adjustments. We all know that there are times when your advisors need to provide your customers with legitimate discounts, a rental car, etc., so what the top shop owners do is set a monthly budget for each advisor. They will tell their advisors that the money is there to be used in ways that fit the situation in order to help ensure ongoing customer satisfaction. Whatever is remaining in each advisor's budget at the end of the month is then split with the advisor. With this approach it's your advisors' money to lose, so they'll think twice before giving unwarranted discounts, refunds, etc.

5. A pay plan that rewards productivity. Regardless of how their pay plan is designed, your advisors need to be rewarded for three things: The sales they are able to generate, the gross profit margins they are able to maintain and happy customers. Remember, any ongoing positive behavior that isn't noticed or rewarded may very well cease to exist.

6. Ongoing training. The top shop owners in America realize that an advisor's job is not an easy one, and that advisors need to keep their skills razor-sharp. This is why they not only enroll their advisors in sales courses at least once a year for a "tune-up" but also help them develop their other job-related skills by enrolling them in management courses.

They may also ask them to read books like *How to Win Friends & Influence People* by Dale Carnegie, a great book that can provide insight on improving people skills.

7. A quality control system that includes customer follow-up calls and the recording of sales calls. Advisors can very effectively learn what they are doing right and where they need to work to improve by listening to recordings of their sales presentations and hearing what their customers have to say about their services. Work to provide them with this opportunity.

8. Appropriate leadership. Simply put, advisors need employers who make a point of catching their employees doing things right and acknowledging their behavior. They need employers who constantly reinforce ethics and create a culture of never putting money ahead of people. MA

BOB COOPER is the president of Elite, a company that offers coaching and training from the industry's top shop owners.
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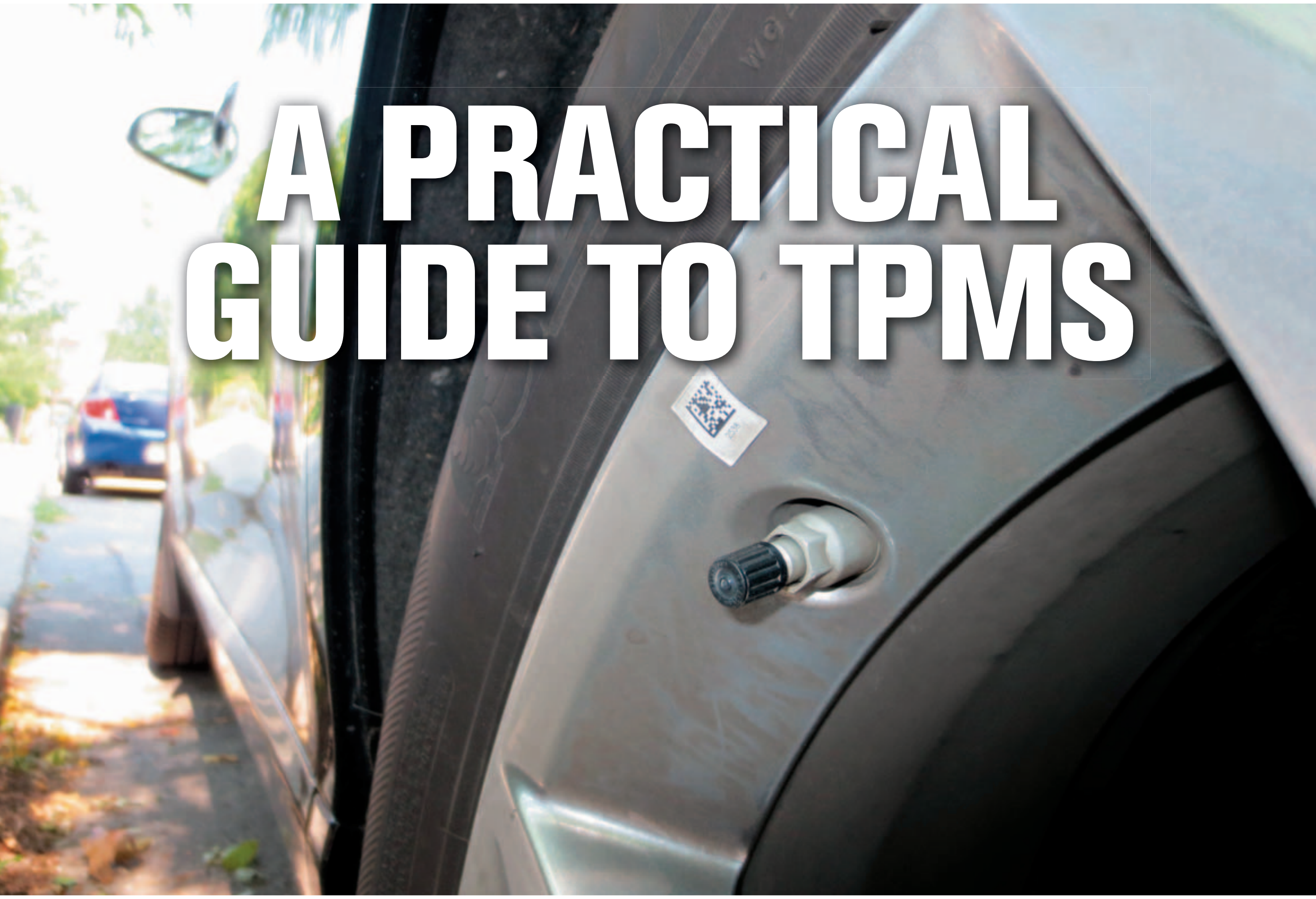
A PRACTICAL GUIDE TO TPMS



TIPS TO KEEP ROUTINE SERVICE JOBS FROM BECOMING TIME-CONSUMING NIGHTMARES

VANESSA ATWELL // Contributing Editor

Tire pressure monitoring systems (TPMS) have definitely become easier to work with since they were first introduced a few years back. That's a good thing, because not only is it difficult to work around or "fool" a TPMS system (for whatever reason) but leaving the warning light illuminated is annoying, and it may cause problems for customers since TPMS is a safety-related vehicle system that shouldn't be disabled.

Even though TPMS systems have improved and become easier to service, it still takes practical experience and knowledge to keep work problem-free and profitable.

In particular, it's important to know about the things that can make a big difference when servicing the systems, such as how to program replacement sensors quickly and effectively, knowing if the system will need anything done after a routine wheel rotation or general service, and if special tools to service the system are required. Guessing incorrectly can cause expensive problems.

Additionally, understanding how to prevent common issues from occurring in the first place (such as using extra caution around known leak points and knowing the things that tend to seize together before they break off and need to be replaced) and knowing how to successfully deal with the things that do go wrong (like sensors that don't work or warning lights that come on at strange times) can prevent simple service issues from becoming big, time-consuming, money-losing headaches.

And it's not difficult at all.

With a bit of knowledge and experience — and, of course, having the right tools and components at hand — servicing TPMS systems doesn't need to be problematic.

PHOTOS: VANESSA ATWELL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General service

Until recently, one of the most common concerns (or fears) about working on a vehicle with TPMS was that performing general tire services, like rotating wheels or installing or removing seasonal tires, would affect the TPMS system and illuminate the warning light. Fortunately, this isn't as much of an issue anymore.

No doubt it's still important to know if the system needs to be reset after service (or if newly installed wheel sensors need to be programmed and if so, how) so that the warning light won't illuminate a few minutes after the customer picks up the vehicle.

But in general, now (always check service information and be sure) if there's just one warning light or message for the whole system, it's fairly safe to assume that the individual sensors likely won't need to be manually programmed to new positions if a wheel is moved to another position on the vehicle — so there's not likely to be issues rotating tires (but always check service information to be sure because there are exceptions). And it's generally safe to assume that if there's a separate reading displayed for each wheel, the system may indeed need to be reset if the wheel moves from its original position (in other words, relearned after tire rotation). But, again, check service information and be sure.

Also fortunately, TPMS relearning and programming is relatively simple to manage with the programming tool. Even better, since many newer vehicles have modules that can determine wheel position without being manually reprogramed, this is becoming less and less of an issue. But, again, always check and be sure — never just blindly trust that the system will adapt on its own. It may not, and the system may illuminate the MIL or not function correctly.

However, if the vehicle does indeed need to be relearned, it's important to note that the procedure for relearning a sensor's position on the vehicle varies among vehicles and manufacturers, and though it's typically done using the tool (as directed by service information and usually prompted by the tool), just as there's no single way of resetting oil change reminder lights or of programming ignition keys, there's also no single way of resetting TPMS systems. Save time and headaches by checking service information and finding out ahead of time what needs to be done.

THIS TRUCK CAME IN WITH ITS TPMS LIGHT ON. A quick visual inspection found that in addition to the TPMS issue, it was also time for new tires – well past time, actually.

Doing a bit of research can prevent time-consuming problems from developing.

Another common TPMS fear was causing problems when switching from winter to summer wheels (or vice versa) — and even this isn't as much of a problem anymore.

Many customers now use "cloned" TPMS sensors, which eliminate the need to program new sensors when the wheels are changed. Customers usually mention when their seasonal wheels have "cloned" sensors and thanks to

THIS TIRE LABEL GOT CAUGHT between bead and rim of this Lexus tire and caused a very tiny leak (less than half a psi every 300 miles). This would have likely gone unnoticed, but the tire pressures were displayed at each wheel and the customer was a fanatic about keeping the pressures equal. Resealing the wheel (after removing the sticker) fixed the problem.


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Internet chat rooms and online parts distributors, this practice is surprisingly widespread and can work well. If this is the case, as with any other TPMS sensor, ensure there are no leaks when the wheels are installed and then ensure the warning light isn't illuminated after service. Hopefully there are no issues.

However, if the sensors on the seasonal wheels do need to be programmed, one tip (from experience) to keep in mind is that it's important to have patience and to perform the procedure exactly as indicated in service information — and also to understand that it may not work successfully the first time.

Even though TPMS systems have improved, some vehicles still need more than one programming attempt before the process is successful — which is unfortunately something that hasn't changed.

If the same rim is being used and just the tires are being changed then (from experience) it's important to ensure the sensor doesn't break or get damaged during service and also to ensure that no new leaks are created during the installation process.

To do this, it's important to replace seals or other parts as directed in service information (or required because they're obviously not fit for re-use) and also to be careful not to over-torque and damage the somewhat delicate TMPS components.

This is important.

It's not just important because over-torqueing breaks and warps things, which causes immediately noticeable problems, but it's also an important step because it prevents future problems from developing.

Leaks and breaks are fairly common, so it's wise to keep this in mind when working in the area. It's better to prevent problems from occurring than to have to fix them later.

METAL VALVE CAPS LIKE THIS ONE have been known to seize to the valve stem. Undoing them with pliers can actually break the sensor. It's best to prepare the customer beforehand if there's any chance of damage during service and be sure to torque caps correctly.

Repairs

Servicing the tire pressure sensors themselves (either because the tires are being changed or the sensor needs replacing) is usually straightforward and relatively simple, but there are a few practical tips to keep in mind to keep the work problem-free.

Typically when replacing a TPMS sensor, the tire is deflated, the retainer is unscrewed and the sensor then drops gently into the wheel. Then the tire is removed, the sensor is re-installed (with new seals or components) or replaced as required, and then the tire is re-installed and inflated, installed on the vehicle and then programmed and re-learned as required.

However, there are ways to keep this routine task both quick and problem-free.

One important thing to keep in mind is that not breaking the sensor off during service can actually be a bit tricky. Customers often replace valve caps with aftermarket ones not designed for TPMS sensors. These can seize to the stems, which can then break off when they're removed (often with pliers) for routine service – not good at all.

Also, it's important to know if the gasket and seals on the sensor will indeed need to be replaced and if so, to have them ready to use. The reason for this is obvious — seals often can't be re-used and it's good to have the replacements on hand so that new leaks aren't created in the wheel. Again, the valve area is a notoriously common leak spot and it's important to prevent this problem if at all possible.

Finally, it's important to make sure any manufacturer stickers are removed from the tire before it's installed so the bead can seal to the rim thoroughly — not doing so can and does cause problems.

One Lexus customer brought their vehicle in because the pressure at a particular wheel would drop by 1 psi each week (all four wheel pressures were displayed so the difference was very noticeable). Turns out when new tires were installed, the bar code sticker was never removed from the bead of the tire and there was indeed a small leak between the sticker and the rim. The wheel had to be broken down, resealed and reinstalled to fix the problem.

Troubleshooting tips

Usually when the TPMS warning light illuminates, the fault is repaired by sealing a leak, correcting tire pressures, pa-


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tiently performing a relearn procedure, or by replacing a faulty sensor (or a combination of all these things).

However, as with any routine diagnosis, it helps to keep a few things in mind to prevent problems from developing.

As with any other troubleshooting, it's important to start TMPS diagnosis by verifying that there actually is a problem and that the bulb comes on during bulb check and then goes off.

If there is a problem, check all tire pressures and adjust them if necessary, keeping in mind that it may take a few moments for the data to refresh and display accurately. Adding or removing a little bit of air at a time tends to be the quickest way to get good results.

One important tip to keep in mind is that using clean, dry air is very important — air lines that spray water everywhere can get water inside the TPMS sensor and develop problems.

One excellent tech I worked with insists that water from air lines damages more TPMS sensors than those spray cans of tire sealer and inflator ever will.

Continuing on, if a low tire is present, be sure to also inspect the condition and wear patterns of all the tires in case they need to be replaced — and because it's better to notice exposed belts and sharp, damaged rims at this stage rather than when they go through your hand during service. It's definitely better to find out early on if extra work is needed or if extra caution will be required during the repair.

THIS IS NOT WHAT YOU WANT to see after service. In this case, the light came on after 15 minutes of driving and went off when the vehicle was shut off, only to return once again when the vehicle was driven for another 15 minutes (a new sensor and relearn fixed the problem).

If everything checks out okay but the system still indicated a tire with low pressure, make sure the control module is seeing the sensors and receiving the data OK. It's not uncommon for one sensor (or more) to be faulty and not send information to the control module. The sensors themselves have batteries that usually last for just over five years, and the batteries aren't replaceable — the whole sensor is replaced and subsequently programmed when the battery fails.

Also, since the warning light is often controlled by the body control module, check that all of the fuses are good (most vehicles have several fuse centers that need to be checked) and note any other problems in the system, such as aftermarket accessories or systems that interfere with electrical signals. Some sensors are sensitive to interference from other sensors and systems. In fact, some Toyota vehicles have QR stickers on the rim so that the techs can simply scan the code with the tool and program the sensor that way, which is quicker and also prevents interference from being an issue (the stickers are supposed to be removed at PDI but have been known to be left in place). Checking for service bulletins or tech tips on this issue can definitely save diagnostic time.

If it is evident that a sensor isn't being read correctly, one tip that may help is to try leaning the same type of tire-sensor-rim combination against the suspect wheel and seeing if the control module can read it (easier to do if you service many of the same vehicles). If the "donor" sensor registers, suspect a bad sensor and proceed from there — usually this means replacing the sensor, programming it, then performing a relearn if required, but, as always, check service information to be sure.

TIRES CAN NORMALLY LOSE about 1 psi of pressure per month – however, wheels with missing valve caps can lose considerably more. Using dry, clean air is very important — air lines that spray water everywhere can get water inside the TMPS sensor and cause problems to develop.

And if the sensors are being read and the system still indicates that a wheel has low pressure and you've tried everything and are out of ideas, from experience, try reprogramming each sensor and then resetting the

THIS IS RARE BUT IT DID HAPPEN and it's worth noting. This customer bought rims with the wrong size valve stem holes and the TPMS sensor wouldn't fit. So the customer drilled another hole and installed a dummy valve 180 degrees from the working sensor. It's still working.

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system. Sometimes this needs to be done more than once, but it's been known to fix the problem. Again, always consult service information — service bulletins and tech tips in particular — but from experience, carefully following the steps exactly as directed using the correct tool (and repeating, patiently, if needed) fixes many TPMS problems. Just be sure to road test the vehicle and verify the repair before releasing the vehicle—TPMS MIL indicators often come on after a few minutes of driving, not right away at start up.

Conclusion

Depending on where in the country you work and what type of vehicles you service, TPMS systems may never cause you a day of stress, or may cause so many problems that the sensors are assembled ahead of time and kept ready to install as needed. From experience, vehicles that go off road or have many aggressive drivers (like fleets of work trucks) are very hard on the TPMS systems and have many problems (in other words, they eat sensors), while pampered, sportier cars can have almost no problems at all. But in both cases, knowing a few practical tips can make TPMS service quicker and easier and keep the work problem-free.

No doubt, the systems have evolved since they were introduced and can actually be simple to work on with the right tools and service information, but since there are still so many different systems on the roads (with unique methods of resetting and programming the systems and their related sensors), it's still important to refer to service information and be sure rather than guess and learn the hard way.

The fact is, the systems are safety-critical, so they're not going away any time soon.

TPMS systems are usually straightforward to deal with, and while you may not make a fortune servicing them, you can definitely avoid costly problems and keep other work trouble-free and profitable.

With practical information and tips from hard-earned experience — plus service information and the right tools — working on TPMS systems successfully doesn't need be a problem at all. MA

VANESSA ATTWELL is a Master Technician for two major manufacturers and has also worked on the bench of an independent shop. She has developed and delivered training for both vehicle manufacturers and independents, and helped develop government training and regulations standards.

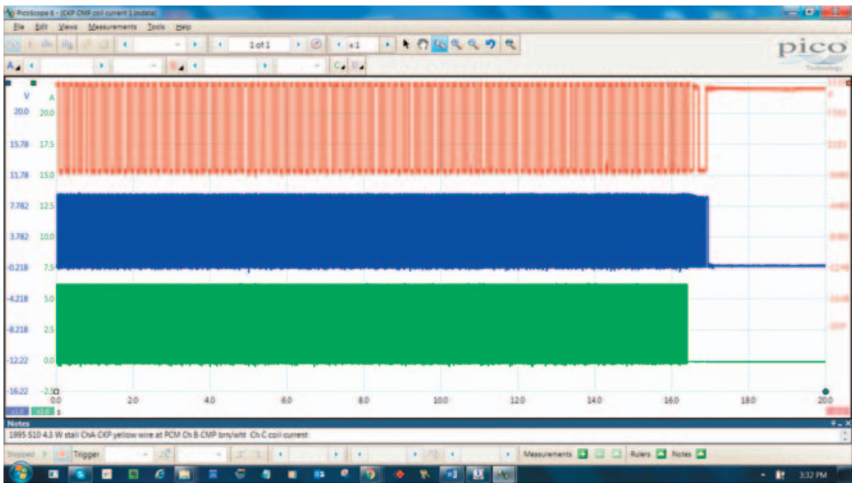
LEARNING THE DIGITAL STORAGE OSCILLOSCOPE

FROM BASIC SYSTEM TESTING TO FINDING THAT INTERMITTENT, THE SCOPE COULD BE THE MOST PRACTICAL TOOL IN YOUR TOOLBOX

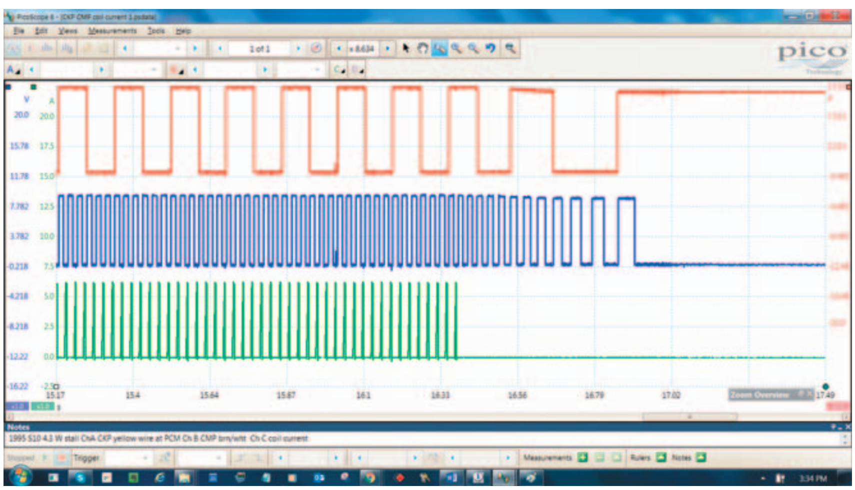
ERIC ZIEGLER // Contributing Editor

Everyone is familiar with the saying "a picture is worth a thousand words." It is thought the modern use of the phrase stems from an article by Fred R. Barnard. He claimed it was an old Chinese proverb to give it more legitimacy. The actual ancient Confucian saying is, "Hearing something 100 times isn't better than seeing it once." Both statements to me express that something that is illustrated or drawn out is more informative or reveals the greatest amount of information. The modern automotive Digital Storage Oscilloscope (DSO) reflects this concept in the world of diagnosing the modern vehicles that are in our service bays.

There was a time in automotive repair in our past when we all embraced the value of an oscilloscope to diagnose ignition issues and "tune up" the cars in our service bays. It seemed almost every competent shop had some sort of big-box scope or ignition analyzer. This was when cars were equipped with fairly simple point-style ignition systems that required adjustments and the performance of the car greatly depended on how well in tune or adjusted the system was. This was about the time that I entered the field, working at the gas station pumping gas and doing light repairs on the second shift.



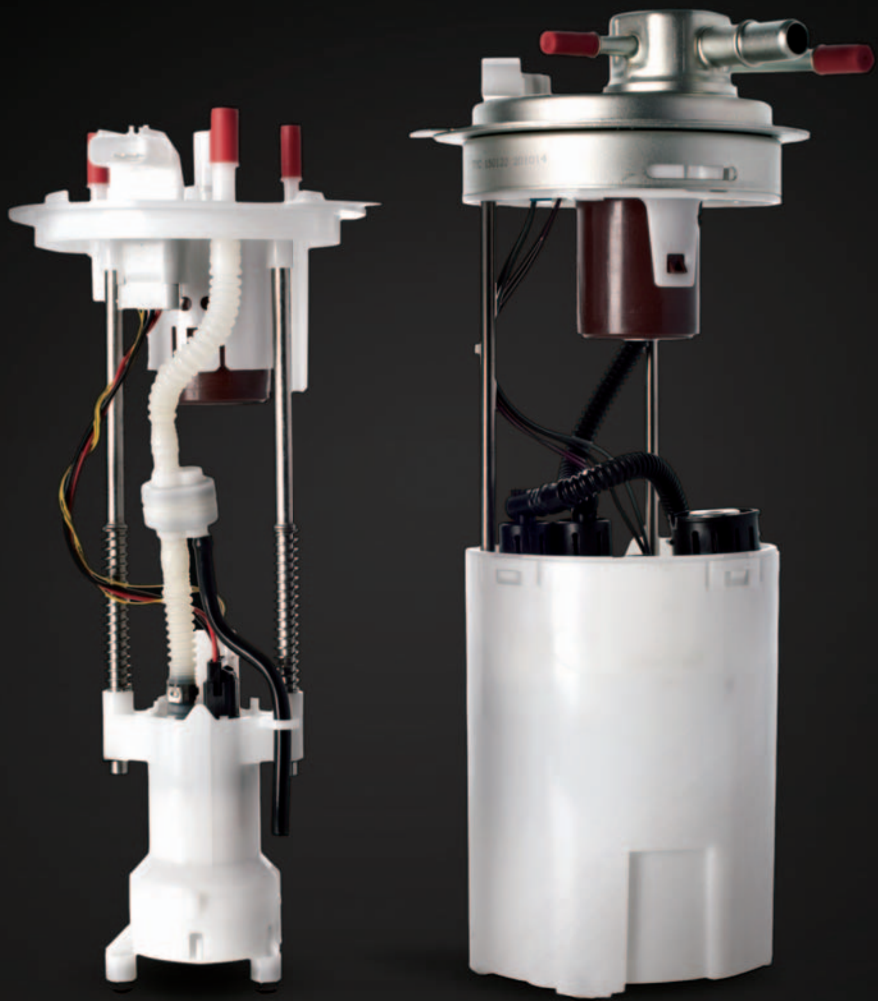
I WAS ABLE TO CAPTURE the cause of the intermittent stall, using the deep record capability of my scope.



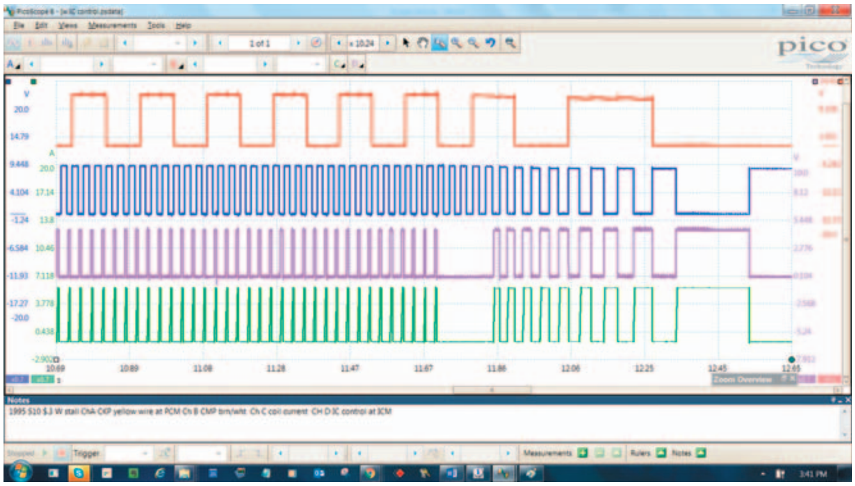
ZOOMING IN ON THE STALL, I could see that the coils (green trace) quit firing.

I still remember the daytime mechanic who was a local stock car driver "power tuning" his racecar on the old Sun 1015 big-box analyzer. All the cylinders were in a "raster" pattern, stacked on top of one another and how they jumped to life on the blue cathode screen with each aggressive snap of throttle com-

PHOTOS: ERIC ZIEGLER



bined with sound and smell of the open headers. It had me at "Hello." I knew this was something I had to learn.



ADDING THE IC TRIGGER CIRCUIT from the PCM to the ICM proved the PCM was at fault.

The DSO — A game changer

Scopes have been around for years. An oscilloscope, simply put, measures electric signals and displays them in a linear fashion of voltage over time. Many of us who have been around a while learned the value of the scope for diagnosing ignition systems issues. We all had some knowledge of how to operate the analyzer, much like a modern tech is familiar with operating an A/C recharge station. Today, most techs in shops I frequent seem either to struggle with or are reluctant to use a scope to diagnose modern car problems. What changed?

Well first off, think about all the advancements we have had in our modern scan tools and the dependable improvement in the vehicle's ignition system. As the scan tool and the scan data got better, our dependence on the once very expensive and space-consuming big-box analyzer waned away and so did our scope skills. Well if you haven't noticed, the scope has undergone some paradigm shifting advancements. First and foremost is the advent of the DSO. The drawback to the big-box machine, aside from the size and cost, as I always saw it, was you had to catch the issue or "glitch" in real time. In other words, you had to be looking at the screen when the issue occurred.

The DSO was a game changer in this regard! Now we have the ability to capture and store large amounts of data in a "buffer" that we can stop, save and "rewind" after the failure event occurs. I like to think of it being akin to the modern TV DVR that affords us the ability to do something other than be in front of the screen watching in real time. The same way we can archive our favorite shows; we can save the digital files or scope captures in a database that we can go back and review at a later date for comparison or print as an educational tool to enlighten our customers. The price of this technology is considerably cheaper than the big-box units that could be north of 25k back in the day. Depending on your needs, a modern DSO can be very affordable, starting at as little as $154 for a cell-phone sized, single-channel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uScope from AESwave.com to a couple of thousand dollars for a very powerful Pico unit. Snap-on incorporates their very powerful scope into their Modis Ultra and Verus platforms as well as a handheld Vantage Ultra. My point in this article is not to sell you on a brand scope, but to sell you on the idea of the practicality of using one to assist you in diagnosing today's modern vehicles.

I like to think of its use as leveraging technology to my advantage. I am only limited by my creativity as to its application. If you think about it, we put a lot of credence in what the scan tool tells us. Let's just think about how the scan tool comes to get its information. First the vehicle's sensors generate an electrical signal of some kind and send it through the wiring harness to the module. The module then processes these signals and converts them into bytes of information that is transmitted over the data bus to the DLC. The scan tool (often with aftermarket software) converts the data to PIDs that we review. I think you can see there are a lot of places where things could go wrong. I think of that old social experiment where you line a group of people up and share a list of things with one person and tell them to share the information with the next person in line. Oftentimes, by the time they reach the end of line, the original information has somehow changed. If you suspect there is an issue with the information you are getting at the end of the line, the person to talk to is the first one in line. In this analogy if you suspect an issue with scan data or have a no-code drivability issue, the place to investigate is where the signals arrive at the PCM. The DSO is a very powerful tool in this regard. I can see if the signals are reaching the module, if their signatures or waveforms are correct for the vehicle I am working on and oftentimes in the case of CM-CKP correlation, whether the engine is mechanically in time. Let's try to keep an open mind and investigate some broken cars and how the modern DSO helped accurately and quickly diagnose the concern.

The "no code" intermittent

A "no code" intermittent stall that several people have had their hands in can be possibly the worst ticket a tech or shop can take on. We never seem to get the complete story as to what has been done to it and especially if the problem is intermittent or only happens at certain times like cold start up, catching it can be difficult at best. Leveraging the technology of the DSO, I can set up my experiment to figure out whether the issue is on the input or output side of things. I can differentiate whether it's spark or fuel. Moreover, I can control what I want to see and how I set up the scope to capture it. I am only limited by my creativity when developing a logical plan of attack (POA) and when "designing the experiment" to prove out my diagnosis.

Let's start with an older vehicle with a stubborn intermittent stall issue. It's a 1995 Chevrolet S10 4.3 "W" V6 with a distributor and poppet-style fuel injection. The shop has replaced lots of parts including plugs, wires, cap, rotor, a different distributor, CKP sensor, a fuel pump and an injector assembly! This vehicle is said to run fine, but intermittently stalls and reportedly sets no codes when it does so. I ask what has been tested and get the list of parts replaced. I ask if a scope has been tried to aid in the diagnosis and the tech tells me, "it's not misfiring and runs fines.... it just stalls."


STOP TRYING
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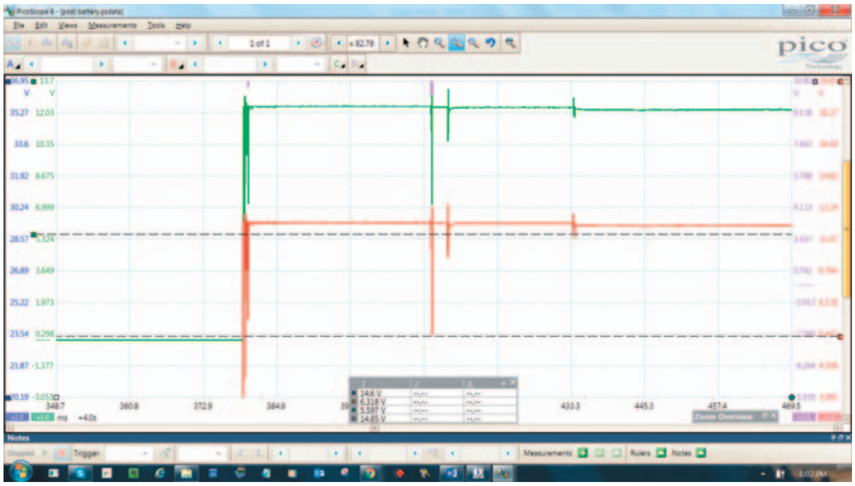
I decided to approach the stall in a logical progression. I start by scoping the CKP, CMP and primary current with a long time base to get an idea whether it is an ignition-related issue. It started and ran fine, I happened to go to my vehicle to take a call and returned to find the vehicle had stalled. The scope has captured the stall! It is in the buffer. I systematically save the capture and then zoom in. The CMP and CKP sensors appear to be present and yet the primary current shows the coil quits firing. I now have gained some valuable diagnostic real estate. I can narrow my focus to the ignition primary and its input and output. The IC trigger circuit is now added and it becomes obvious that the primary trigger from the PCM to the ICM drops out precisely when the IC stops firing. The CKP and CMP are rock solid. The feeds, grounds and control circuit of the PCM are inspected and found to be OK. A PCM is ordered and fixes the vehicle. Leveraging the power of the DSO and having a systematic plan of attack made this a fairly straight-forward diag.



A SCOPE CAN PERFORM voltage drop tests on circuits a DVOM cannot.

Voltage drop plus

Another great use for the DSO is to do voltage drop testing. The scope does an excellent job of catching dropouts caused by voltage drop or excessive resistance. The following is an example of this. The vehicle in question is a 2000 Grand Am with a blower motor that intermittently drops out, the MIL on the dash comes on, the IPC illumination lights dim and sometimes the vehicle stalls. Occasionally, the vehicle will not start. This seems to me on the onset that it could be a ground or power distribution issue. Due to the high failure rates and pattern failures known, I suspect the ignition switch may have an intermittent excessive voltage drop affecting the blower motor and IPC circuit. A quick check of the power distribution schematic gives me direction and I design the experiment, or best way to hook up my scope, to prove out or disprove my theory. My scope is hooked up to the following; DLC pin 16 (B+), PCM ACC fuse, IPC BFC ACC fuse and the Ignition SW Bat 1 fuse.

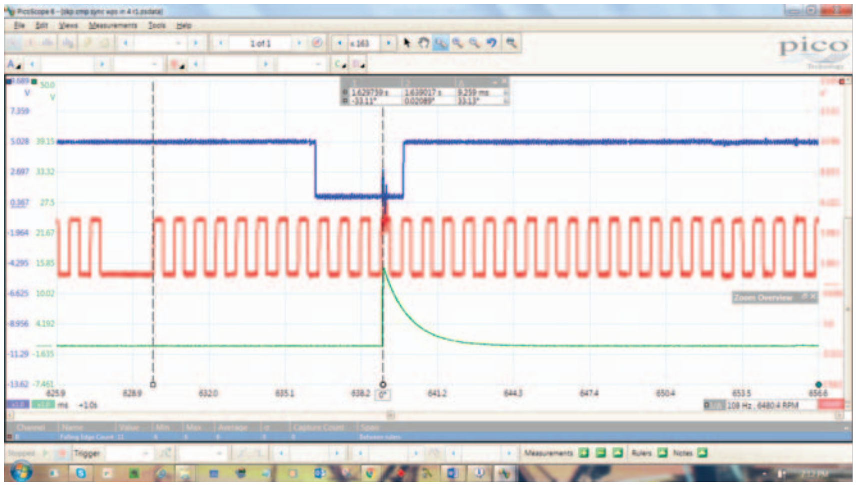
NOT ONLY DID THIS TEST prove a fault in the ignition switch, it also identified a weak battery.

I am basically doing a loaded voltage drop, testing the circuits in the environment in which they live. Turning the key from off to on, I notice there is an excessive momentary voltage drop in the switched ignition circuits at the two fuses. I also notice in the capture the cranking voltage is low due to a weak battery. The battery is changed out but the voltage drop and electrical accessory issues remain. An ignition switch is ordered and replaced and the vehicle is remedied.

Voltage drop plus

Perhaps one of the great uses for a modern DSO labscope is to check mechanical integrity. The relative compression with sync test has been detailed many times in the magazine so I will not include it again. Scoping the PCM inputs of the CKP and CMP sensors can give us an excellent indicator of engine base timing between the crank and the cams. CKP- CMP sync captures help verifyied engines that are out of time. Moreover, it can be a great aid diagnosing those pesky CKP- CMP correlation codes caused by stretched timing chains. The vehicle in question is a 2007 Equinox with a 3.4 VIN F V6 with an MIL on. The engine was a freshly installed remanufactured unit that would turn the MIL on shortly after start up. Multiple CKP and CMP sensors, both aftermarket and OE, were installed. The reluctors were inspected for chips or nicks and a used and new PCM were installed. Several hotline phone sessions have not resolved the issue. A local mobile diagnostic company (mine) was contacted to try to get scome closure.

The engine is started and the vehicle's MIL comes on almost immediately. A quick scan of the PCM for codes reveals a P0016 CKP-CMP correlation code stored. PCM codes were cleared and the engine started again with same results. This code can be a tough diagnose without time-consuming engine disassembly unless you harness the power of a labscope. My logical approach is to scope the CKP and CMP sensors and verify their signals and most importantly their relationship or correlation to one another. This case study also illustrates the need for a "known good" waveform for comparison. Some OEMs provide waveforms in their service information (SI), others do not. There are pay online sites like iATN that have a great database of waveforms. In this particular case there are a lot of 3.6 CKP-CMP waveforms but this 3.4 F motor is a rare option and at the time I tested it there was no known good available online. I used all my "phone-a- friend" options to no avail. I suspect this is a mechanical issue, but have to prove it. There was no TSB related to this issue at the time I looked at this vehicle. To complicate matters, the engine runs smoothly, has great compression, and



THIS CAPTURE FROM THE AILING EQUINOX may have the answer I'm looking for, but I'll need a "known good" to know for sure.

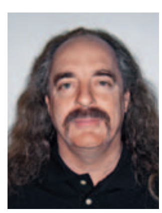
fuel trims are decent....the other issue is the MIL. Furthermore the SI at the time doesn't list how much differential between CKP-CMP sync will set this code; it simply stated something along the lines of "exceeds a predetermined value" in the enable criteria for P0016.

So my POA is simply to scope to CKP and CMP signals and figure out a way to find one to compare it to.

I often say, "I would rather be lucky than good" and lucky I was — not two days later I got a call to program a replacement PCM in a 2008 Equinox with 3.4 F engine. Post programming, the shop was kind enough to let me get a baseline of the CMP-CKP signal off this engine with 90K on the odometer with no MIL on or P0016 code present. A quick comparison confirmed my suspicion that there was a mechanical issue with the replacement remanufactured engine. In this case, it isn't timing chain stretch but rather the pressed-on reluctor for the CKP was "misclocked" or indexed incorrectly. The engine was replaced and the issue was resolved. It wasn't but a few months later that GM published a TSB for this condition of the shifting or incorrectly indexed reluctors with pictures of how to recognize, but nothing about labscope testing. I can't think of a better tool that shows just what exactly the PCM is seeing to make the determination if CKP-CMP is in sync and the correlation is correct. Moreover, this case study illustrates the need of a good database and the importance of archiving waveforms for use at a later date.

The real tool?

Here are some final thoughts regarding using the DSO to help diagnose vehicles. Scope skills are experiential; you have to use it to learn it. Practice on known good vehicles. Create a database. Do the extra test and use a logical plan of attack and design the experiment to test your theories. Leverage the technology of the modern DSO to your advantage and remember that you are the most powerful diagnostic tool in your arsenal! MA



ERIC ZIEGLER is an ASE Certified Master Tech who specializes in module programming, drivability, electrical and network systems diagnostics. He owns and operates EZ Diagnostic Solutions Inc. and is a trainer for Automotive Seminars and The Driveability Guys.
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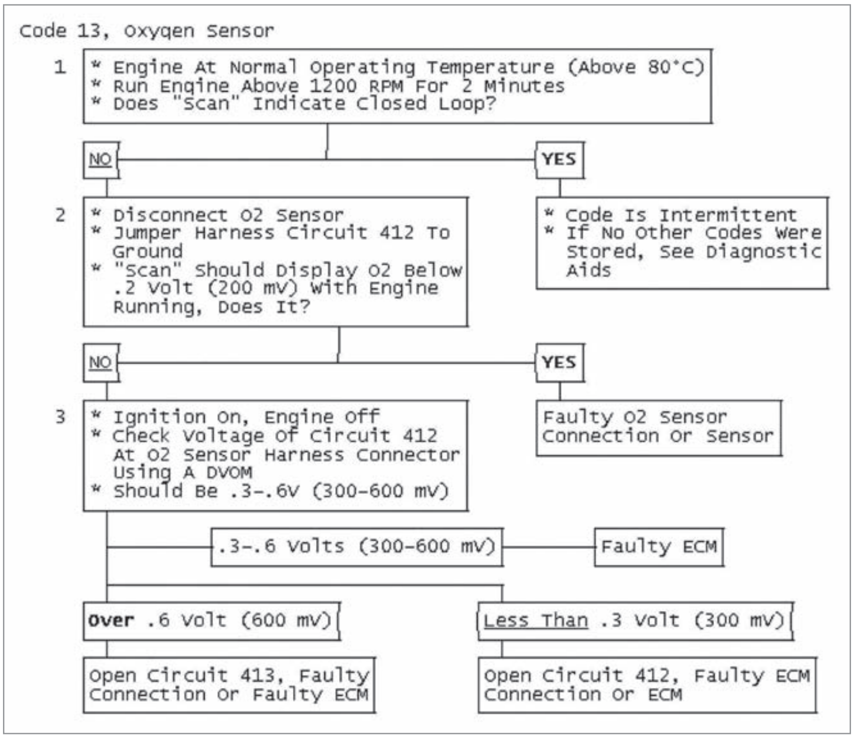
DID YOU KNOW THAT AN IGNORED COOLING SYSTEM CAN ACT LIKE A BATTERY?

JAIME LAZARUS // Contributing Editor

I've said it for years that if my body was a car, its value wouldn't be so adversely affected by its age than it would be by its mileage! High mileage and vehicle age are things we must take into consideration when performing maintenance. It's much the same as when a doctor sees a patient. Doctors take into consideration the age and other factors of the patient before making recommendations.

This article is a follow-up to one I wrote last year ("A tale of two cars," November 2016) about some maintenance I was performing on my own car. In the time since, it has occurred to me that all of us know what maintenance should be performed and at what mileage. If we don't, we can always look it up in our service information or in the owner's handbook. What a lot of us don't know though, is WHY we perform tasks in certain ways.



THIS IS AN OBD I VEHICLE using a single wire oxygen sensor. Notice the double-digit code instead of the "P" style codes you may be more used to.

PHOTO: MITCHELL 1

Batteries and cooling systems

Take for instance, in my previous article I mentioned when refilling a cooling system, I mix distilled water with pure antifreeze instead of using tap water to produce a 50/50 mix. I received numerous letters and emails regarding that particular maintenance procedure. Here, I will expound on why it's so critically important to maintain a clean cooling system.

Now, I don't claim to know a lot about chemistry, physics or science. What I've learned came from people much more educated than myself and has been proven repeatedly; therefore, I believe it. I try to keep things simple in my mind (I am getting older, you know).

Take for instance the ways that I think of a typical car battery. We start with an insulated case that houses plates that are made of lead and other metals. We fill this case with a non-conductive fluid, which happens to have a very low pH. In other words, the fluid is acidic. So basically we've submerged two or more types of metals in an acid solution. Doing so creates voltage. Is that a basic enough description?

Yes, that's a very basic description, and most of the time I really don't need to know any more details. I mean, do I? Do I need to know exactly what pH? Do I need to know what metals? Do I need to know how many plates? Even when performing battery maintenance or electrical system diagnostics, I don't need to know all of the scientific details. No, I'll perform the tests as instructed and determine whether they pass or fail to know where a fault is. I said I like to keep things simple.

I'm bringing up the typical car battery because I want to talk about the

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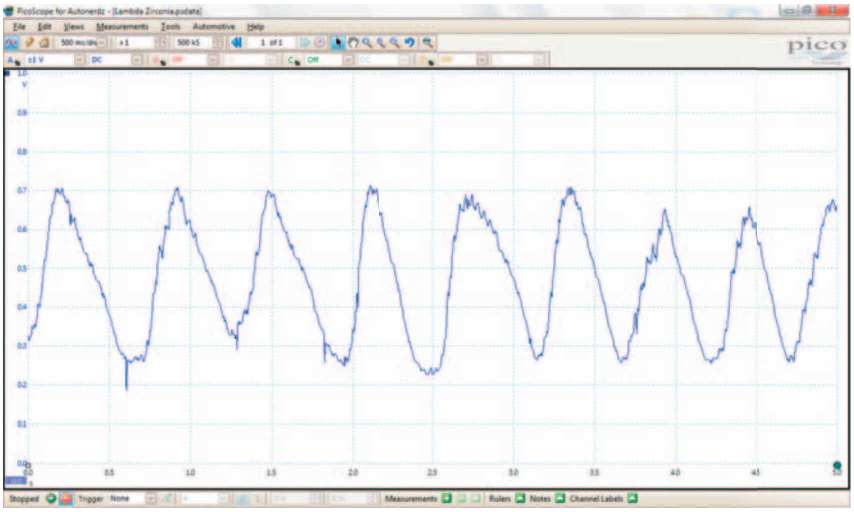

MY READINGS WERE NORMAL with the ground lead of my scope referenced to the exhaust manifold and my positive lead on the oxygen sensor wire.

relationship between batteries and cooling systems. What's that? You say you're not aware of any relationship between the two? Maybe that's because you weren't told why it can exist.

A story of explanation

Randy is a friend of mine who lives even further away from the city than me. He tries to save himself time and money when he has a vehicle problem by doing what he can himself. Randy's 1988 Chevrolet pick-up truck had been illuminating the check engine light from the time he purchased it at the farmer's auction several years before. I think this truck was the second production year that GM had used a Throttle Body Injection (TBI) system, and because of the newness to us at the time, we techs were generally nervous and excited at the same time when we got to diagnose one. I think back to those days when new systems are brought to market today, like the Gas Direct Injection (GDI) systems that have arrived on the scene in the past few years. There's no difference in my emotions each time. Are you that way, too?

Randy cared little about the light and drove the truck a couple of years like that. He was using it as a work truck around the farm. Then he had an interested buyer for it so Randy decided to take his truck to have the codes read by his local parts supplier. He felt, since they didn't charge anything for the service, that he might not need to bother me (read: travel to and have to pay me) for the same service. He also figured that once he knew why the light was staying on, it might be a simple fix (and one that he could do it himself, thereby saving even more time and money). Randy may sound like one of your "cheap" customers, but in reality, he has very little time in his day to waste (and he lives about 45 minutes away from me). His primary motivator was the time factor in this case.

The scan of the truck's Engine Control Module (ECM) revealed a code 13, described in the service information only as "Oxygen Sensor." No, it was not a P0013. Those of you who aren't familiar with anything built prior to the second generation of On-Board Diagnostics (OBDII) might not be familiar with any non-standardized Diagnostic Trouble Code (DTC) format that contained as few as one digit. I use the term "privileged" loosely with my tongue in cheek, but we older folks were privileged to have been around before the second generation was even conceived. We had

PHOTO: PETE MEIER

AS IT TURNS OUT, I was reading voltage produced by the cooling system. When the coolant mix gets too acidic, the cooling system becomes one big galvanic cell – just like a battery.

to diagnose those primitive — by today's standards — systems using what few tools we could get our hands on.

The parts supplier was kind enough to provide Randy with a print out of the DTC, a brief description of what the code meant and offered a list of parts prioritized by what they felt most often solved their customer's Code 13 problem. Now, I don't know from where the data was obtained that was used to prioritize that list, but imagine the tape register receipt on which it was printed — it was three feet long! I'm confident a majority of the customers who received that list probably resolved their Code 13 before purchasing and installing every possible option listed on the print out. I also believe those customers most likely were not driving a high-mileage vehicle. If I recall, it was in the late-1990s that I saw the vehicle and at that time, the truck's odometer showed more than 200,000 miles.

In Randy's case though, he went through the list methodically. He installed the oxygen sensor first. Notice I didn't call it a heated oxygen sensor (HO_2S)? Sorry, those hadn't been in use yet on a production-line Chevy. Notice too, that I didn't mention the location (like B1S1 or B2S2). Well, that's because they only had one O_2 sensor on this vehicle! I said it was primitive, but if you believe it would be simple to diagnose because of its comparative simplicity, you'd be mistaken.

In the past, we couldn't clear codes using a scan tool. The procedure to immediately clear the stored DTC, instead of waiting for the 50th key cycle to occur without the problem being recognized again, was to disconnect one of the battery terminals for at least 10 seconds. Randy followed the oxygen sensor replacement with the clear DTC procedure and excitedly started the truck. It was within moments the check engine light illuminated and completely eliminated any confidence that he had resolved the problem. Back to the auto parts supplier Randy went.

It was an indication of a lack of confidence in the quality of parts they carried when the store representative jumped to the conclusion the part that was sold to Randy was a "defect" and offered to replace it. Randy installed it right in their parking lot and got the same results that he got with the first one. Then he started working down the list of parts that could cause a Code 13 to set. He bought a few at a time, brought them home and after the replacement of each component, the clear DTC procedure was followed. He grew increasingly frustrated when every time he replaced a part and cleared codes, the problem would not go away. Eventually, you guessed it — the threads in the battery gave way, requiring a battery replacement!

Now it's mine

It was at this time that Randy admitted he had neither saved any money, nor any time by choosing the methods he did to address his check engine light. After calling me to verify, I could (and would) take on the job, he trailered the truck to my shop. Upon arrival, he shared with me each of the events

WITH MY METER REFERENCED TO BATTERY GROUND, I was reading a negative output from the same sensor that was reading normally a moment ago. It's all about the meter lead placement and referencing the entire circuit path.

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chronologically and reviewed with me the list he was given at the auto parts store. He was past the ECM and was asking if I had a PROM (Programmable Read Only Memory) 'chip' that would work in this vehicle. For the benefit of those who don't know what that is, we used to calibrate a module to a particular vehicle using replaceable components that were snapped into the module. Most were called PROMs. Today's modules are calibrated quite differently.

It is my first step in every diagnostic challenge — visual inspection. I include a check of all fluid levels if the complaint requires the hood to be opened for any reason, as was the case with Randy's pick-up. Nothing was noted to be low, but I did see a lot of evidence of rusty water stains on the right inner fender area that had come from the radiator at some point in time. Since it was safe for me to open it, I looked in the radiator and saw what I expected from an old work truck. I saw no evidence of any antifreeze and returned the cap from where it came.

I scanned the ECM and found the Code 13 (and no others) and at the same time, I reviewed the data list. The oxygen sensor voltage parameter was stuck at zero volts, even after running the truck a few minutes at around 2,000 RPM. I reviewed the DTC "Diagnostic Trouble Tree," the chart of instructions written to direct technicians in a logical manner (hopefully) to where the problem exists that made the light turn on. It will usually include "branches" like an inverted tree, where if you answer "yes" you are directed down one branch, and if you answer "no" you're directed down a different branch.

In the case of a Code 13, the technician is instructed to check only a few things. I don't always follow these charts step-by-step but instead use them as guides and then test circuits and components logically. Experience plays a big part in my decision of whether I'll use a chart or not.

In this case, having read the O_2 sensor data list value is zero volts, I went directly to the sensor to read the voltage it was producing. I attached my oscilloscope's negative lead to the exhaust manifold then back-probed the sensor's connector using my red lead. To my surprise I was reading a varying voltage between 100mV and 900mV! Convinced the sensor was working as designed, I felt it was time to check the voltage at the ECM. I placed the scope on the open hood facing the windshield (the ECM is located inside, forward of the glove box) and connected my ground lead to the battery's negative cable attaching bolt (very close to the ECM). Then I back-probed the purple wire at the ECM connector when I got settled inside the vehicle. I was seeing no pattern displayed at all!

So, armed with this information, wouldn't you think like I did, that there had to be an open circuit between the sensor and the ECM? Well, the Ohms test showed the circuit was intact! What do you think I did now? Re-test of course, and I got the same results (of course)! It was time to step back and think about what I was doing and what I was seeing. Do you already know what I found?

Lead placement matters

I started thinking about how I was performing my scope tests and concluded the movement of my negative lead was contributing to the different readings on the scope. I installed longer leads so I didn't have to keep moving it (the O_2 sensor was on one side, the battery on the other). I prefer to keep my negative lead on the battery negative terminal

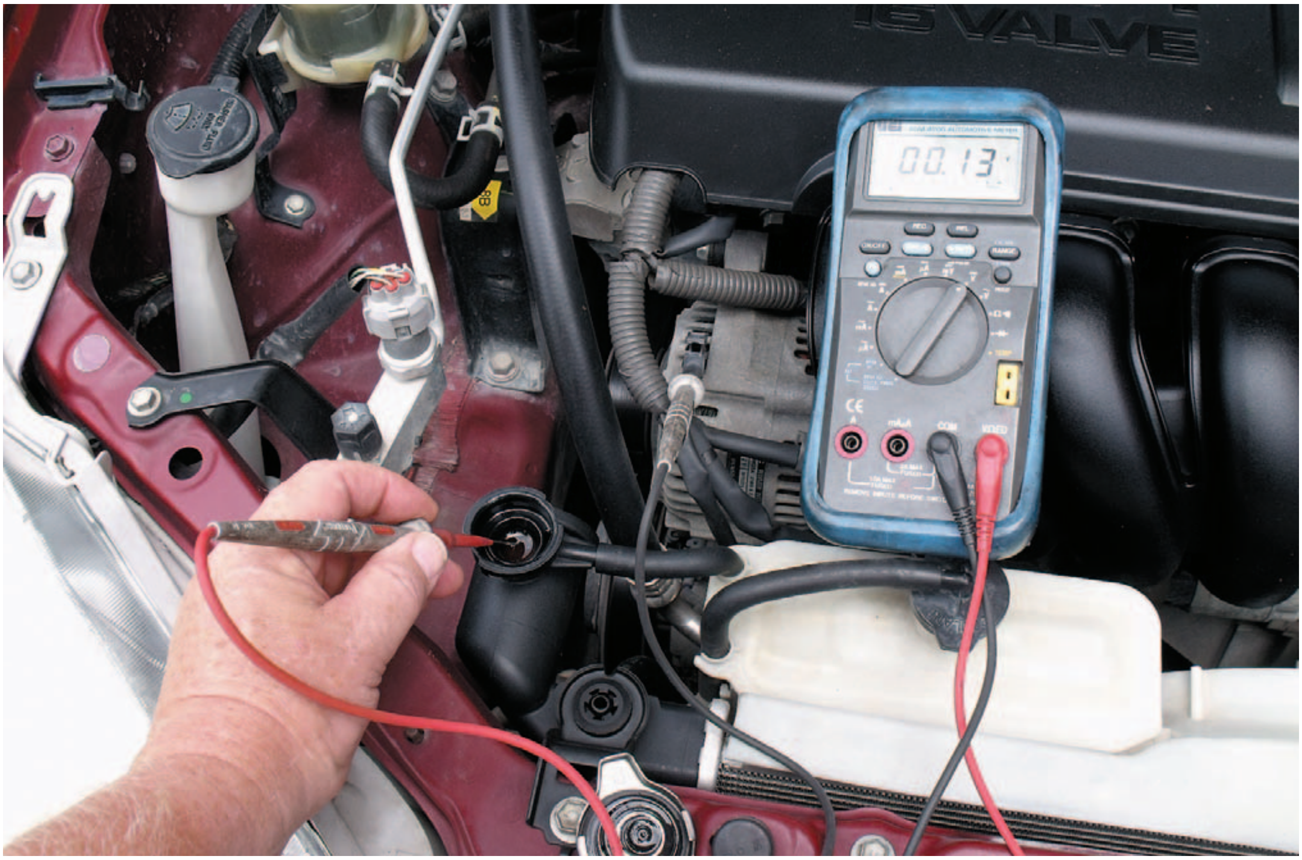

PHOTO: PETE MEIER

AS IT TURNS OUT, I was reading voltage produced by the cooling system. When the coolant mix gets too acidic, the cooling system becomes one big galvanic cell – just like a battery.

whenever possible and this truck is a perfect example WHY.

Without moving my negative lead from the battery I went back to the sensor. This time I used the scope's "Signal Finder" function. It displayed one of the most beautiful images, an almost textbook picture of an O_2 sensor, only the pattern was displayed between the (-)2.8-volt mark and the (-)1.8 volt mark. That's right, it was operating perfectly, but it was well below zero volts! Testing at the ECM connector gave me identical results. How in the world can this happen? So, what do you think an ECM sees when a signal is below zero VDC? The answer is "zero, just like it was displaying in the data list!

Why did I get these results? Remember my simple explanation of what a typical car battery is made of? Let's apply the same principles here. There are dissimilar metals that coolant flows through. The cooling system had been badly neglected, thus causing a very low pH, or highly acidic, coolant mix. Basically, instead of submerging metal in a solution, we had an acidic solution surrounding many types of metals producing voltage in the cooling system! In this case it was a negative voltage. Dipping my Digital Multi-Meter red lead into the neck of the radiator gave me proof.

Now, where do you suppose the ECM's grounds terminate on this vehicle? The bolts that mount the thermostat housing to the intake manifold (through which all the engine coolant eventually passes) hold the ECM's ground eyelets. Imagine how this change in the (perceived) ground circuit would affect all the sensors' signals!

It took nearly the whole afternoon and an unknown number of cooling system flushes to reduce the cooling system voltage to below half of a volt difference to the battery negative. I eventually used baking soda in the radiator, a last resort, to neutralize the acid that took years to get so bad.

Now you know — there's a close relationship between batteries and cooling systems! Keep those services done in a timely manner and leave the voltage production to those folks who build batteries! MA

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DIESEL ENGINE OIL CHALLENGES

DIESEL ENGINE OIL has undergone another transformation with the development of the PC-11 category, which includes the CK-4 and FA-4 specifications.

WHAT YOU NEED TO KNOW TO SELECT THE PROPER OIL FOR YOUR DIESEL ENGINE

TONY MARTIN // Contributing Editor

There is no shortage of challenges for those who design the vehicles we drive. Ever-tightening safety and emissions regulations, combined with increasing customer demands, keep automotive engineers continually on their toes. The moment one problem is conquered, they are sent back to the drawing board to deal with the next pressing issue. This has led to vehicles being designed in a more holistic manner, because the "low-hanging fruit" has already been harvested. For any given problem that needs solving, progressively more vehicle systems become candidates for redesign.

Lubricant engineers are not exempt from this dynamic. Engine lubrication is an example of a system that has sometimes been viewed in narrow terms. No one would deny that oil is the lifeblood of the internal combustion engine; however, it is now widely recognized that it plays a critical role in fuel economy as well. Fuel economy has always been important to the diesel engine manufacturers, but their hand is now being forced with the advent of greenhouse gas (GHG) emissions regulations. This issue has gained importance in recent years because fuel economy is directly related to the production of CO_2, which is a greenhouse gas. And now, like never before, engine oil is playing an increasingly important role in meeting those regulations, as well as lowering the total cost of ownership to the vehicle owner.

Diesel engine oil has been taken to a higher level of performance with the development of new American Petroleum Institute (API) specifications known as API CK-4 and FA-4, which were officially released for licensing on Dec. 1, 2016. There are some important changes that

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the diesel engine owner should be aware of regarding this new category of oils, and this information can help them choose the correct engine oil for their specific application.

A historical perspective

Big changes were afoot for on-road diesel engines leading up to the 2007 model year. The diesel particulate filter (DPF) was being widely adopted as a solution in order to comply with new EPA regulations regarding particulate matter (PM) emissions. The DPF wasn't a bolt-on fix; there were numerous changes that had to take place in fuel and lubricant technology to make it all work. First, sulfur had to be virtually eliminated from diesel fuel because it disabled the catalyst coating found on most DPFs. The allowable sulfur limit had been 500 parts per million (ppm), now it was being lowered to 15 ppm. Diesel engine oil additive formulations would also have to change. For decades, engine oil blenders had made extensive use of an additive known as ZDDP, which contains zinc and phosphorous for anti-wear protection. Sulfated ash is also used to increase the total base number (TBN) of the oil. These metals formed part of the PM emissions of the engine and would collect as ash in a DPF, thereby shortening the DPF service life.

PHOTO: SHELL LUBRICANTS

CK-4/FA-4 OILS are formulated for better aeration control, increased oxidation resistance and improved shear stability.

To address these and other issues, API developed the PC-10 category for diesel engine oils, which led to the release of the CJ-4 specification in 2006. Among other improvements, CJ-4 placed chemical limits on the use of phosphorous and sulfated ash in diesel engine oil in order to extend the service life of DPFs. CJ-4 was backwards compatible with previous diesel engine oils, and met the requirements that had been established with CH-4, CI-4 and CI-4+. All 2007 and newer on-road diesel engines required the use of CJ-4, which became the standard for more than 10 years.

The advent of CK-4 and FA-4

While discussions concerning a new diesel engine oil category started shortly after CJ-4 was introduced, work on the new diesel engine oil specification began in December 2011 with the formation of the New Category Development Team (NCDT), chaired by Dan Arcy, Global OEM Technical Manager for Shell

THE LIST IS GROWING

Shell Lubricants has recently announced that they have a total of six CK-4 approved engine oils that also meet the Ford WSS-M2C171-F1 specification. Other oil blenders are making similar announcements as they continue to develop their products to meet the needs of the marketplace. While the list of Ford-approved oils is growing, you must continue to do your research and make absolutely sure that you purchase and install the correct engine oil for your application. The days of "one size fits all" are long gone, and every diesel engine owner must stay informed about the specific engine oil requirements for their vehicle.

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[†]IMR Research Study 2015

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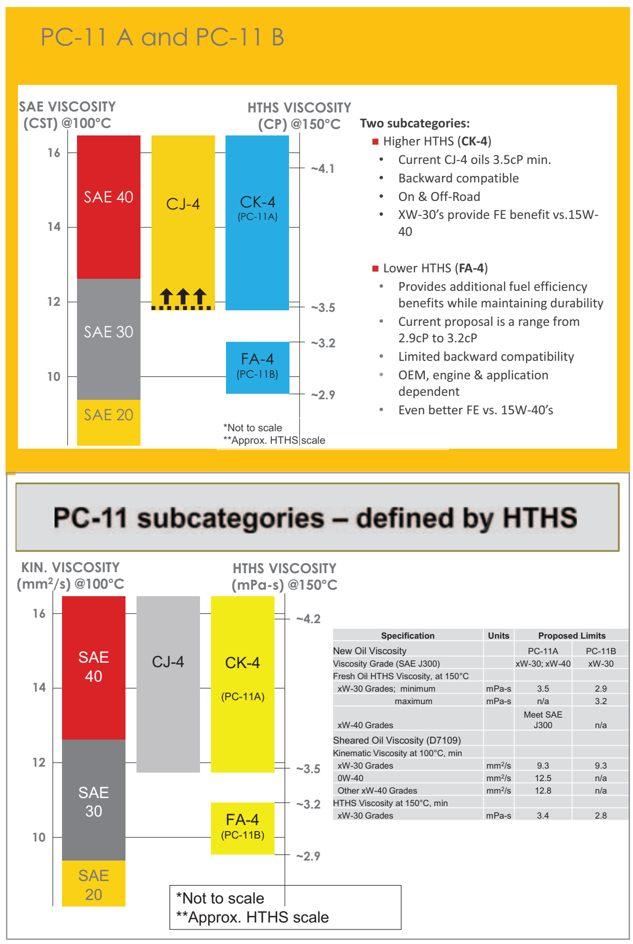
Lubricants. The NCDT committee consisted of members from the API Lubricants Group, Truck & Engine Manufacturers Association (EMA), American Chemistry Council (ACC), and representatives from the major engine manufacturers. The NCDT's main objectives were to improve specific aspects of diesel engine oil performance, as well as to provide a tool for engine manufacturers to meet the 2017 EPA regulations regarding greenhouse gas emissions.

The NCDT's work on the new category, initially identified as PC-11, evolved into the development of two sub-categories, PC-11A and PC-11B, which then became known as CK-4 and FA-4. CK-4 is a direct replacement for CJ-4, and while it has improved performance, it is also engineered to be backwards compatible. CK-4 is available in multiple viscosities, including XXW-40 and XXW-30 (by way of explanation, XXW-30 includes 0W-30, 5W-30, and 10W-30). FA-4, on the other hand, is specifically formulated as an oil with lower viscosity and is only available as a XXW-30 grade. FA-4 is not backwards compatible and would only be used if specifically recommended by the diesel engine manufacturer.

The process of developing a new engine oil category includes creating tests to prove out the performance of the oil. In the case of CJ-4, there were seven tests that were used, but some of these had become obsolete/unavailable over the years, so new ones had to be created for CK-4/FA-4. A total of nine tests are being used to assess the performance of CK-4 and FA-4 engine oils. The following are three main areas where CK-4/FA-4 was improved over CJ-4:

Oxidation resistance. The Mack T-13 oxidation test was developed by Volvo and ExxonMobil to assess the oxidation resistance of CK-4 and FA-4 engine oils. The newest generation of diesels is designed to operate at higher temperatures in order to increase their efficiency. Engine oil reacts with oxygen in atmospheric air, an effect that accelerates as the oil temperature increases. The rule of thumb is that oil life is cut in half for every 18˚F (10˚C) increase in oil temperature. Oil oxidation is a breakdown in the base oil itself and results in the accumulation of acids, varnish and sludge. Oxidation will also cause increases in oil viscosity and corrosive wear. Additives can be used to reduce the effects of oxidation on engine oil,



Specification	Units	Proposed Limits	
New Oil Viscosity		PC-11A	PC-11B
Viscosity Grade (SAE J300)		xW-30; xW-40	xW-30
Fresh Oil HTHS Viscosity, at 150°C			
xW-30 Grades; minimum	mPa-s	3.5	2.9
maximum	mPa-s	n/a	3.2
xW-40 Grades		Meet SAE J300	n/a
Sheared Oil Viscosity (D7109)			
Kinematic Viscosity at 100°C, min			
xW-30 Grades	mm^2/s	9.3	9.3
0W-40	mm^2/s	12.5	n/a
Other xW-40 Grades	mm^2/s	12.8	n/a
HTHS Viscosity at 150°C, min			
xW-30 Grades	mPa-s	3.4	2.8

PHOTO: SHELL LUBRICANTS

THE DIFFERENCE BETWEEN CK-4 AND FA-4 IS VISCOSITY. FA-4 engine oil has a lower high-temperature, high-shear viscosity and is able to achieve increased fuel economy and lower GHG emissions.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prolonging its life and extending the drain interval. The net effect is a reduction in operating expenses by not having to change the engine oil as often.

Aeration control. Modern diesel engines are more suspect to oil aeration issues due to higher operating temperatures and pressures. It is inevitable that air will become trapped in the oil; higher performing oils will release the air more quickly. To assess aeration dissipation of CK-4/FA-4 engine oil, the Caterpillar Oil Aeration Test (COAT) is used. The COAT test measures how quickly an oil can release entrained air, and of course, faster is considered to be better. Improved aeration control can help limit oil oxidation, as well as improving its cooling and lubrication characteristics. This is particularly important to HEUI (Hydraulically-actuated Electronically-controlled Unit Injector) diesel engines built by Caterpillar and Navistar, which suffer from major drivability issues (including no-starts) if their engine oil is aerated.

Shear stability. Viscosity (resistance to flow) is the most important property of an engine oil. Multigrade engine oils use viscosity index (VI) improvers to increase their viscosity at higher temperatures. For example, a 10W-30 engine oil starts out as a 10W base oil, then has polymers added that make it act like an SAE 30 oil at engine operating temperature. VI improver polymers are chains of molecules that curl up into a ball at low temperatures, then unwind at high temperatures to increase the oil's viscosity. A common problem with these polymers is that they are often vulnerable to "shear," which is being physically cut apart when under severe stress. This can take place when the oil passes through high-stress areas such as between helical gears or a cam lobe and its follower. Shearing is a serious problem because it permanently lowers the viscosity of the oil, which can lead to wear of critical engine parts. There was a time when soot thickening could compensate for shear, but modern engines don't produce nearly as much soot as they once did. Polymer shear can also lead to misdiagnosis of engine issues based on oil sample results. According to Dan Arcy, "Sheared polymers can make a 15W-40 engine oil test as a 15W-30, which could cause a technician to conclude that they are dealing with a fuel dilution issue." Arcy continues by explaining that "the cure for this is higher quality polymers that are less suspect to shear."

PHOTO: SHELL LUBRICANTS

CK-4 WAS FORMULATED to be backwards-compatible and thus be a direct replacement for CJ-4.

More on FA-4

The FA-4 category was designed as lower viscosity to give diesel engine manufacturers another tool to help them meet the latest GHG emissions regulations. Lower viscosity engine oils pump more easily and lower engine-rotating friction, which translates into increased fuel economy and, therefore, reduced carbon dioxide production.

There are four different tests that are used to assess the SAE viscosity of engine oil. These include:

1. Low-temperature pumping viscosity
2. Low-temperature cranking viscosity
3. Low shear rate kinematic viscosity
4. High-temperature high-shear (HTHS) viscosity

Of these four, the tests that define the SAE viscosity grade (for example, the 30 in 10W-30) are Kinematic viscosity and HTHS. The HTHS test is a defining characteristic of CK-4 and FA-4 engine oils. It is important to note that the only difference between a CK-4 and FA-4 oil of the same grade is that the FA-4 oil will have a lower high-temperature, high-shear (HTHS) viscosity. For example, a 10W-30 CK-4 oil is spec'd at the high end

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of the HTHS viscosity range for 10W-30 oils, where a 10W-30 FA-4 oil is spec'd at the low end of the viscosity range.

FA-4 currently has limited endorsement for 2017 diesels. This includes GM, FCA and Ford, none of whom recommend FA-4 for use in the diesel engines available in their heavy-duty pickups. The initial licensing date for CK-4 and FA-4 was originally slated for April 2016, however, various delays in development pushed this date back to December 2016. According to Kevin Ferrick, API Engine Oil Program Senior Manager, "The late release of the CK-4 and FA-4 categories might not have given the diesel engine manufacturers enough time to assess the use of FA-4 oils in their latest engine designs. For this reason, and perhaps others, we have seen limited adoption of FA-4 as a recommended engine oil."

While FA-4 is currently awaiting approval from almost all of the diesel engine manufacturers, not everyone has endorsed CK-4 as a replacement for CJ-4. Shortly after API introduced the CK-4 and FA-4 standards, Ford Motor Company issued a position statement that said, "Ford will not be recommending the use of CK-4 motor oils in any Ford diesel engines, new or old. Ford testing has shown that some CK-4 type formulations have shown inadequate wear protection compared to CJ-4 formulations developed and licensed before 2016." Despite what appears to be a prohibition of CK-4 oils, Ford goes on to state that they have developed a diesel engine oil standard of their own known as WSS-M2C171-F1, and that their customers should use an oil that meets this specification. At the time the position statement was published, there weren't any oils available that had been approved for WSS-M2C171-F1 and PowerStroke owners were being told to use a CJ-4 engine oil in the interim. Since that time, Ford has accumulated a long list of approved CK-4 oils; the current list can be viewed at MotorAge.com/FordCK4.

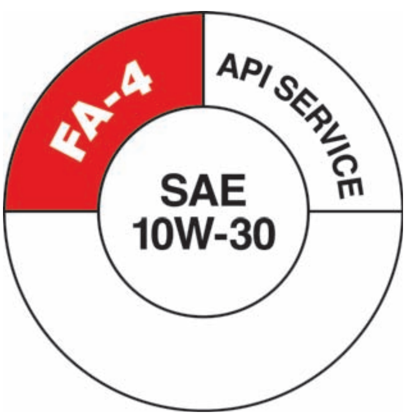

PHOTO: SHELL LUBRICANTS

THE API DONUT SYMBOL FOR FA-4 is unique in order to help prevent incorrect purchases. FA-4 currently has limited diesel engine manufacturer approval for use in 2017 diesel engines.

The difficulties Ford identified with the use of CK-4 engine oil in PowerStroke engines are most likely related to chemical limits on the use of the anti-wear additive phosphorous in some formulations of CK-4. Ferrick explains; "If an engine oil blender wants to have their 10W-30 diesel engine oil approved for both the CK-4 and SN categories, they cannot use more than 800 ppm phosphorous. In contrast, an XXW-40 engine oil that is approved for CK-4 can have up to 1200 ppm phosphorous." In their position statement, Ford says that a 10W-30 oil that is approved for both CK-4 and SN cannot meet WSS-M2C171-F1 and should be avoided.

The bottom line? You can use CK-4 motor oil in a PowerStroke diesel, provided it meets the Ford Material Engineering Specification WSS-M2C171-F1. It should be listed right on the bottle, otherwise check the link above to see if your engine oil has Ford approval. For any other brand of diesel, do your research and only install the oil that is recommended by the engine manufacturer. You don't want to make a mistake that could shorten the life of your very expensive diesel and jeopardize your warranty as well.

PHOTO: TONY MARTIN

FORD MOTOR COMPANY has expressed concerns on the use of CK-4 in PowerStroke diesels. To get Ford's approval, a CK-4 engine oil must meet their WSS-M2C171-F1 specification.

The future

CK-4 and FA-4 were a long time coming, and the hope is that it will be around for some time to come. In the meantime, API has established a work group to start the discussions on how the next category of diesel engine oil will be developed. To be sure, the drivers will be the same as they were for CK-4 and FA-4; a new phase of regulations known as HD-EMA GHG Reduction Phase 2 kicks in 2021 to 2027. According to Shell's Arcy, "look for a move towards 0W-20 and 5W-20 oils and increased drain intervals for HD fleets. However, so far no change is being talked about for pickup trucks."

There are two things we know for sure: requirements for engine oil will increase and lubricant engineers will be working hard for the money. And, at the end of the day, we will have diesel engines that produce more and pollute less. MA

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WHAT'S YOUR ROUTINE?

ARE YOU GIVING EACH AND EVERY CUSTOMER THE FULL BENEFIT OF YOUR TRAINING AND EXPERIENCE?

PETE MEIER // Technical Editor

Much of the work we do every day is "routine," isn't it? Oil changes, tire services and routine repairs are the norm. The drivability and electrical challenges that come in are relatively few in comparison, though they are often the jobs that require the most focus and time to resolve — and so, tend to stick out the most in our memories. Faced with these challenges, we pull out all the stops and use every tool and technique we can think of in our efforts to find and fix the underlying problem.

Do you give those "routine" jobs the same level of attention? Are you really giving the more difficult ones the full benefit of your experience and expertise?

Our profession is often compared to the medical field. Our patient is our customer's car, and it is up to us to diagnose what ails it and then apply the correct treatment to bring it back to health. The thought process is similar to that of a physician diagnosing your medical complaint, though our patient isn't "running" when we perform our version of surgery on it. Whether our physician counterparts are faced with a particularly troubling diagnosis, or just providing you with a "routine" check-up, there are certain processes they apply. Baseline information is gathered; height, weight, blood pressure, temperature, general history and so on. What type of baseline do you take on the cars you work on? Does it vary by the type of complaint or do you consistently apply your process to each and every vehicle?

DAMAGED HEADLIGHT LENSES have an impact on nighttime visibility. Do you recommend this type of repair to your customers?

PHOTOS: PETE MEIER

Thoughts on a professional inspection

Like the doctor you rely on to keep you healthy and safe, your customer relies on you to advise them on the state of health of their automobile. Here are a few thoughts on what you should be checking on each and every car you touch.

Let's start with the tires. This is, admittedly, a pet peeve of mine because it was so often overlooked in the shops I worked for when I was still a full-time tech. Even the shops that marketed themselves as tire specialists! One experience that really stands out in my memory was a car that came in for an unrelated minor repair. As I brought the car into my work area, I took note (as was my habit) of the mileage and overall condition of the vehicle, and saw that this particular customer had just recently had a routine oil change performed in the last 30 days or so based on the sticker affixed to the upper left hand corner of the windshield.

Nothing unusual about the car or the tires caught my eye as I moved around the vehicle setting the lift arms. As I began to raise the car, a loud "boom" echoed through the shop, startling the you-know-what out of me. The right front tire had blown out as soon as the weight of the car shifted from the tires to the lift. The inside edge of the tire was worn to the steel belts and the hole that was left after the failure was big enough to put my hand in. Is it possible that this amount of wear happened after the last service had been performed? Yeah, I guess so, but I tend to doubt it.

If you don't do anything else I recommend here today, and you're not doing so already, please make it a habit to inspect the tires of each and every car you touch. And not on the ground either. I mean lift it up, check the wear and look for tire punctures around the entire circumference of each one. And check/adjust the tire pressure while you're at it. Yes, we have TPMS (Tire Pressure Monitoring Systems) in place on a lot of the cars you're working on, but even they won't report a low tire until the tire has lost 20 percent and that's (according to most tire manufacturers) 10 percent too much. Can you imagine the potential results of the blowout I just shared with you had that customer been driving down the freeway? I, for one, would not want the end results of any accident on my conscience because I didn't look when I had the opportunity.

EVERY CAR DESERVES 100 percent of your talent, experience and expertise.

And that's the real point I'm trying to make here. It is up to us, as professionals in our field, to provide our customers the very best we have to offer, to give 100 percent to every paying customer. It is a moral and ethical responsibility to advise our customers when we see any condition on their car that could cause a safety issue for them and their families AND it is our responsibility to look for these potential safety issues on each and every car we touch. I've preached this in the past, and I already know I'll get the usual comments about "not happening on flat-rate; I don't get paid for that" from some of you. To those, I ask you to consider how you'd feel if the roles were reversed and it was one of your family members that suffered because the last "tech" that saw their car decided it wasn't worth the time.

A few more items to check

I'm not going to go into the more common areas I think we all check, or I hope so anyway. Brakes, suspension components and wheel bearing condition are just a few of the "easy" things to check on every car and also the areas that tend to make for great upsells if work is needed.

Other areas are not so routinely checked, I think. Another pet peeve of mine are those vehicles on the road missing rear lights, especially brake lights. I can't count the number of times I've had to slam on my own brakes because the vehicle in front of me didn't have more than one, if that. It's easy to do a walk around to check most of the exterior lights, but you need to expend a little more effort to check the stop lights. Some shops use mirrors mounted so that the tech can see the rear of the car. Some techs have a buddy check while they hold the pedal down, and some (like I did) just use a lock rod to hold the pedal down and check them solo. It's a small thing, and the work sold won't make you rich, but you are doing your customer a favor by performing this small task.

While we're on the subject of lights, what is the condition of the lenses on your customer's headlights? Are they clear or hazed over to the point that the headlight can't penetrate the lens? Often the reduction in visibility is so slow that the customer hardly notices, but it does make a difference.

Another is the condition of the wiper blades. Most customers don't think about their wipers unless it's raining, and even if the blade is ready to fall off of the arm, as soon as the rain stops they forget all about them. Torn blades can lead to damage to the windshield itself, resulting in a much costlier repair. And inspecting them only takes a minute.

I'm sure there are a few other items you can add to this list — items that are often overlooked but are vitally important to the driver when they aren't as they are supposed to be. Checking them need not take a lot of time and most can be easily incorporated into your normal workflow.

CUSTOMERS ONLY THINK of their worn out wiper blades when they're needed and then forget about them when they're not.

CHECKING BRAKES is easy and something most of us do routinely.

OUR PATIENTS usually aren't running when we perform "surgery."

What to do with it once you got it

Now that you've completed your inspection, what do you do with the results? If your shop is set up like the majority of the ones I worked in, you have to take that information to your service advisor and let them deal with the customer. I could perform the most complete inspection ever, but if the service writer didn't feel like bringing any of that to the customer's attention, it was a waste of time for me and for my customer. I'd like to shift the conversation a bit from the back of the shop to the front counter, so shop owners — pay attention.

I'm sure there are service writers (or advisors, whatever term you happen to use) that are true professionals. It's probably been my personal misfortune to not work with too many of them. I have worked with those that would simply ignore any recommendations made and those that would sell the services that were on this week's "spiff" sheet, but I have worked with very few who would take the time to share with the customer the true condition of their car from a perspective of what was best for that customer.

And that is the factor that can make a ton of difference, both in the short term and definitely in the long term.

Our customers, in general, are leery of the "upsell." They've come to expect it and they are prepared, in advance, to reject any suggestion that additional work is needed. How that information is presented to them is key in changing that attitude. If we can, by our actions, show that we truly care about their needs and have their best interests at heart, we can break through the stereotype they hold and make them lifelong customers.

Do what's right for the sake of what's right, and the rest (our wallets and our bottom lines) will take care of itself. MA

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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FAILURE TO COMMUNICATE

SWAPPING AN ENGINE OR TRANSMISSION? BOTH ARE BIG JOBS — BUT YOU STILL HAVE TO PAY ATTENTION TO THE DETAILS TO ENSURE A SUCCESSFUL RESULT.

JOHN ANELLO // Contributing Editor

I was called to a shop for a simple task of reprogramming a new ECM on a 2012 Ford Focus with a 2.0L engine (Figure 1). There are a lot of shops in the industry that do not want the responsibility of programming a new ECM due to the liability and costs involved in doing the job. Some shops may not be properly equipped with the proper interface or laptop and may not want to go to the internet to fill out an application to sign up with an individual manufacturer and purchase a daily subscription. This may be coupled with a need to be registered through NASTF as a security professional to access theft procedures that may be needed during the post-programming procedures. There is also the need to have a proper battery charger in the shop that can provide a "Programming" mode that will maintain a specific voltage range while a current surge occurs, such as with a cooling fan coming on during the programming process. Some manufacturers will terminate pro-

PHOTOS: JOHN ANELLO


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gramming if voltage falls below 13.1 volts or if voltage exceeds 14.0 volts. An older battery charger with only low, medium and high settings is not recommended and may pose a problem if too much AC ripple is introduced.

Is the ECM to blame?

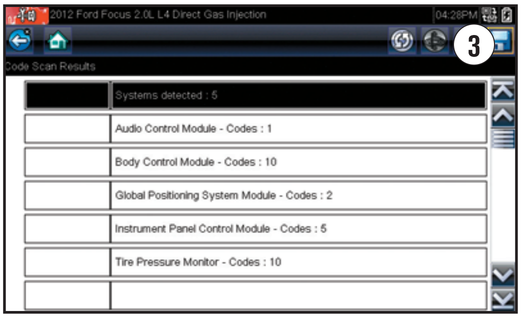
When I arrived at the repair shop, I questioned the shop technician to see why he had made the decision to replace the ECM. It is not uncommon for a shop to jump the gun to condemn a control module without probable cause. I'm not in the business to just go ahead and reprogram a control module at will without making sure it will resolve their issue with the vehicle. The last thing I need is to charge a shop to program a new or used control module only to find out that it was wasted cost without a cure for their problem. I will usually question the shop to see if they followed the proper procedures to condemn the module. This would include checking power and ground feeds, shorted reference voltages, communication lines or even an issue with their testing equipment.

The shop told me that they just replaced the transmission (Figure 2) and when they got done the vehicle would no longer start. They checked the vehicle and found that the

ECM was not responsive, so they figured it might have been damaged during the repair procedure. This is a bad situation of what I call "drive them in/push them out." We have all been there before at one time or another in the repair business. It becomes an unwanted marriage between you and the vehicle and your only way out is to resolve the issue at your own cost because you can't expect the customer to pay it. In the end, it all becomes a learning experience but you're under the gun to get things resolved ASAP before the customer is aware of his or her new dilemma.

When I hooked up to the new ECM to program it, I was unable to communicate with it. The shop was under the impression that the new ECM would not communicate because it needed to be programmed. This is misinformation that a lot of shops seem to believe, and I had to school them on this belief and to educate them on how to evaluate no communication issues with a vehicle. They have to always make sure that prior to condemning a controller they check EVERY power and ground feed at the ECM and scan the entire vehicle to make sure it is not just a single control module issue without focusing too much of their attention only on one single controller. By scanning the entire vehicle they will get a better evaluation of all the operating systems that are responsible in starting the vehicle. Sometimes the clues to their problems may

resonate in other modules on board that may put them on a better path in their diagnostic process.



Start at the beginning

I placed my scan tool on the vehicle and did a full scan of the entire vehicle. I discovered that only five control modules were present on the multiple networks this vehicle had on board (Figure 3). These were the Audio, Body, GPS, Instrument and Tire Pressure Monitor control modules. This vehicle had three separate CAN networks on board: Medium-Speed, High-Speed and Entertainment CAN networks. The High-Speed CAN network was inoperative. The controllers on this network included the Transmission, Engine, ABS, Power Steering, Steering Angle, Air Bag and Occupant Classification control modules. It was highly unlikely that all these control modules were bad or that they all had a common power or ground feed failure. What was common to all of them was a network circuit that was either open or shorted.

It is very important to understand how a CAN network is structured prior to testing it. Keep in mind that all the controllers wired on a single CAN network are all considered nodes, and they are all wired in parallel. The CAN network consists of a twisted pair of communication lines to eliminate electromagnetic interference. There has to be a way to stabilize waveform reflection within the network and this is done by putting a terminating resister at each end of the network. A 120 ohm resistor is commonly used at both ends of the network and may be internal to a module or externally mounted on the network wiring. The 120 ohm resister internal to a control module will usually be the control modules furthest at the ends of the CAN network. If we use Ohms Law we can mathematically figure out the total resistance of the network. The total resistance of the network will always be the sum of the inverse of each individual resistance. Total resistance will also always be lower than the smallest resistance. In this case:

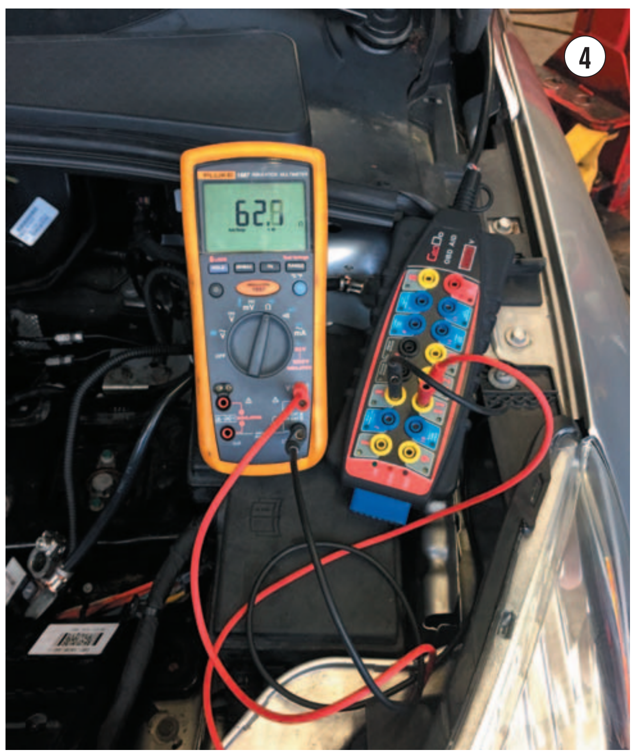
1/Rt = 1/R1 + 1/R2

1/120 = 0.0083

0.0083 + 0.0083 = 0.0166

1/0.0166 = 60.24

With this equation we should expect about 60 ohms across each network.



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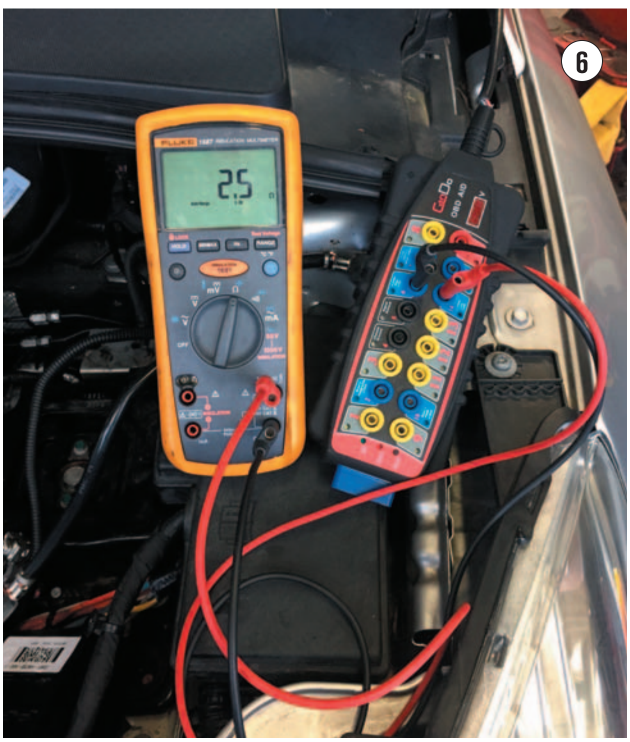
The battery would have to be disconnected prior to doing an ohm check because the system cannot be alive while using an ohm meter. I used an OBD interface box to make things easier while working under the dash. As you get older you want to work smarter without having to put too much pressure on the lower part of your vertebrae while hanging upside down under the dash. The interface has labeled ports that reflect the 16 pins of the OBD II connector, and each port is coupled with LEDs that alert your attention to the presence of power, ground or data activity. I used my Fluke meter and tested the Medium Speed CAN network first at pins #3 and #11 and acquired a reading of 62.8 ohms (Figure 4). Then I preceded to the Entertainment CAN at pins #1 and #8 and acquired a reading of 62.3 ohms (Figure 5). These readings were well within the tolerances of a healthy CAN network.

Module or wiring?

I now proceeded to check the High Speed CAN network pins #6 and #14 and acquired a reading of 2.5 ohms (Figure 6). This network was shorted together. This would make sense why seven controllers fell off the radar. The hard part now was to put together a game plan of attack to locate the source of the problem. The possibilities that could be laid out were that any one of these seven controllers could be shorting out the network or the network harness could be shorted somewhere in the vehicle. I printed out a diagram and circled the seven controllers involved and checked off the ones that were the easiest to access. The eighth controller was an optional Parking Aid Control Module that was not fitted on the vehicle. My plan was to unplug each controller one at a time to see if the short would be eliminated. If the problem remained, then I knew I had a harness problem.

I wanted to start with the easiest controllers to gain access



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Now you can have the speed of a cabled solution while operating wirelessly. With our WIFI wireless, we leap past traditional Bluetooth®-based devices in speed and range. What's more, we maintain the compact hardware our customers love.

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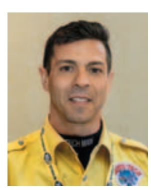
to without too much work involved, so I went to the engine compartment first. I disconnected the engine and transmission control modules that were already exposed near the base of the transmission and there was no change. I next decided to go after the ABS control module that was located at the driver side firewall. In order to access this module I had to pull the battery out of the way (Figure 7). As I was reaching for the ABS connector I was looking down at something that caught my eye. There was a harness crushed under the battery tray (Figure 8). This was not good. I proceeded to remove the crushed harness and exposed what turned out to be damaged CAN network wires (Figure 9).

Problem found — on to the fix

The two wires that were crushed in the network connector were for the High-Speed CAN network. I simply repaired the wiring and put everything back together, and the vehicle started right up with no problems. It was amazing how these two wires took down the vehicle and put it out of commission during a routine R&R of a transmission assembly. These seven control modules were cut off from the rest of the vehicle as if they were stranded on Gilligan's Island away from all interaction with the rest of the crew.

The seven modules were are still responsive and in good working order with good powers and grounds but were no longer able to communicate among each other or with other controllers on the network. This led to the other controllers setting "U" codes for loss of communication with modules within the networks.

Repairing vehicles today is much more difficult because you're now working in tighter quarters and components are not always easy to get to or even remove and replace. It is so important to watch your every step to make sure things are put back the way you found them and to be very careful not to put components in harm's way. When you experience a problem, you always need to go back to where you were last. Don't be so honed in to one module problem; branch out your diagnostic routine to include a full scan of the entire vehicle to enable you to dot the Is and cross the Ts. MA



JOHN ANELLO owns Auto Tech on Wheels in northern New Jersey, which is a mobile diagnostic service for 1,700 shops, providing technical assistance and remote programming. He is also a nationally known trainer.
atowscopeit@aol.com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TIRE CHANGER
ROTARY
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1080

AUTOMOTIVE FILTERS

Purolator provides premium oil, air, cabin air and fuel filters for the automotive aftermarket. With countless filtration patents, Purolator is trusted by both technicians and DIYers to provide exceptional Dirt Removal Power™. It's our mission to stay a step ahead of contaminants — safeguarding your engine, your fuel tank and even the air you breathe. Learn more about Purolator's impressive product lines online.

WWW.PUREOIL.COM

SCAN TOOL

AutoEnginuity announces the release of Giotto 15.3 scan tool software. Giotto is a first of its kind touch-based scan tool making the user-experience faster and smarter, while remaining a powerful tool. Giotto 15.3 introduces a leap forward in coverage for Jaguar, Land Rover, and Porsche. AutoEnginuity added new systems, system tests (including diesel tests), and added odometer reporting to trouble codes. This release will allow our coverage to stand above all others for both the collision and repair industries.

WWW.AUTOENGINUITY.COM

DURABLE LAPTOP

The Panasonic Toughbook® CF-20 is a fully rugged, lightweight laptop that easily detaches to become a 10.1" tablet. And it only takes one hand. The detachable laptop features a durable MIL-STD-810G and IP65 design, along with a magnesium alloy chassis, so it will take the abuse of most any job site or application.

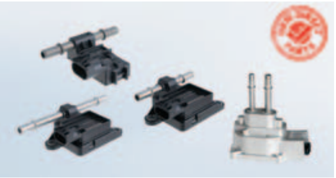
WWW.BUSINESS.PANASONIC.COM

DIAGNOSTIC TABLET

The new Autel MaxiSys Elite diagnostic tablet can rapidly perform every job from comprehensive vehicle diagnostics and analysis to advanced programming and now features a longer battery life. An additional second year of warranty and software updates is available exclusively to Advance Professional and Carquest customers. For more information on advanced diagnostic tools, call your local Advance Auto Parts or Carquest delivery location.

WWW.SHOP.ADVANCEAUTOPARTS.COM

FLEX FUEL SENSORS



VDO OEMDP Flex Fuel Sensors are genuine OEM replacement parts. They are identical in fit, form, and function as the OE components supplied by Continental to auto manufacturers worldwide. VDO Flex Fuel Sensors are the latest in green technology for GM vehicles. They calculate the percentage of ethanol in fuel and adjust the output signal to the ECU creating dynamic ignition timing and E85 capability.

WWW.VDO.COM/USA

HEAD GASKET SEALER

BlueDevil Head Gasket Sealer will repair and seal leaks in blown head gaskets, warped or cracked heads, heater cores, and freeze plugs. BlueDevil head gasket sealant contains no solid or particulate matter, and will not clog or harm your engine. It bonds to metal, aluminum, cast, alloy, or plastic. BlueDevil Head Gasket Sealer is compatible in gasoline and diesel engines. Many people are unsure how to fix a blown gasket, but know that BlueDevil's Head Gasket Sealer is the best formula available as it stops leaks permanently.

WWW.GOBDP.COM

OIL FILTERS

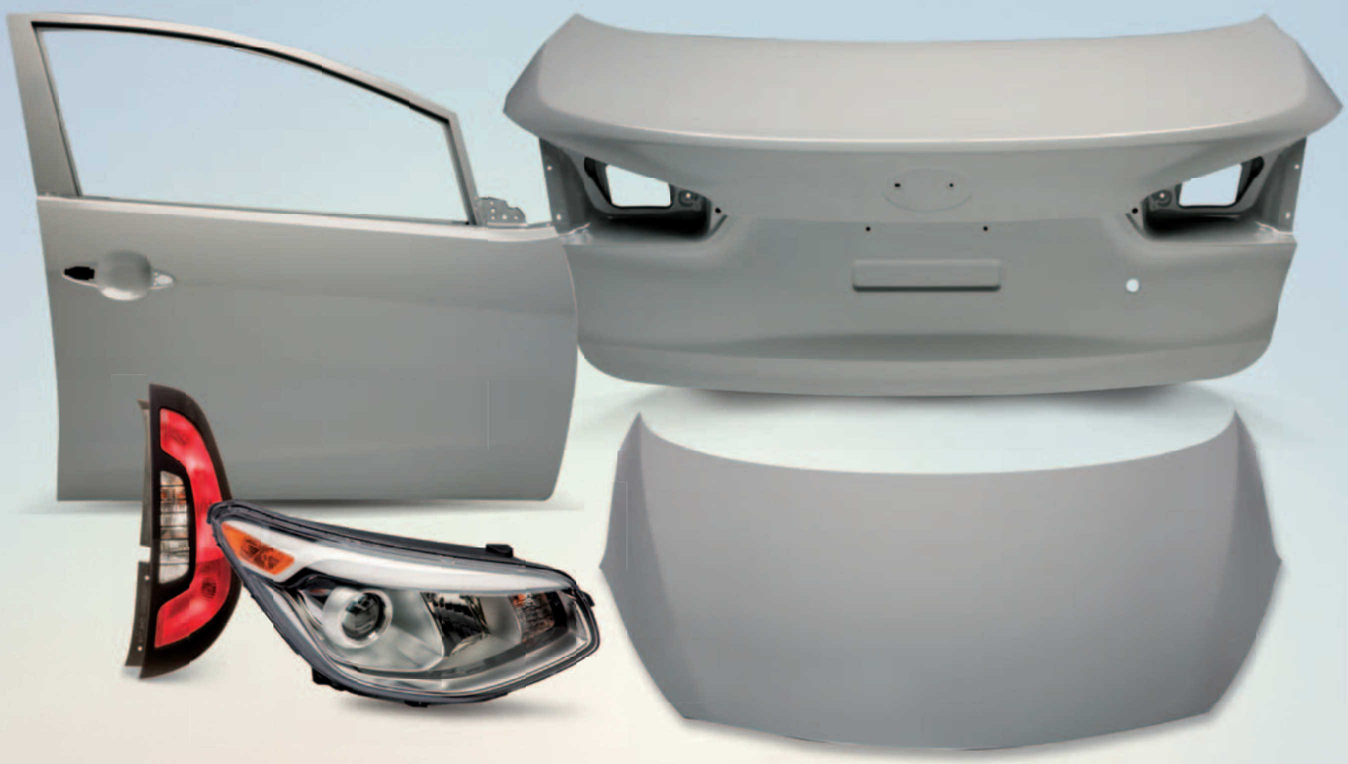
The NAPA Platinum filter offers technology for the latest advancements in synthetic oil and performance oil filters. Featuring a host of oil filter innovations, including wire-reinforced, fully synthetic media, ultra-durable hydrogenated nitrile compound antidrain back valve (where applicable), this oil filter provides the ultimate protection in the NAPA family of oil filters.

WWW.NAPAFILTERS.COM

MARKETING SERVICES

Mitchell 1 has added a new feature to its SocialCRM auto repair marketing services to help make auto repair businesses more visible online when customers search for auto repair. LocalSearch is an optional add-on service that complements SocialCRM by assisting shops in building their brand and boosting their selling and marketing opportunities.

WWW.MITCHELL1.COM



REAR AIR STRUTS

Arnott offers new, not rebuilt, rear air struts for the 2002-2008 BMW 7 Series featuring heavy-duty ContiTech air spring bladder and a shock custom designed for the 7 Series with a larger piston, providing excellent ride quality and stability. These new struts are assembled in the USA using the highest quality materials and come pre-assembled for an OE fit.

WWW.ARNOTTINC.COM

REFRIGERANT RECHARGING MACHINE

The Robinair 34788NI and 34788NI-H A/C machines recover, recycle, evacuate, leak-test and recharge R-134a with an industry-leading 98.5 percent efficiency. The 34788NI features a large display and fully automatic function to reduce technician downtime. An optional refrigerant charge and oil capacities database is available for North American market vehicles. A WiFi/Bluetooth module will be available this year, along with a variety of productivity boosting accessories, making A/C service more effective and efficient.

WWW.ROBINAIR.COM

DIAGNOSTIC SCAN TOOL

This unique OBDII drivability diagnostic scan tool allows the technician to complete testing sequences in short order. As the go-to tool for drivability and fuel trim diagnostics, you can gather loads of data in a simple test drive, save it and analyze it on the road or back at the shop. It's the only tool on the market that allows for testing of the vehicle that provides enough information to the technician on a short test drive that when they get back they understand what needs to be done to the vehicle.

WWW.AUTOMOTIVETESTSOLUTIONS.COM

AIR HYDRAULIC JACKS

Chicago Pneumatic has launched a new series of air hydraulic jacks, extending its workshop equipment range for professional vehicle maintenance customers. The CP85XXX range of high quality, high lifting capacity air hydraulic jacks are perfect for tire changing and general mechanic applications on heavy vehicles such as buses, trucks and agricultural vehicles.

WWW.CP.COM/WELIFTYOUUP

6-WAY BREAKOUT LEAD SET

The Pico Technology Premium 6-Way Breakout Lead Set contains 11 sets of six different sized universal breakout leads and a set of six back-pinning probes. The breakout leads come with seven different sized flat-blade connectors and four different round pin sizes. The individual breakout leads are designed with the ability to clip together into a single block for ease of handling.

WWW.PICOAUTO.COM

SIGHT BLOCK KIT

The Pico PQ071 Sight Block kit adds another level of diagnostic capability to the WPS500X Pressure Transducer. This accessory is extremely useful when you are looking for air in low-pressure fuel systems. The kit comes with a stop valve for testing a negative pressure fuel pump under load and three sets of hose barbs for connecting to different size hoses.

WWW.PICOAUTO.COM

BATTERY CHARGERS

New Bosch SmartCharge Battery Chargers/Maintainers employ self-monitoring functions for safe and smart charging. With three different models to choose from, including the SmartCharge Pro, SmartCharge Plus and SmartCharge, Bosch SmartCharge Battery Chargers suit the needs of the professional technician. Bosch SmartCharge Battery Chargers promote long battery life while delivering spark protection, overheating protection, reverse polarity protection and overcharging protection.

WWW.BOSCHAUTOPARTS.COM

PRODUCTS CATALOG

Arnott® Air Suspension Products features more than 300 air suspension replacement products — including dozens of new and updated aftermarket parts for Audi, BMW, Land Rover and Mercedes-Benz — in its 2017 Automotive Products Catalog. The 40-page publication lists Arnott's complete line along with products in development.

WWW.ARNOTTINC.COM

TEMPERATURE CONTROL KITS

Stant Corporation has introduced a new line of temperature control kits. Specially developed to simplify cooling system service, the new kit includes all the parts needed to complete the repair in one box. The new line of Stant temperature control kits cover over 82 million vehicles in operation (VIO) with only 21 part numbers. Each kit contains a thermostat, gasket, radiator cap and coolant temperature sensor and when installed, regulates both temperature and pressure for the cooling system.

WWW.STANT.COM

ELECTRIC WATER PUMPS

Gates has introduced three new electric water pump part numbers, with two being used in the same vehicle but in different locations with different functions: Buick LaCrosse and Regal hybrids. The first pump is auxiliary to the heater and the other is for battery cooling. These electric water pumps ensure OE form, fit, and function as well as easy installation while restoring the heating and cooling systems to proper operation and performance.

WWW.GATES.COM

AUTOMOTIVE LED LIGHTING

Lumileds, a global lighting solutions company and the exclusive supplier of Philips-branded automotive lighting products, has just introduced a new and advanced generation of automotive LED lighting for a wide range of interior and exterior vehicle applications. Philips Ultinon LED lights deliver brilliant, high-tech lighting in a variety of colors so that drivers can easily see and be seen.

WWW.PHILIPS.COM/AUTOMOTIVE

EMISSIONS CONTROL PRODUCTS

The Walker® Emissions Control product line now covers an additional 21 million passenger-vehicle repair opportunities as a result of Tenneco's introduction of 103 new direct-fit catalytic converter, premium muffler/muffler assembly, pipe, resonator and hardware part numbers.

WWW.WALKEREXHAUST.COM

ELECTRONIC TORQUE WRENCH

The Matco Tools 3/8" Drive Flex Head Electronic Torque Wrench 10-100 Ft. Lbs. with Angle offers a sealed ratchet head for better performance and the flex head design provides added access and control in tight spaces. The angle measurement eliminates the need for angle meters for applications specified by manufacturers. Featuring 100 percent steel body construction, it offers a non-slip, comfort grip and the flared handle provides a secure hold.

WWW.MATCOTOOLS.COM

LIFTING EQUIPMENT

MAHLE Service Solutions has partnered with Gray Manufacturing to offer ShopPRO® – a full line of hydraulic and pneumatic equipment for the commercial vehicle market. The ShopPRO product line includes 12 product categories: air lifts, axle jacks, component lifts, engine stands, fluid handling, forklift jacks, service jacks, shop cranes, shop presses, support stands, vehicle lifts and wheel service equipment.

WWW.SERVICESOLUTIONS.MAHLE.COM

SPARK PLUG REMOVAL TOOL

The OTC 6918 Ford Spark Plug Remover Kit is designed to prevent breakage of the three-piece spark plug with a unique design that locks the plug porcelain core to the plug hex, allowing it to turn as one complete unit. The kit comes with detailed instructions to maximize success rate and is compatible with the a wide range of Ford engines.

WWW.OTCTOOLS.COM

HIGH CARBON BRAKE DISCS

Textar, the world's leading manufacturer of OE brake pads, offers a range of German-engineered, high-carbon brake discs for European applications. Engineers have developed a brake disc to ensure ultimate braking performance, and the brake discs are available at WORLDPAC.

WWW.WORLDPAC.COM

Knowledge is power when connecting with maintenance-deferring millennials

Last year, millennials, those born from the early 1980s to the early 2000s, became the largest generation in the United States, and their influence over the automotive aftermarket will continue to grow until it surpasses the baby boomers — a trend that shops and technicians cannot ignore.

In the short run, engaging millennial customers will be a big — but not insurmountable challenge — based on a survey* of 1,000 consumers and 150 automotive service professionals conducted for ACDelco, General Motors' true original equipment maintenance parts brand.

Two very important facts about this generation came to light in the survey: Millennials routinely defer maintenance and repairs, and they are more likely than any other age group to drive a vehicle in a potentially risky condition.

Technicians said some of the most neglected maintenance repairs fall in to the "safety triangle" of tires, brakes and suspension. This could be why half of millennials surveyed said they have been towed at least once in the last five years and 13 percent have been towed three or more times.

At the same time, the survey showed 60 percent say they want to learn more about "do it yourself" maintenance, which could include changing spark plugs, brake pads and oil changes. Shop owners and technicians can leverage this eagerness by becoming their source of information, building loyalty and long-term relationships with these young customers.

"Millennials defer maintenance and repairs for all kinds of reasons — they may be short on funds or short on time or both. But if shop owners engage them in the right way and share practical information and know-how, they can start turning them into loyal customers," said John Latner, training director, ACDelco.

One almost turn-key way is to leverage programs like ACDelco's "Knowledge is Power" toolkit, one of the many benefits of becoming an ACDelco Professional Service Center (PSC).

Through Knowledge is Power, ACDelco provides shops with everything needed to host a customer car care seminar, including a customizable presentation and materials to help announce and promote the event.

In Knowledge is Power events, customers can learn:

- How certain vehicle systems work and why they may need maintenance
- Symptoms, noises and smells
- Child passenger safety and teen driving tips
- How to accurately describe vehicle problems with technicians

"Car-care seminars are a great way to instill a preventative maintenance mindset with customers, especially if shop owners keep the communication going," Latner said. "You're planting the seeds that will grow into a long-term relationship, which will benefit everyone in the long run."

*Survey conducted by Babcox Insights and Data on behalf of ACDelco.

ACDelco

Playing the diagnostic game

Without a doubt, diagnosing automotive vehicle problems is a complex issue and the most difficult service to profit from. The tidal wave of technological complexity installed in today's vehicles make it even more difficult to consistently profit while satisfying our customers. Your shop needs talented technicians and service advisors with great attitudes towards serving your customers to be successful. Your team should constantly seek knowledge to stay abreast of new technologies and your shop must commit to a solid diagnostic workflow process that includes investment in tools, equipment and continuing education. Many shops have struggled to keep up and are now using a mobile diagnostic technician. While this is a solid solution, it does not always serve the customer's immediate needs in respect to timing and convenience. Here are a few tips that may help you get your shop's diagnostic house sorted.

First let's define diagnostics. Most shop owners define diagnostics as the techs' work to determine the root cause of a customer's concern. It is the information you stand on when making a service recommendation. And, of course, diagnostics is the least profitable service you provide. There are no parts involved (and thus no parts margin) – to the point that some have resorted to giving diagnostic services away if a customer buys the repair.

To your customers, diagnostics is viewed as inconvenience that costs money; money that they don't think they need to spend. Many customers don't understand or accept the value, because they feel you should know what's wrong with their car.

An all-encompassing definition of diagnostics is 'Identification of a condition or problem by systematic analysis of the background or history, examination of the signs of symptoms, evaluation of the research or test results, and investigation of the assumed or probable causes.'

Systematic means process. This service isn't just an approach using experience-based diagnostic web sites. It requires a plan of action that is followed every time.

Analysis is different that diagnose. Analysis is taking all the information gathered and considering how it relates to the problem. Diagnosis has the perception of a solution while analysis is the process of getting to that point. Background and history consider all that has happened with the specific vehicle prior to the point in time a customer brings it into your shop.

Examination relates to running a series of tests based on the analysis of the vehicle history and symptoms. Test Results implies you actually ran tests and the results are included in the analysis. Investigation is focused on determining if the results of the analysis are logical and make sense as a solution.

Customers don't simply want a diagnosis. They want you to 'just solve the problem!' when they walk into your shop. This discussion of the way we define diagnostics should prompt you to think about your own best practices from a different points of view.

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 for Advance Auto Parts.

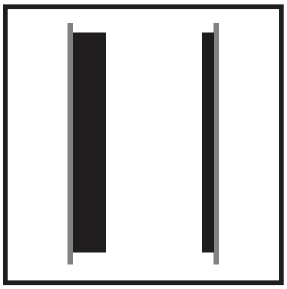
TECH TIPS ADVERTORIAL

Diagnosing caliper issues: Brake pad wear clues

Problem: Uneven or rapid brake pad wear is sometimes blamed on a defective caliper, but often other issues in the brake system are the real problem.

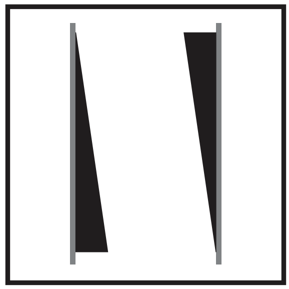
Cause: Defective mounting hardware, faulty installation or other issues in the brake system may be the actual problem.

Solution: Before replacing the caliper, use the wear guide charts below to help diagnose the true issue behind pad wear.



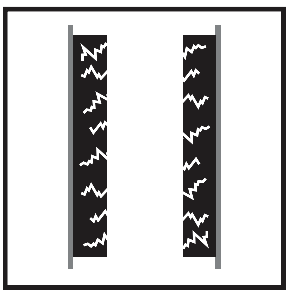
Wear pattern: Outboard pad is worn

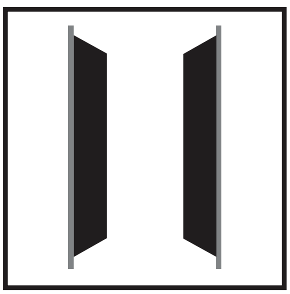
Cause: Caliper slides or mounting pins not are functioning properly. Inspect and replace as needed.



Wear Pattern: Tapered wear - horizontally or vertically

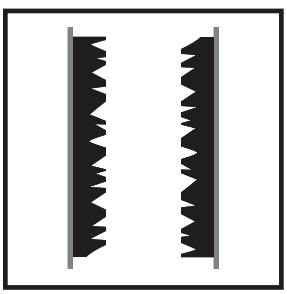
Cause: Worn caliper bushings or defective mounting hardware.





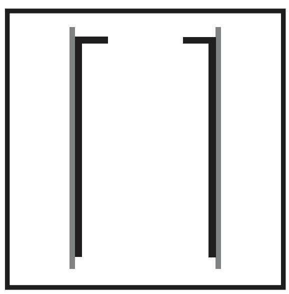
Wear Pattern: Cracked lining, chipped friction edges or fast wear

Cause: Excessive heat build-up due to constant friction caused by faulty brake hoses, brake pedal or booster maladjustment, or mounting hardware.



Wear Pattern: Grooves in the surface of friction material.

Cause: Rotors should be turned or replaced.



Wear Pattern: Step in lining.

Cause: Pads were improperly installed. Inspect installation, check for defective mounting hardware, and replace as necessary.

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CARDONE

Simplify TPMS by avoiding common mistakes

While there are a lot of factors out there that can complicate TPMS service, it doesn't have to be difficult. In spite of multiple part choices, application variants, scan tool concerns, and installation details, TPMS service can be as rewarding as it is profitable. The best way you can simplify your TPMS service work is to avoid the four most common pitfalls typically encountered by some shops:

No.1: Using a relearn tool with out-of-date software

Relearn tool manufacturers and OEMs update software almost on a monthly basis. Many factors can initiate a software change, such as new vehicle model introductions or older vehicle recalls. Keeping your relearn tool up-to-date with latest software will ensure quick and accurate relearns.

No. 2: Not performing the factory relearn

Factory relearn procedures should be performed every time you service a tire or TPMS sensor to ensure that the entire TPMS system is fully functional. Because the sensors work in harmony with the vehicle's receiver, skipping this step can send incorrect information to the vehicle operator and create a safety concern. Many vehicles offer a "pressure by location" feature that shows drivers exactly which tire is not at factory recommended pressure. If tires are rotated and a relearn is not performed, the TPMS sensors can transmit an incorrect location to the driver.

No. 3: Not replacing the sensor service parts

When a tire service is performed, a TPMS service kit should be used to replace the TPMS sensor mounting seals, related hardware, and hex nut. This is highly recommended and very important. These components are key to providing a leak free seal between the TPMS sensor and the wheel.

Always replace service parts

Keep relearn tool up to date

No. 4: Not verifying vehicle application data

In order to select the correct replacement TPMS sensor, it is essential that you have the exact vehicle year, make, and model data. Quite often the vehicle model year is not the same as the vehicle build date. There are a couple of easy ways to quickly and accurately identify the correct vehicle data. One way is to confirm the production year by using the 10th digit of the VIN. Another is to use a relearn tool with a VIN reader feature. Either way, knowing exactly what vehicle is being serviced will guide you to the correct replacement TPMS sensor.

These helpful tips are brought to you courtesy of Continental, manufacturer of the VDO REDI-Sensor™ Multi-application TPMS Sensors and one of the industry's leading innovators of complete Tire Pressure Monitoring Systems, sensors, and service parts.

For more information, visit: VDOREDI-sensor.com or contact: salessupport-us@vdo.com.

VDO

Dickies Shop Collection: Built for today's workforce

Automotive professionals take pride in the quality of the job they do, and they need gear that works as hard as they do. Fueled by extensive input from top garages, the Dickies Shop Collection is built for today's automotive workforce.

Designed to deliver maximum durability to every automotive worker, from technicians to engineers, the Dickies Shop Collection has the fit, fabric and function they need on the job.

- In the shop, workers need to stretch, reach, bend and climb to get the job done. The Shop Collection's range of classic and modern fits ensures they can perform any activity with maximum comfort and mobility.
- Cutting-edge fabric technology is woven into The Shop Collection, with advanced cooling mesh technology and moisture-wicking properties that keep workers comfortable and focused on the task at hand.
- Every detail of each Shop Collection garment is engineered with the worker in mind. Flex fabric wicks away stains and wrinkles for easy care, while multiple pockets keep essential tools close at hand.

Above all, the Dickies Shop Collection maintains the premium level of quality, durability and comfort that working professionals have always expected from Dickies.

As temperatures begin to plummet, the work inside the shop won't slow down. Built to withstand winter's demands, the Dickies Insulated Color Block Jacket is the perfect combination of durability and versatility. Similar to Dickies' classic Eisenhower jacket, but with a motorcycle jacket collar, this jacket is both functional and stylish. Adjustable waist tabs and cuffs allow for customizable comfort, and water resistant technology makes it ready to tackle any climate. Two front slash welt pockets and a pencil pocket on the left sleeve provide ample storage for the tools you can't put down. The Dickies Insulated Color Block Jacket is available in black/silver and dark navy/silver.

To purchase the Dickies Shop Collection log onto www.DickiesAutomotive.com.

Dickies

Light the way 2x to 4x longer

Wagner® LongLife HD premium lamps provide extended service life preferred by many automotive, fleet customers

Every season is lighting season across North America, but in the fall, as daylight hours shorten, consumers and commercial vehicle operators are especially interested in lighting replacement and upgrade opportunities. Wagner® — the "Automotive Lighting Experts" — has an excellent lighting solution to help consumers and operators of utility, municipal, over-the-road truck and other hardworking vehicles achieve up to 2 to 4 times longer lamp service life than Wagner Standard.

Wagner LongLife HD premium headlamp capsules, sealed beam headlamps and miniature lamps are engineered specifically for customers who demand increased product durability and heavy-duty dependability. Wagner LongLife HD lamps are equipped with extra-strength filaments that may also include a patented fifth lead support wire to enhance durability and withstand greater vibration than Wagner Standard grade. The new LongLife HD headlamp capsules provide up to two times longer life than standard Wagner capsules, while LongLife HD sealed beams — featuring impact-resistant quartz glass and a rugged lamp housing design — last up to four times longer than conventional Wagner units.

Wagner LongLife HD miniature lamps are charged with a premium Krypton gas that helps enhance filament life and provides a purer, whiter light than standard incandescent lamps.

"A burned-out vehicle lamp is inconvenient at best and can end up being extremely expensive if the owner receives a ticket," said Wagner Lighting Brand Manager Eli Wolnerman. "Offering customers an alternative that can last up to 2 to 4 times longer than our Wagner Standard grade product is a great way to turn a comparatively fast, easy repair into a service experience the customer will appreciate and remember.

More value for every customer

Wagner offers a broad range of other lighting upgrades that can make a real difference in customer satisfaction. These include **Wagner BriteLite**® capsules, projecting a beam pattern that is up to 80 percent brighter and 120 feet longer than Wagner standard halogen headlamps.

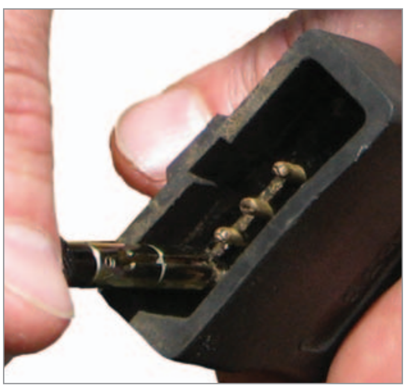
Another option is Xenon gas-charged **Wagner TruView**® capsules, which provide exceptional forward visibility by projecting a blue-white light for better contrast and increased visibility.

WAGNER®

www.WagnerLighting.com

Explaining the three levels of contact care

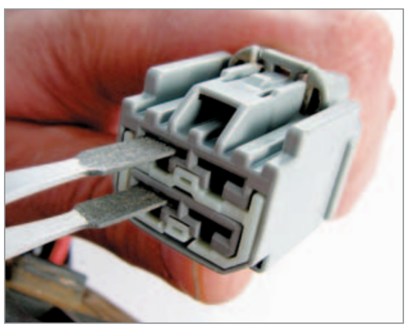
Corrosion buildup on electrical connectors inevitably leads to electrical component and circuit failures. With technicians reporting corroded terminals on vehicles less than a year old, it's imperative for any shop to have the tools necessary to combat these issues. While everyone is familiar with battery terminal cleaners, the term "contact care" was introduced to the industry 7 years ago when Innovative Products of America® (IPA®) saw a need for contact care on a wide range of connectors. The result is a line of cleaning tools that clean and renew all connectors including male, female, spade and round. Contact care is a general term to describe corrosion prevention and maintenance on all types of electrical systems, including flat/spade, round and bullet type pins. The concept behind contact care involves servicing three levels of corrosion.



Level 1: Preventative maintenance should be performed periodically but especially any time mating harnesses or terminals are separated. This includes checking pins for tightness and applying a corrosion inhibitor, such as dielectric grease or DeoxIT® Contact Cleaner and Shield, to remove

any microscopic corrosion.

Level 2 (most common): Removing visible corrosion for diagnostic troubleshooting or rejuvenating a terminal to like-new condition before reconnecting. A common mistake is using improper tools such as screwdrivers, knives, emery cloth and welding tip cleaners which can stretch, deform or break pins leading to more costly repairs. Although cleaning terminals can be tricky, especially on smaller male and female pins, it is easily accomplished using the right tools for the job. A good example is IPA®'s #8040 Diamond-Tip Electrical Terminal Cleaners for cleaning flat-type pins. Once corrosion is successfully removed, a corrosion inhibitor should be applied.



Level 3: Replacing a terminal that is too corroded to save. In these instances, you would need to identify the correct pin replacement number or possibly replace an entire harness. For a single pin replacement, you can use one of the many kits of

terminal release tools on the market.

Using patented designs, IPA®'s Contact-Care Tool Line can clean most types and sizes of electrical contacts ranging from .020 (20 Thousandths) to 1.0 (1") found in automobiles, commercial tractors, trailers, plows, forklifts, ag and industrial equipment, etc. These tools can access many of the smallest terminals and are designed to precisely scrape corrosion from male and female pins without damaging the integrity of the terminal. These terminals are commonly used with 12V and 24V electrical systems. For a full list of professional contact-care tools, visit www.ipatools.com.

Crash Avoidance Systems require maintenance

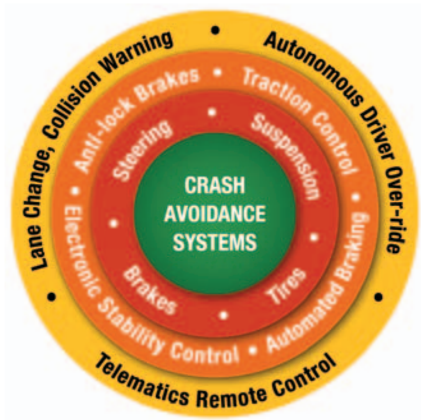
Your customer's vehicle and its Crash Avoidance Systems capability may be at risk unless you help them make good ride control (maintenance) choices. That's correct: Shocks, struts, steering, suspension, brakes & tires are the most critical components of a vehicle's Computerized Crash Avoidance System!

TV commercials and new vehicle salespeople would have you and the motorist believing that just because a vehicle has all the latest high-tech, fancy name features that it's nearly Crash-Proof. What they don't tell you is that it only works well (if) you maintain the designed performance of its ride control components. That's when a parts professional can really help the motorist… Stay in Control.

A computer system like Electronic Stability or Traction Control can't actually stop a vehicle, it can't change lanes quickly and it can't help grip the road. Only the tires, brakes, shocks & struts and ride control components can! Computerized controls can only observe how a vehicle is behaving and make decisions about how to correct a bad driving situation. Electronics and computer software can't actually correct the problem nor avoid an accident by itself. The parts you recommend are what make the difference between it working well, or not.

So, are shocks & struts important to Crash Avoidance? Of course they are because they control the vehicle's springs, which in turn controls body movements like pitch, roll & yaw. When too much spring movement occurs due to shock & strut wear the steering becomes unresponsive which causes under & oversteer problems as well as reduced tire to road contact. As a vehicle begins to lose control, Crash Avoidance kicks in and tries to keep the vehicle in control by applying brakes, slowing engine speed and in some models it changes transmission, cruise control & steering functions.

You may be surprised to learn that National Highway Traffic Safety statistics show that most vehicle accidents occur to vehicles that are 4 to 8 years old. Virtually all vehicles in that age range are equipped with Crash Avoidance Systems, but they're still involved in the most collisions. That's where you, the parts professional, can help your customers: by helping them understand the importance of ride control maintenance parts like shocks & struts that help keep Crash Avoidance working at its best.



KYB is one of the world's largest suppliers of shocks & struts to new vehicle manufacturers and are original equipment on many of the world's top selling vehicles. The importance of Crash Avoidance is why all KYB shock & struts have original equipment quality and are specifically calibrated to help restore a vehicle's designed performance.

Helping the motorist stay in control is an auto care industry shared responsibility. The more you know and share with the customer, the safer we all drive!

TECH TIPS ADVERTORIAL

Enhance your employee's Know How with NAPA Autotech

Vehicles are becoming more technologically advanced. What used to be an easy repair has suddenly gotten a little more complicated. As a shop owner you are going to need your technicians to be up to date with the latest automotive advancements. To help you accomplish this NAPA Autotech offers the the latest high-tech training. Not only are each three to four-hour class held in the evening, but they cover topics important to your business, such as hybrid maintenance, no code diagnostics, diesel issues, scan tool dynamics, electronic circuit testing and more.

Learn from the best

All NAPA Autotech classes are led by experienced trainers who are certified technicians. They will use their work experience with the latest technologies to provide your technicians with the best training currently available. Their instruction will enhance your technicians' understanding of vehicle systems and increase first-time repair capability, which leads to increased customer satisfaction.

With ClassPass, training doesn't end when class does

NAPA Autotech wants you to have continuing education at your fingertips 24/7. So, after you've completed a course you can access additional information online with ClassPass. When questions come up, just go to napaautotech.com. There your employees simply enter their ClassPass ID and have unlimited access to supplemental materials, such as slides and notes, step-by-step procedures and common fixes for repair situations.

Autotech helps improve the bottom line

There are a lot of reasons for your employees to go through NAPA Autotech training, but the most important is that it can help make your shop more successful. Shop owners who previously attended classes boasted that it helped their technicians speed up diagnostics testing times and increased employee productivity, which can help improve your operation's bottom line.

Sign up for a class

NAPA Autotech wants to help keep your employees up to date with the latest automotive advancements. To find out more about the classes being offered, go to napaautotech.com and search for classes in and around your ZIP code. Keep your business running longer, stronger with NAPA KNOW HOW.

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NAPA AUTOTECH™
Training You Can Get Your Hands On

Finding the fix with 5 easy steps

Have you ever struggled with a fix and by the end felt like you were just part swapping? Sometimes the answer to finding a quicker and more accurate diagnosis is in your process.

One powerful way to improve your process is to fully utilize all of the automotive repair information available to you. Let's briefly walk through five steps that can help you gather information to build a diagnostic strategy that will improve your efficiency and accuracy.

Step 1: Verify the symptom or complaint

This is the basis of your diagnosis and a crucial step in setting yourself up for success. Having a complete understanding of the problem will guide you to the best place to start. Step 1 actually has two parts.

The first part, understanding the problem, begins the moment the customer walks in the door. That initial conversation with the customer gives you the opportunity to ask the right questions and collect as much information as possible.

The second part, replicating the problem, can give you further insight into the symptoms causing the problem that maybe your customer did not notice. Sometimes this can be done in the bay, but often it means driving the vehicle to re-create the customer complaint. Resources like the Top 10 Repairs List in Mitchell 1's ProDemand can help you quickly identify the likely cause or lead you to even more specific questioning.

Step 2: Analyze symptoms

Once you've verified the symptoms, it's time to build your diagnostic strategy. This is where you do all of your thinking and plan the work, putting your diagnostic tools to good use.

- **Scan tools**: Pulling codes with a scanner should be your first stop.
- **Real-world information**: OEM information may not be enough when you're running into issues like multiple unrelated codes. This is where real-world information can help. ProDemand's SureTrack real-world information, for example, lets you see how other professional technicians have solved the same codes and symptoms for the same vehicle.
- **Common repair procedures and probable components**: Having information about common repair trends and known fixes for specific codes and symptoms can also help set you on the right path with the most likely components to test first.

A GOOD DIAGNOSTIC PROCESS IS CRITICAL FOR BOTH ACCURACY AND EFFICIENCY.

Step 3: Isolate the fault through testing

Now that you have your plan in place, you can execute the diagnostic strategy and isolate the fault through testing. There are some great shortcuts that can help you save time. In ProDemand, these include features like Real Fixes, component test information, the ProView tool for diagnosing multiple codes, and a library of known-good waveforms and PID graphs.

You will also use your handheld scan tools like the new ZEUS from Snap-on, as well as oscilloscopes, multi-meters, smoke machines and more specialized equipment like fuel injection testing equipment.

Step 4: Correct the problem

Once you have identified the component/s that failed, you can move forward and complete the repair. Access the basic information you need — repair procedures, diagrams and specifications, etc. — in your repair information resource, such as ProDemand.

Step 5: Check for proper operation

Once the repair is complete, it's quality check time! Verify the fix by driving the vehicle — look for the original code or symptom and make sure it has been addressed and no codes or check engine lights come on.

This quick overview highlights how using a resource like ProDemand can reduce diagnostic time, and give you more confidence when building and carrying out a diagnostic strategy. For more detail, check out the webinar, "Using Real-World Information Throughout the Diagnostic Process," accessible from the Mitchell 1 blog: mitchell1.com/shopconnection.

www.mitchell1.com
800-896-3126

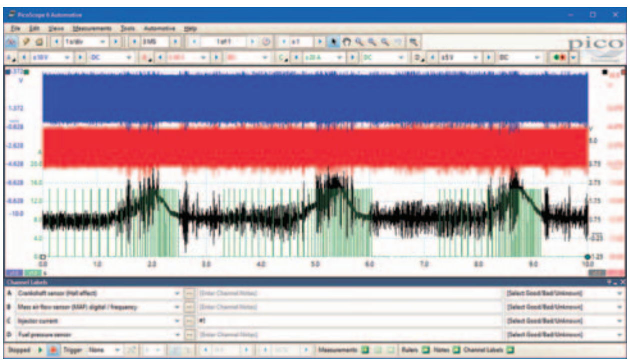
Mitchell1®
In your shop, at your side

TECH TIPS ADVERTORIAL

Graphing and filtering with PicoScope

It is often said that you need two skill sets for oscilloscope diagnostics, one for capturing the waveform and one for analyzing it. There is an element of truth in this, but the more you familiarize yourself with the features of PicoScope, the less daunting it becomes. Our Guided Tests will assist you with settings and probe selection, while the included technical information provides a description of the captured waveform. As your confidence with data capturing grows you soon hunger for the lesser-known features that can simplify waveform analysis.

Two of these features are graphing and filtering. Both are invaluable when looking at waveforms captured over longer periods. The following waveform is a typical example of a crankshaft signal in conjunction with a digital MAF signal from **idle > WOT > idle**. We also have Cylinder 1 injector current and fuel pressure. The first impression of this waveform is not a favorable one, given the huge amount of data on the screen.



So how can you possibly extract usable data from this mayhem? You can zoom and measure different points on Channel A and B to determine any change in frequency, which is fine but time-consuming. Alternatively, you can use a *math channel* to graph the data into something more digestible, and filtering to remove intrusive noise.

The math channel function in PicoScope opens up infinite possibilities when analyzing data, assuming you know what formula to apply. So what is a math channel and how can it simplify the data above?

A math channel is an accurate, graphical representation of the waveform data you wish to display. For example: Assume you have captured battery voltage on Channel A and starter motor current on Channel B. If you create the math channel: A x B (voltage x current) you generate and display a third waveform, graphing the *Power* of the starter motor in Watts (Watts = Voltage x Amps).

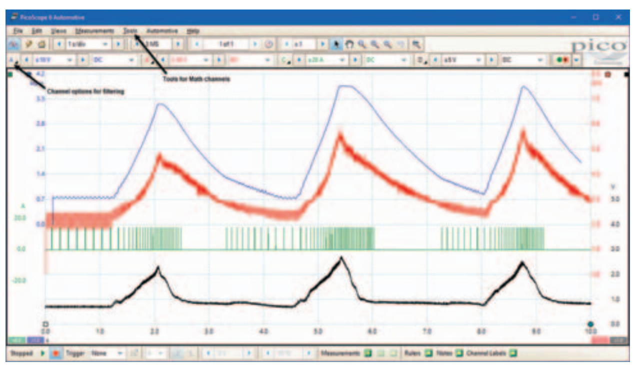
Now back to our original capture: Create a math channel that graphs the frequency of our crankshaft and airflow meter signals by clicking **Tools > Math Channels > Create** to open the *Math Channel Wizard*. The initial step is to enter the all-important formula used to reconstruct the captured data on your chosen channel.

Looking at Channel A, the formula includes a filter and is written as *LowPass(freq(A);8)*. Follow the Wizard to select the color of your math channel (it helps to choose the same color as the channel you wish to graph) next select the **Range** and how you wish the **Units** to be displayed (rpm). Finally, click **Next** and **Finish** to complete your math channel and close the Wizard. Now, tick the box adjacent to your created math channel in your math channel library to display it on the screen.

Repeat this process in order to display the data captured on Channel B as a frequency graph in kHz. The formula required is written as *freq(B)*.

Over and above math channels, the feature *Lowpass filtering* is available under the *Channel Options*. Select a 20 kHz lowpass filter on the channels to remove unwanted noise. Select a 1 kHz filter for low-frequency signals (Channel D). This will improve the resolution dramatically.

This is the original waveform with graphing and filtering applied. See the clarity compared with the raw original. Channels A and B have been hidden from view (right-click on the screen, select *Channels* and tick the box adjacent to the channel you wish to hide).



This is just one example of how PicoScope and its features can assist with the challenges of capture and analysis.

Read more about filtering here: https://www.picoauto.com/library/training/filtering

pico® Technology

Prepare the brakes for winter driving

Winter is right around the corner and for a few of us it's no big deal. But for the majority of us, it is a big change in weather and the way we drive. If you live in the "rust belt" or anywhere there is snow and ice, your brake system will be pushed to its limit on occasion. Wheels lock up a lot easier on wet, icy and snowy roads. Subzero temperatures make rubber parts hard and plastic parts brittle. Ice melting products such as salt and calcium chloride corrode metal pieces, making parts that are supposed to slide, stick and bind up. This may look like a bleak picture, but the good news is you can prepare the brakes for winter with the following guidelines.

First, check the brake fluid. Not just for proper level, but also for excessive moisture content. High amounts of moisture will corrode parts internally and can cause brake fluid to freeze. Brake fluids have anticorrosion additives when new and these additives break down with time.

Next, do an overall brake inspection. Pull all wheels and notice any unusual wear patterns. With electronic brake distribution on most vehicles, front and rear brake wear is much more even. Left and right on the same axle should be wearing the same. If the caliper slides are a little hard to move now, imagine what they will be at minus 10 degrees and full of road slush. Don't forget to check all rubber hoses and brake lines for leaks and cracks. Damp areas are the first signs of rust or fatigue.

As stated earlier, brake systems get a good workout in winter due to wet and snowy roads. The ABS will activate many times on an icy road and the electronics, such as electronic stability control (ESC), will be trying to keep drivers on that slick road. ESC can apply a single brake to keep the vehicle from spinning out without the driver touching the brake pedal. This is why all components must be working perfectly.

Raybestos® has developed parts that stand up to this kind of weather. All of the RPT Rust Prevention Technology™ parts are subject to a salt spray test (ASTM B117) that ensures the parts can stand the test. Calipers and brackets have an all-weather zinc plating that prevents the rust expansion that binds up the pads in the bracket. Remember, ESC can apply a single brake in milliseconds to prevent that spin out. Brake pads stuck in place will not cut it.

RPT rotors not only look good, but also keep brake temperatures in check. Rotors are coated with Grey Fusion 4.0™ and go through that same salt spray testing as the calipers. The whole rotor is coated, including the cooling vanes. This is important because once the vanes get clogged with rust, the rotor cannot dissipate heat as designed and the harmonics change. In other words, the brakes may wear out quicker, stop poorly and make noise. Realize the coating comes off where the pad contacts the rotor. But, the very edge of the rotor surface keeps the coating and prevents the dreaded "rust jacking." That is when rust creeps under the ceramic material that transfers to the rotor every brake application.

So get ahead of winter and prepare the vehicle's brake system for the worst conditions. Raybestos RPT Rust Prevention Technology products are made for this type of weather. And, they look good doing it.

Raybestos is widely recognized for quality brake components, including friction, rotors, drums, calipers and hydraulic products. For more information, visit www.raybestos.com.

SKF Flange kit offers solution for worn-out wheel bearing

SKF Flange kit BR930558K offers a solution when a worn out bearing needs replacement on 2007-2013 Jeep Compass and Patriot as well as 2007-2012 Dodge Caliber.

When replacing a worn-out wheel bearing, the wheel flange is often overlooked as the source of the bearing failure. Flanges that are bent or cracked will cause additional load to the bearing. SKF recommends doing a visual inspection and runout check of the wheel flange.

Damage to the wheel flange can also occur during removal. This can occur when the inner ring of the bearing is still attached to the flange after removal. In order to remove the inner ring, it needs to be cut off the wheel flange or pressed off. The cutting process can create scaring and jeopardize the integrity of the flange. The best process is replacement with a new bearing and wheel flange.

Currently, OEMs only offer an expensive option that comes with a knuckle assembly and backing plate. SKF offers a professional replacement kit that saves potential comebacks, time and cost. Only the necessary wear parts are included for replacement. The kit includes a wheel flange, wheel bearing, retaining clip and axle nut.

SKF FLANGE KIT BR930558K

SKF – the only hub bearing kit in the aftermarket

To avoid the risk of purchasing various replacement parts individually and from different suppliers, consider choosing the SKF all-in-one hub flange kit – the only kit in the aftermarket

OEM KNUCKLE ASSEMBLY

that includes all the parts needed for a hub reassembly, including a cartridge-style wheel bearing, c-clip, axle nut, seals and hub flange. Engineered to meet rigorous OE specifications, SKF's premium parts are designed to fit and work properly the first time.

SKF YouTube channel offers in-depth technical videos

The SKF Vehicle Service Market YouTube channel offers a number of in-depth product and technical training videos designed to provide users with the information they need to conduct vehicle maintenance and repairs. Visit www.skfpartsinfo.tv to see more technical training videos or follow us on Twitter @skfpartsinfo.

SKF

890 North State Street, Suite 200, Elgin, IL 60123
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TECH TIPS ADVERTORIAL

Dan-Am Air® Advanced Aluminum Air Pipe System

Today's clean air requirements are more critical than ever. Air tools, blow driers, HVLP spray guns, and supplied air respirators may require more air volume and better air quality than needed in the past. Not only does clean air effect equipment performance, but it is also critical for paint coatings performance. Dan-Am Air, along with SATA filtration can solve all of these issues.

Dan-Am Air is lightweight, aircraft grade, powder coated aluminum, which provides clean, dry air up to 232 psi. The reinforced composite Nylon fittings have dual seals, which rest on un-scraped pipe, providing a leak free guarantee. Our Press-to-Connect fittings feature a full bore design for turbulence free air delivery. This quick, instant connection eliminates the need to thread, solder or glue, accounting for far less installation times than traditional copper or black pipe.

We also stock a large array of threaded connectors and adapters, allowing Dan-Am Air to be integrated into existing systems without compromising performance, making DAA perfect for upgrade or expansion projects.

Designed with simplicity in mind, DAA allows you to do-it-yourself. Measure, cut, de-burr, then simply Press-to-Connect, equaling lower installation times and cost. All fittings arrive pre-torqued for immediate assembly and pressurization, as well as being interchangeable, allowing for ease of future addition or expansion. "This "Press-to-Connect" subject tends to be the most misunderstood instructions in the DAA system. We have all been taught since we were young, to loosen a given item, put it together, then tighten it back up, right? That is wrong with Dan-Am Air. DO NOT loosen fitting caps before installation. It really is as simple as push the fitting onto the pipe until it bottoms out. Done. Stop. Move on. The only reason to loosen a fitting cap, is to remove the fitting from the pipe. Loosening the cap relieves the pressure on the grip ring, allowing you to gently back out the pipe. To reuse any given fitting, simply re-torque the fitting cap to factory specs (line the arrows up, see figure 1), and "Press-to-Connect. As each cap is individual to its fitting, the arrows are either solid, or hollow respectively. Fitting caps are NOT interchangeable.

DAA also allows you to take your investment with you in the case of relocation, as all components are reusable.

Product design and support is readily available from Dan-Am Company. They also have all products on hand and ready to ship, as well as in-house support for quotes and general information.

Dan-Am Co., is the Exclusive Importer of SATA Products for the US and Puerto Rico. Anywhere you can purchase SATA Products, also has access to our Dan-Am lines as well, including Dan-Am Air.

Please visit our Website at www.danamair.com, as well as our Facebook page www.facebook.com/danamaluminumairline for recent install pics, comments etc. Both of these have proven to be valuable resources for customers to understand exactly what can be accomplished with SATA and Dan-Am Air combined.

Watch our video to learn more about our easy-to-install system

BRAD GRAVENHOF has been in the automotive industry for over 30 years and serves as DanAm Company's Sales and Technical DanAm Air Specialist.

DanAmAir®

The intelligent diagnostic strategy

The diagnostic strategies of old are not relevant or effective in the modern repair scenario. When a vehicle pulls into the bay, technicians are likely to encounter multiple interdependent fault codes, hundreds of live data points, graphs, never-ending flow charts, and eye-crossing diagrams. With too much information available, the biggest challenge is to find and follow the right clues to a solution.

But there is some good news, too. The same computer and information technologies that add complexity to vehicles, are enabling improved diagnostic strategies that drastically simplify and reduce time spent in diagnosis and repair.

Diagnostic specialists stress the importance of using a logical approach to tough problems — an approach that doesn't neglect the basics. Regardless of the technology and system being diagnosed, the basics still apply: air, fuel, spark, amperage, voltage, and grounds are all critical to making today's automobile perform properly. But the introduction of the ZEUS platform from Snap-on, which includes Intelligent Diagnostics software, has revolutionised the process and made it much more efficient. Intelligent Diagnostics brings together all of the tests and information related to a Diagnostic Trouble Code (DTC) to one place.

Intelligent Diagnostics can be used whenever a code is present on a vehicle and includes smart shortcuts to take you to information directly related to that code including:

- TSBs recalls and campaigns
- Scanner data, including custom data lists, along with Smart Data that automatically configures the display to show PIDs relevant to the fault code
- Functional Tests and resets
- Guided component tests
- SureTrack® real fixes, tips and top repair charts

Intelligent Diagnostics and using a logical step by step diagnostic process will allow you to get through your diagnostic workload.

Step 1: Check for codes. Nothing new, right? Diagnostic trouble codes are still the first and best source of clues to narrow the search. Once we know if there is a code, we can go to step two and use the code or symptom to determine a likely cause. Identifying a code then opens up the possibilities of putting the Intelligent Diagnostic software to best use.

Step 2: Search factory technical service bulletins. Intelligent diagnostics narrows down the TSBs to only those for that code. TSBs have become a critical time saver with OEM experience on failures after a vehicle has been on the road for a while. They are a great companion to fault codes, and SureTrack. Most technicians use a good repair information system like ShopKey Pro® or ProDemand® for all-makes TSB access. Intelligent Diagnostics takes you directly to the TSBs related to the DTC you are investigating.

Step 3: Check SureTrack® for real world answers. SureTrack is a powerful tool, which makes precise answers out of big information. SureTrack takes the clues: vehicle, code, symptom, and shows the most common parts used to repair similar vehicles and problems. This is based on experience from millions of successful repair orders, so we see the actual parts used to complete the repair.

Step 4: Smart data "filters" unrelated PIDs so that you only need to look at what is relevant to the code. It also automatically sets PID triggers which will "flag" PID red or blue. Out of limits or within limits.

Step 5: Use functional tests or component tests to pinpoint and verify the problem. Using Snap-on's Intelligent diagnostics, Fast-Track Guided Component Tests take you to the specific information you need, relevant to that code, showing what to test, how to connect and what results to look for. Directly testing the suspected component is the best way to verify a component before replacement.

This diagnostic process may vary depending on your personal workflow, and the job at hand. But with the power of Intelligent Diagnostics, you will save time and provide a confident solution on many repairs.

Snap-on

ZEUS™

Ford 6.0L diesel injectors explained

The Ford 6.0L Powerstroke engine uses Hydraulic Electronic Unit Injectors (HEUI). These injectors receive energy to open from engine lube oil that's pressurized by a gear-driven high-pressure pump.

How they fire and release

The PCM communicates to the fuel injection control module (FICM) that it's time to fire the injector. When that happens, an electrical signal is sent from the FICM to the electrical coils on the injector. The signal magnetizes one coil at a time, drawing the spool valve to the apply side to allow high-pressure oil to flow past the spool and push on the intensifier piston. The intensifier piston then travels down on the fuel plunger to deliver fuel to the nozzle area. The fuel achieves the "crack" pressure, lifting the pintle from its seat and delivering the fuel to the combustion chamber.

When the PCM decides that it's time to close the injector, an electrical signal is sent to the opposite magnetic coil on the injector to pull the spool valve in the opposite direction that it was previously pulled. The spool valve moves to the release side, allowing the contained high-pressure oil to flow past the spool and exit the vent port. The intensifier piston travels upward from spring pressure, allowing the fuel chamber to recharge with fuel for the next injection cycle.

What to keep in mind during repairs

A faulty injector will cause the engine to smoke or run rough. You can identify the cylinder with the faulty injector by using a scan tool that's capable of performing a power balance test. For efficiency's sake, many technicians replace all of the injectors on a bank or even the entire engine at the same time. Here's what you need to know about this job:

Rail Sealing - A standpipe delivers high-pressure oil to the oil manifold. A common problem is that the seals warp under the heat and pressure, leading to a high-pressure oil leak that causes loss of injector control. Use updated plugs and standpipes when replacing injectors. Another common leak point is the ball tube in the high-pressure rail that connects the injector to the rail.

Injector Connectors - Before removing the retaining bolt for the injector, properly release the connector pigtail from the cylinder head using a suitable tool such as the OTC6766.

Injector Bolt - To avoid damaging the injector solenoids, use a long shank T40 (not a short shank T40) on the bolt that secures the injector hold down bracket. When you loosen the injector clamp bolt, be careful not to drop the clamp and bolt into the engine. Before installation, remove oil and debris from the threaded injector clamp hole in the cylinder head. Otherwise, the injector may not be fully seated, which can lead to compression leakage in the fuel system.

Injector Seals - Make sure the compression seal on the injector tip comes out with the injector. Also, check for signs of fuel contamination at the injector fuel inlet screen. Any source of contamination must be located or the replacement injectors will fail. Use clean engine oil to lubricate any seals before installing the injector.

Installation - To install, assemble the clamp and bolt to the injector. Be careful to note the orientation notch. Once the engine is assembled, crank the engine over (without starting it) to bleed any air out of the high-pressure oil system. Don't forget to change the oil, oil filter, and fuel filters, and install an upgraded fuel pressure regulator

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PARTS

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AD INDEX

AD INDEX

PRODUCTS

THE 411 ON TPMS

KEEPING THE LIGHT OFF AND YOUR CUSTOMER HAPPY!

PETE MEIER // Technical Editor

TPMS, or Tire Pressure Monitoring Systems, have been mandatory equipment on cars and light trucks for the last decade. Even so, how many times have you had a customer return after a routine service or repair that required tire/wheel removal with a now illuminated TPMS warning light?

Recently, I had a similar situation hit home. My wife's 2014 Scion Tc suddenly turned on the warning indicator. And it wasn't the first time this has happened. In every other instance, a quick check revealed a punctured tire. Not this time. A check of the tire pressures found them all in specification! A check of the sensors themselves revealed no faulty components and no trouble codes related to the system were stored in the controlling module. So why was the light on?

Both scenarios require the servicing technician to have a foundational knowledge of how TPMS works in order to resolve them. In this edition of "The Trainer," I'll go over the fundamentals of the indirect and direct TPMS system functions and talk a bit about how to test both. More importantly, I'll share tips on what to do before and after any service that could impact the TPMS system operation in order to avoid unnecessary comebacks. Last but not least, I'll share the story of the Scion and what the final fix turned out to be! MA

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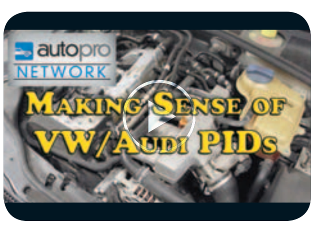

Making sense of VW/Audi PIDs

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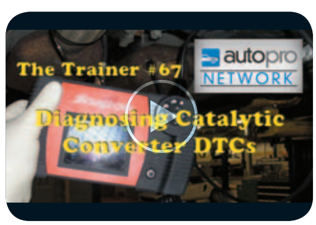

Tackling catalytic converter DTCs

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When fuel trims won't trim

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2017 FORTE 5 SX
[Shown with optional features]
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A TIGHT FIT
New part improves hub vacuum sealing

GETTING CLOSURE
Striker adjustment alleviates trunk issues

THE SILENT TREATMENT
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Our View

Quality recognition

Kia's reliability and vehicle satisfaction are touted

Continuing a multi-year string of quality and reliability awards and accolades, J.D. Power's 2017 Initial Quality Study (IQS) recently recognized Kia Motors as the highest-ranking nameplate in the United States for the second year in a row.

Kia's improvement marks the best nameplate performance within the last 20 years of the IQS study, driven by five segment awards — the most of any nameplate — for the Soul (Compact Multi-Purpose Vehicle), Forte (Compact Car), Cadenza (Large Car), Niro (Small SUV) and Sorento (Midsize SUV). The Kia Soul took home an IQS award for the third consecutive year while Kia's two newest models, Cadenza and Niro, were outstanding performers in their first model year, with the Cadenza earning the top score among all models ranked in the study. Together with the Optima and Sportage, each of the seven award eligible Kia models included in the 2017 IQS study finished first or second in their respective categories.

"When Kia beat out the entire industry in last year's J.D. Power Initial Quality Study many people wondered if we could maintain such a lofty position. Today, the answer is loud and clear as Kia owns the top spot for the second straight year with more 2017 segment award winners than any other nameplate," said Michael Sprague, chief operating officer and EVP, Kia Motors America (KMA). "Our back-to-back chart-topping IQS performances reconfirm Kia's status as today's world-class automaker and reflect the exacting standards and craftsmanship our team members instill into every car, crossover and SUV Kia builds."

In addition to the IQS announcement, three of Kia's highly acclaimed models, the 2016 Optima midsize sedan, the 2016 and 2017 Cadenza premium sedan as well as the 2017 Sportage Compact CUV, were named segment winners in AutoPacific's 2017 Vehicle Satisfaction Awards in the midsize car, large car and compact cross-over SUV categories, respectively.

"Kia is a leader in design, quality, technology and value, and the AutoPacific Vehicle Satisfaction Awards are another validation of our world-class products and their ability to meet and exceed customer expectations," said Orth Hedrick, vice president of product planning, KMA. "As a two-time winner, Optima illustrates that if you buy a Kia, you are going to love it. With Cadenza and Sportage also winning their categories, Kia is delivering what buyers are looking for in any size of vehicle."

The Cadenza and four other Kia models earned the prestigious J.D. Power's 2017 IQS awards.[1]

As for those who service our cars, we think you will find that they are designed and engineered to meet the highest standards making them easy to service and maintain.

Kia Motors America, Inc.

All trademarks and tradenames are the property of their respective owners. 2017 Kia Forte 5 SX shown on the cover and above with optional features. Not all optional features are available on all trims. Some features may vary.

[1] The Kia Cadenza received the lowest number of problems per 100 vehicles reflecting higher quality among large cars in the J.D. Power 2017 U.S. Initial Quality Study based on 77,419 total responses, evaluating 189 models, and measures the opinions of new 2017 vehicle owners after 90 days of ownership, surveyed in February-May 2017. Your experiences may vary. Visit jdpower.com/cars.

IN THIS ISSUE

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A tight fit

New part improves hub vacuum sealing

In order to improve hub vacuum sealing during 4WD operation for 1998-2001Sportage 4WD vehicles, we recommend using a new inner seal, along with corresponding revisions to knuckles and CV shafts. A service kit is available from Kia to retrofit the new seal; installation instructions are described in this article.

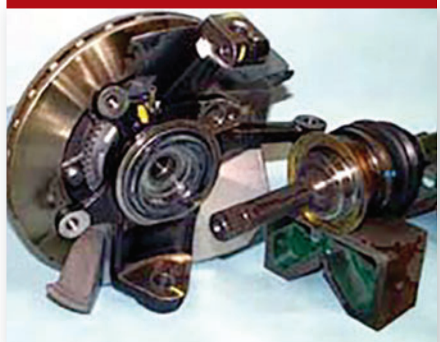
PART NUMBER DESCRIPTION

Description	Previous P/N	New P/N	Affected Vehicle Production Range
Knuckle/Hub Assy w/o ABS Knuckle/Hub Assy w/ABS	0K083 04 500 0K083 04 600	QK081 33 020 DQ QK082 33 020 EQ	1998, 1999, 2000 and some 2001 MY Sportage 4WD models with production dates between 9/1/97 and 10/21/00.

» TSBs may be updated from time to time. Please refer to TSB Vol. 2, Chassis, 007 at www.kiatechinfo.com for the latest procedures.

» All images are for illustration purposes only.

NEW STYLE



PREVIOUS STYLE

Repair procedure

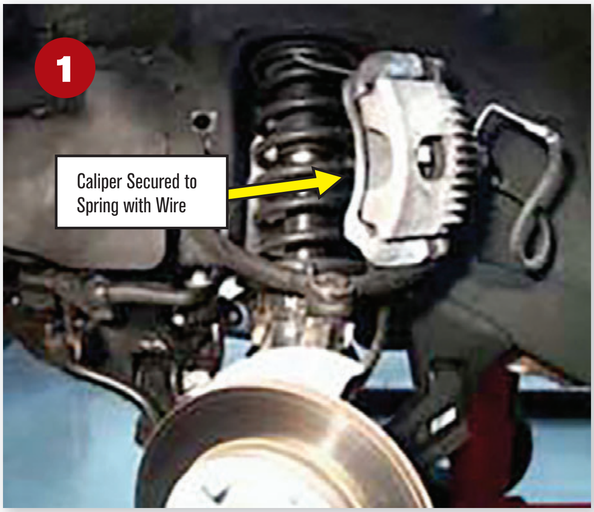
1. Raise the vehicle on hoist. Remove the front wheel/tire assembly.

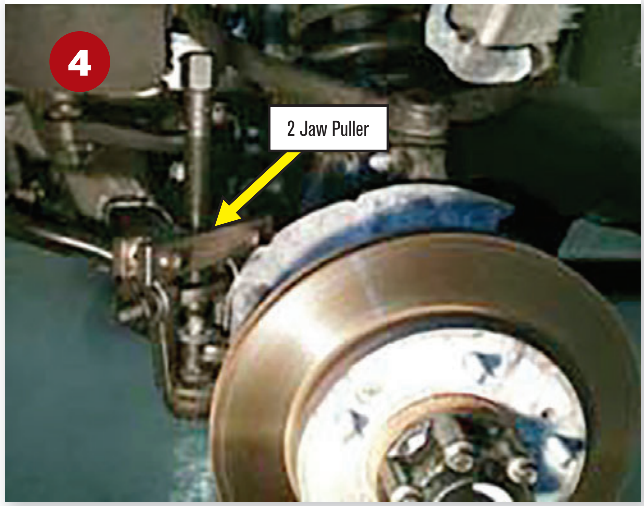
Remove the two bolts attaching the brake caliper/anchor to the knuckle and remove the caliper/anchor assembly from the rotor. Secure the caliper/anchor assembly out of the way with wire or tie wraps.

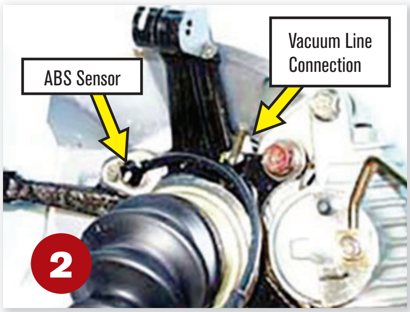
2. Remove the two screws securing the brake rotor to the wheel hub and remove the rotor.

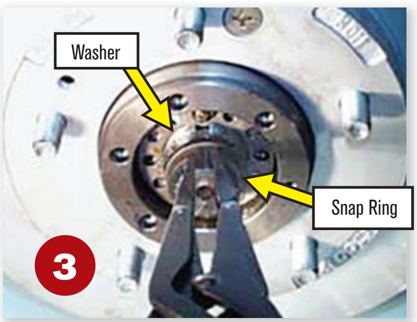
Disconnect the vacuum hose from the fitting on the knuckle.

Remove the ABS sensor attaching the bolt and the sensor from the knuckle (if ABS equipped).









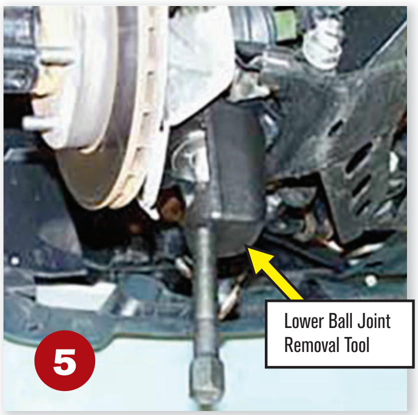
Notice: Do not allow the caliper/anchor assembly to hang from the brake hose.

3. Remove the six bolts securing the vacuum locking hub to the wheel hub and remove the wheel hub.

Remove the snap ring and washer from the CV axle shaft. Discard the snap ring.

4. Remove the tie rod cotter pin and nut; then with a suitable puller (such as Snap-on® CJ82B), disconnect the tie rod end from the knuckle.

Notice: Do not use a pickle fork type tie-rod separator because seal damage will occur.



5. Remove the lower ball joint cotter pin and nut; then with a suitable puller (such as Snap-on® CJ119B), separate the ball joint from the knuckle.

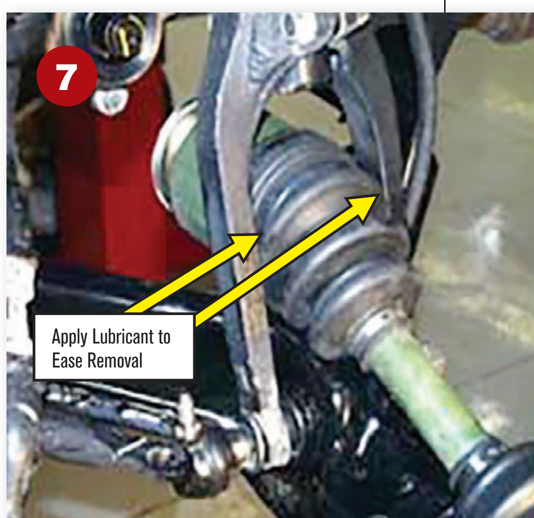
Notice: Do not use a pickle fork type ball joint separator because seal damage will occur.

6. Remove the 10 mm pinch bolt and nut securing the upper ball joint to the knuckle.

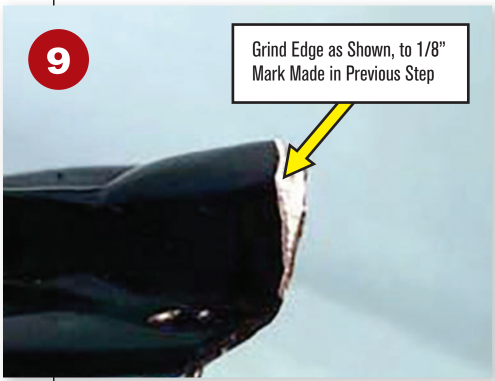
Remove the knuckle/hub assembly from the vehicle.

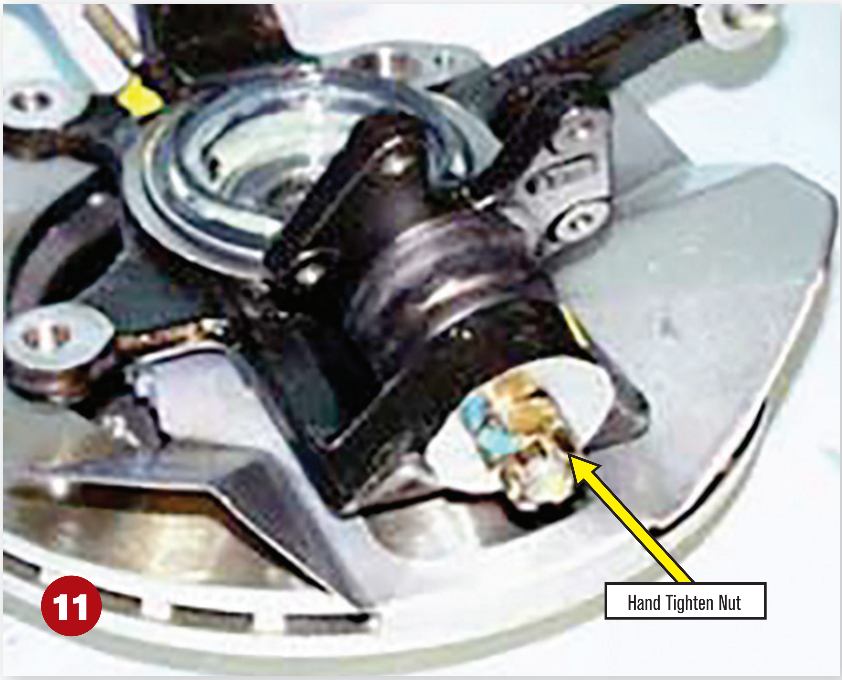
Using a suitable jack under the lower control arm, load the suspension and raise the strut fork opening sufficiently to allow the drive shaft removal. Pull the CV shaft free from the front axle by using the outer part of the shaft as a slide hammer.

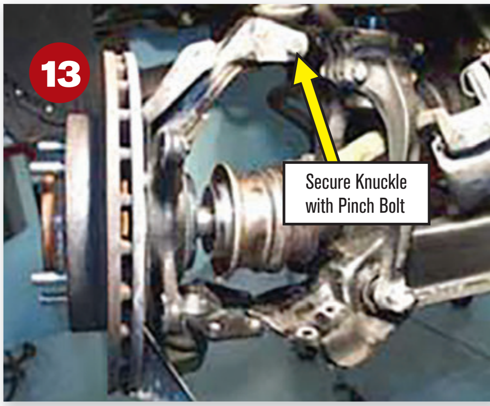
7. Remove the shaft from the vehicle, carefully guiding the CV joint through the strut fork.



Notice: Apply lubricant to the CV boot edge and the fork edges to facilitate removal. Do not use undue force as damage to boot may occur.







8. Mark the edge of the lower control arm at 1/8-inch from edge as shown.

9. Remove the 1/8-inch of material marked in Step 8 by grinding the edge at an angle as shown. Touch up reworked area with black paint.

Notice: This material removal on the lower control arm is necessary to prevent interference between the lower control arm and the new knuckle and/or the inner seal dust shield on the CV shaft.

10. Inspect the retaining ring on the output shaft of the front axle, replace if damaged. Position/rotate the new drive shaft to line up with the splines in the front axle output shaft, then install by pushing it in place, using the outer part of shaft as a slide hammer. Unload the suspension and remove the jack.

11. Remove four bolts and separate the old ball joint from the lower control arm. Install the ball joint on the new knuckle and hand tighten the attaching nut.

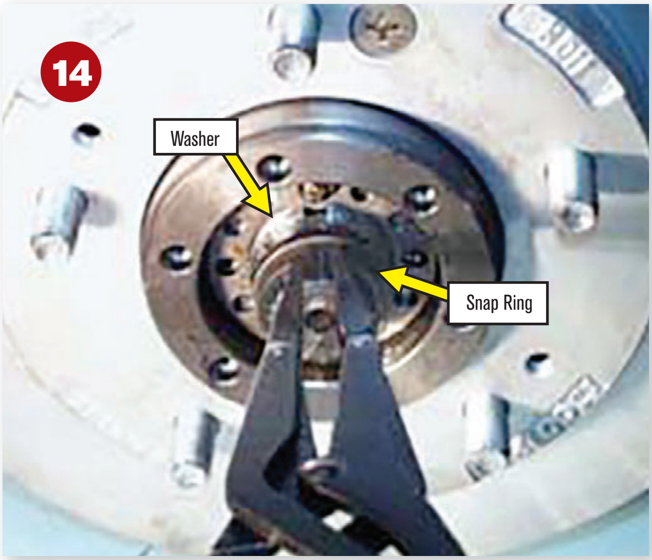
Notice: Installing the knuckle to the upper control arm first with the lower ball joint already installed on the knuckle will help prevent damage to the dust shield on the drive shaft and/or seal.

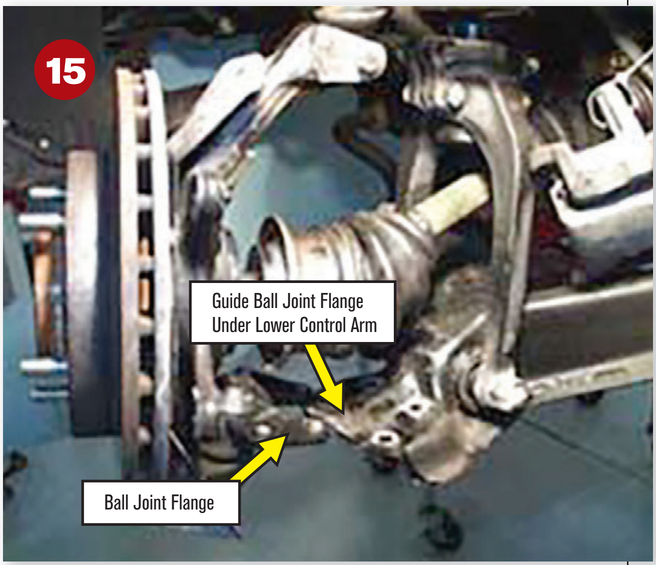
12. Apply grease to the inner bearing surface and to both sides of the new knuckle spacer (0K011-33-044, included in kit) and install onto the CV joint.

Apply grease to the inner seal in the new knuckle/hub assembly.

Notice: The spacer has a chamfer on the inside diameter; this chamfer must face the CV joint.

13. Install the knuckle/hub assembly by first installing it over the CV axle shaft, then insert the upper ball joint through the top of the knuckle. Retain with the 10 mm pinch bolt and nut.





Notice: Suspending the knuckle from the upper control arm before attaching the ball joint to the lower control arm will help prevent damage to the dust shield on the drive shaft and/or to the seal.

14. Make sure the CV axle shaft is inserted all the way into the hub, install the washer and secure with new the snap ring (P/N 0K-011-27-145, included in kit).

15. Lift the knuckle assembly up and guide the lower ball joint flange under the lower control arm and secure with four bolts. Torque the bolts to 16 –19 lb - ft.

Tighten the upper ball joint pinch bolt to 36 lb - ft.

Tighten the lower ball joint nut to 110 lb - ft and install a new cotter pin.

Insert the tie-rod end into the knuckle, install the nut, tighten to 27 lb - ft, and install the new cotter.

Make sure there is no interference between the lower control arm and the knuckle or the inner seal dust shield when turning the steering from full left to full right. If there is interference, recheck/repeat Steps 8 and 9.

Install the ABS sensor into the knuckle and tighten the mounting bolt to 7 lb - ft (if ABS equipped).

Apply a small amount of oil to the O-ring on the vacuum locking hub.

16. Install the vacuum locking hub to the wheel hub and tighten the six bolts in two passes using crisscross pattern.

First pass: Tighten to 19 lb - ft
Second pass: Tighten to 23 lb - ft

Connect a handheld vacuum pump to the vacuum fitting on the knuckle and check for vacuum leakage. The hub should hold a vacuum of 20 in Hg for 10-20 seconds. If it does not, check for seal damage or mis-installation and excessive wheel bearing play.

17. Check the vacuum hoses, steel lines, vacuum canister and vacuum solenoid for restrictions, cracks, and contamination or rust. Clear with compressed air if any debris or restrictions are found. Replace any unserviceable parts.

Connect the vacuum hose to the fitting on the knuckle.

Install the brake rotor and the two retaining screws.

Install the brake caliper/anchor assembly and tighten the two mounting bolts to 72 lb - ft.

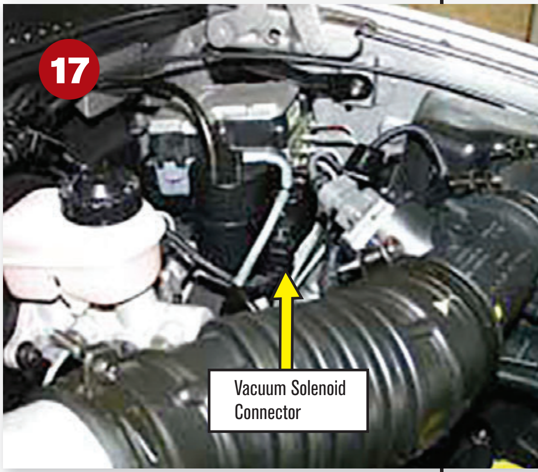
Install the wheel/tire assembly and tighten the lug nuts to 74 lb - ft.

Repeat the procedure for the other side of the vehicle.

Confirm that the vacuum solenoid harness connector is securely installed on the solenoid.

Notice: This connector may have been disconnected on vehicles modified for use with earlier style locking hubs.

Test the vehicle and verify the 4-wheel drive operation.



Getting closure

Striker adjustment alleviates trunk issues

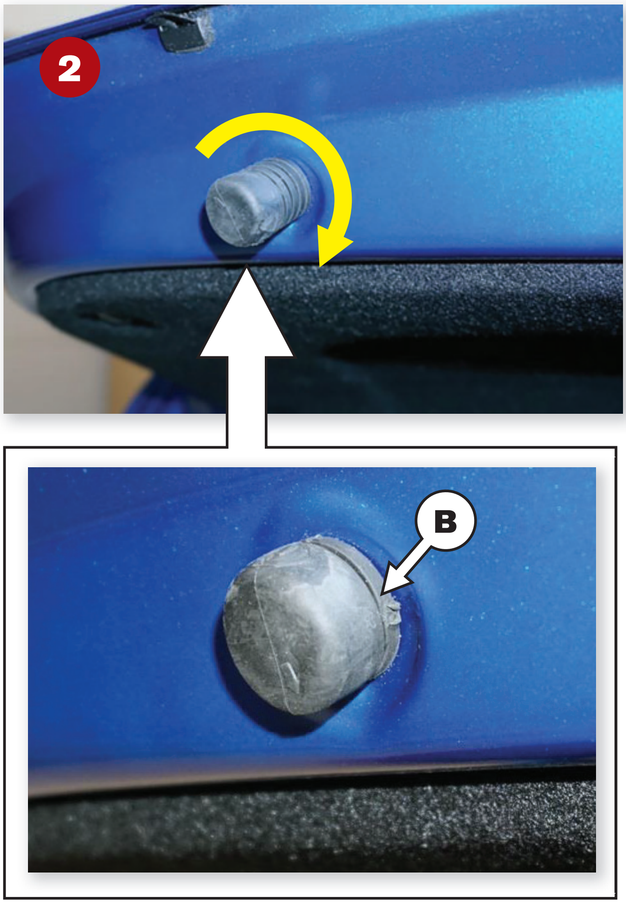
You may encounter a 2014MY Forte (YD), produced between February 1, 2013 through February 28, 2014, that exhibits a rattling noise from the trunk area and/or difficulty closing the trunk. If you do, following the procedures outlined in this article may resolve these issues.

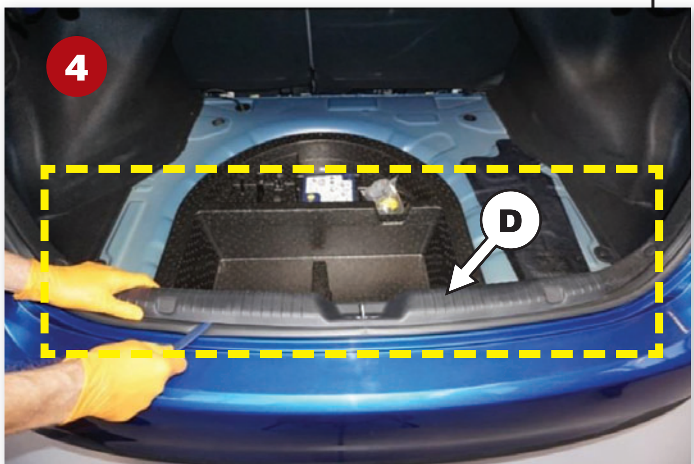
AFFECTED VEHICLE PRODUCTION RANGE

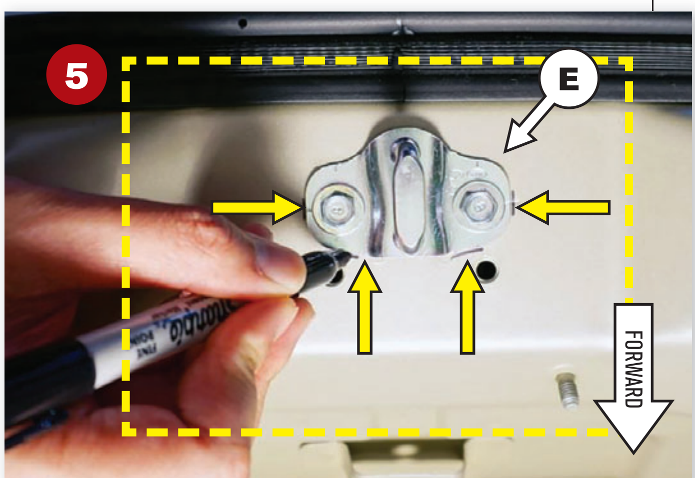
Model	Production Range
Forte (YD)	From February 1, 2013 through February 28, 2014

» TSBs may be updated from time to time. Please refer to TSB BOD122 at www.kiatechinfo.com for the latest procedures.

» All images are for illustration purposes only.







Service Procedure

1. Locate the two trunk rubber bumpers (A).

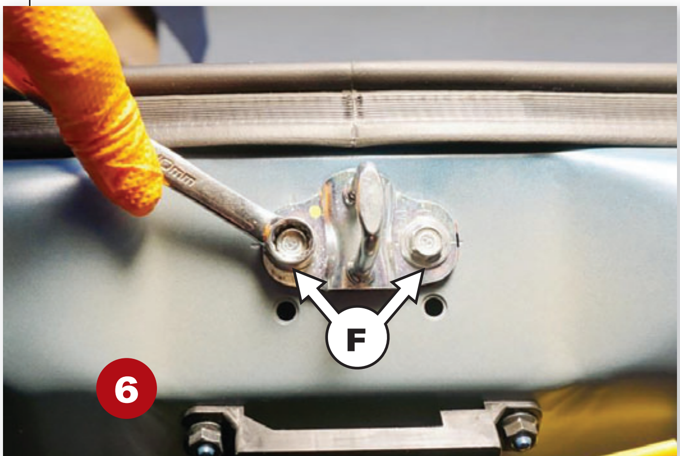
2. Check and adjust, if necessary, the height of the rubber bumper until only one adjustment line (B) is visible above the trunk surface.

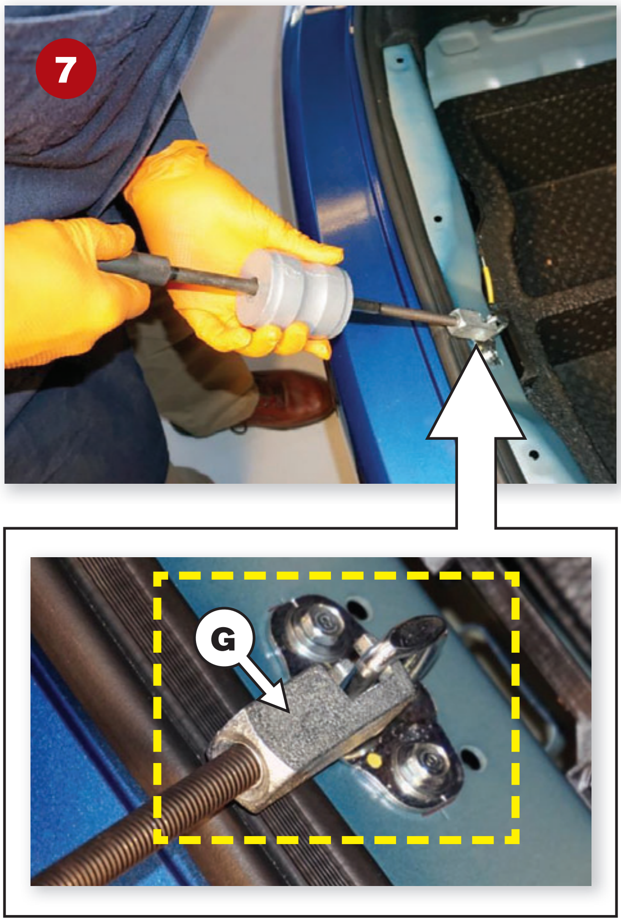
3. Remove the luggage compartment mat (C).

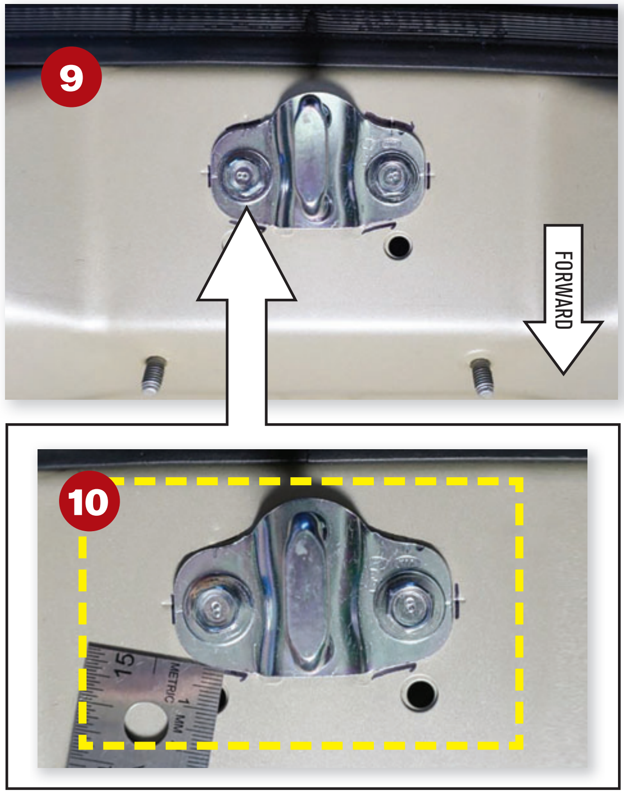
Caution; Use only non-marring trim removal tools (such as Snap-on® P/N PBN5 or equivalent) to avoid damaging trim pieces. Wear disposable gloves to avoid soiling interior trim components.

4. Carefully remove the trunk compartment trim (D).

5. Locate the striker and use a marker to make four reference marks (E) around the striker, as shown. Note: The reference marks will make it easier to measure striker movement after adjustment.







6. Loosen the two striker mounting bolts (F) by 1/3 of a turn. Note: Do not loosen the bolts past 1/3 of a turn. The bolts must remain tight.

7. Install a hook adaptor (G) onto the end of a slide hammer, or a similar tool, and install it onto the striker, as shown.

8. Use the slide hammer to pull straight back on the striker, as shown. Note: Do not allow the slide hammer to deviate laterally while adjusting the striker.

9. After completing the first pulling operation, use a ruler to measure the amount of striker adjustment, relative to the reference marks. Note: If more adjustment is required, repeat step 8 until the striker reaches the required adjustment.
Required adjustment: 0.011"~ 0.019" (0.27 ~ 0.49 mm)

10. After striker adjustment is complete, torque the striker mounting bolts to specification.
Tightening Torque: 5.1 ~ 8.0 lb-ft (6.9 ~ 10.8 Nm)

11. Reinstall all removed components by reversing the order of removal.

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Inspect your customer's vehicles and advise them about the condition of their mufflers (and entire exhaust system, for that matter). If there is excessive corrosion or damage to a muffler, recommending a replacement could be in order.

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