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TRAINING OPPORTUNITIES

INDUSTRY PARTNERSHIP BRINGS TRAINING THROUGH WORKSHOPS

MOTOR AGE WIRE REPORTS //

The Automotive Service Councils of California is proud to announce its most recent corporate partnership with Automotive Training Institute (ATI), an industry leader in automotive business coaching, providing expert management and consulting services through one-day workshops and an all-inclusive Re-Engineering Program. This includes weekly business coaching from an industry expert coupled with classes in marketing, hiring, finance, leadership and sales.

Since 1980, ATI has been helping independent shop owners improve their businesses and their lives, with proven, measurable and field-tested strategies and practices. Through the hard work of their wonderful and very talented associates, ATI has grown into the leading coaching and consulting automotive management company in the world, with 1,500 active members who represent the best shops in the United States and Canada.

>> CONTINUES ON PAGE 6

BREAKING NEWS

AUTONOMOUS VEHICLES

ASA TACKLES CAPITOL HILL TO DISCUSS AUTOMATED VEHICLES

In late April, ASA Chairman Roy Schnepper, and ASA President and Executive Director Dan Risley, met with key leaders in Washington, D.C., to discuss automated vehicle policy and data access. During Capitol Hill meetings, Schnepper and Risley outlined the importance of data access to independent automotive repairers.

They highlighted U.S. Sen. Jim Inhofe's, R-Okla., amendment to S. 1885, the AV START Act, which would form an advisory committee on automated vehicle data access issues. The amendment provides for the HAV Data Access Advisory Committee, comprised of stakeholders, to provide a report to Congress within 30 months of enactment. This process allows for independent repairers to educate federal regulators about the importance of this issue to repairers.

>> CONTINUES ON PAGE 6

TRENDING

GBSC RELEASES SAFETY ALERT ON BRAKE PAD FAILURE MODES

The Global Brake Safety Council released the alert as a continuation of a systemic brake-field study related to brake pad rust and the impact of vehicle safety.

MOTORAGE.COM/FAILURE

MEMA SPEAKS OUT AGAINST ANTI-SAFETY INSPECTION BILL

MEMA weighed in on Missouri House Bill 1444 in a letter sent to all members of the Missouri House of Representatives that expressed concern for vehicle and driver safety.

MOTORAGE.COM/1444

SKF OFFERS WEB-BASED TRAINING, REWARDS PROGRAM

SKF now offers the SKF Parts Xperience, a web-based training and rewards program designed to help techs boost productivity and stay up to date on technology.

MOTORAGE.COM/SKF

YANG ANNOUNCES Q2 REGIONAL MEET-UPS

The Young Auto Care Network Group (YANG), a community of the Auto Care Association and geared at those under 40, announced its line-up of Regional Meet-Up events for the 2018 Q2 period.

MOTORAGE.COM/YANGQ2

AUTO CARE TESTIFIES ON DCMA REPAIR EXPEMPTION

The Auto Care Association's Aaron Lowe testified in support of expanding the current exemption for consumers under the Digital Millenium Copyright Act (DMCA).

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Snap-on

>> CONTINUED FROM PAGE 4

"In order to keep a competitive advantage, it is important to improve your shop by taking workshops that will help increase your overall success as a business owner, and ATI can do just that," said John Eppstein, Chair, ASCCA Revenue and Benefits Committee. "With over 30 years of experience, ATI brings immense knowledge of the automotive industry and is dedicated to ensuring your shop succeeds."

Whether you need training, coaching or a state-of-the-art business model, ATI has systems to help make the changes you want right away.

>> CONTINUED FROM PAGE 4

ASA also met with officials at the U.S. Department of Transportation to share views about the importance of continued access to vehicle repair information. Following the meetings, Schnepper said, "Automated vehicle policy will affect the entire automotive industry, not just OEs and consumers. These issues are complicated and nuanced, and we were encouraged to hear that our leaders in Washington are taking this seriously. If passed, the Inhofe amendment in the AV bill will allow more time for the industry to provide additional insights to Congress and the Administration."

ASA LEADERSHIP, ALONG WITH ASA'S D.C. REPRESENTATIVE, met with lawmakers and government officials in Washington, D.C., on vehicle data access and new technologies. From left: Roy Schnepper; Dan Risley; Adam Sullivan, assistant secretary of Government Affairs, Department of Transportation; Bobby Fraser, senior government affairs officer; and Robert L. Redding Jr.

BLOCKCHAIN DATA PLATFORM LAUNCHED

MOTOR AGE WIRE REPORTS //

SHIFTMobility Inc. (www.shiftmobility.com) revealed the world's first blockchain-powered platform for the automotive industry. As modern vehicles continue their transformation into smart devices, today's mobile-enabled world requires a platform able to connect to, understand, and harness demand from the myriad of vehicle and supply chain apps, commerce channels, enhanced diagnostics, and transportation logistics now and into the autonomous future.

By connecting drivers to vehicles, services, and everything else, the platform satiates high consumer expectations while simultaneously liberating previously siloed data for proper use and meaningful intelligence. With SHIFTMobility, data from the driver to the car, insurance, service visits, real-time condition, and more is merged into a single unbroken, secure, distributed and transferable data chain; like a fingerprint containing complete medical history — only for your car.

"In an age of privacy concerns and rapid evolution in vehicle technology, our automotive blockchain platform will ensure the security and integrity of customer and vehicle information while maintaining the intrinsic benefits of a globally connected ecosystem. As pioneers in this field, all our solutions use blockchain to secure,, distribute, and validate transactions across all our constituents. We now look forward to offering the infrastructure necessary to drive blockchain adoption across the industry." Pavana Jain, co-founder and CEO of SHIFTMobility.

By eliminating remaining information barriers, security risk, and costly IT infrastructure, any concern about massive transaction volumes from vehicle generated demand can be relegated to the historical dustbin. All SHIFTMobility branded solutions are powered by its Automotive Cloud Platform. Learn more at www.shiftmobility.com/automotivecloud-platform/.

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SHOP EQUIPMENT

CHOOSING THE RIGHT LIFT FOR YOUR SHOP

MOTOR AGE WIRE REPORTS //

Repair shops walk a fine line when choosing the types of services to perform, the volume of customers they can handle and the types of equipment they purchase. Investing in one or more lifts is one of the biggest decisions a shop owner will make, because lifts are not only a significant budget expenditure, but they must yield a positive return on investment.

Take the guesswork out of choosing the right lift by ensuring your selection has been third-party tested and certified by Automotive Lift Institute (ALI), is built by a trusted manufacturer that has a strong reputation for quality and customer support, and is the right size and style for the jobs your shop handles.

"When choosing new or replacement lifts, shop owners need to consider the types of vehicles they service and the tasks they perform to make sure their equipment is working as hard as possible for them," says John Uhl, director, light-duty product manager for Forward Lift parent company Vehicle Service Group. "Forward Lift not only offers affordable lifts that can handle a variety of jobs, but they are backed by a trusted network of distributors, installers and ALI-certified inspectors to ensure top performance from day one through the life of the lift."

One important step to choosing the right lift is selecting the appropriate type of lift. The most popular light-duty lift types for independent repair shops include two-post lifts, four-post lifts, low/mid-rise lifts and scissor lifts.

Two-post lifts: These surface-mounted lifts are the best-selling lift type in the world.

- They have a smaller footprint than some other lifts, allowing them to fit into standard-size bays, and are generally affordable.
- Two-post lifts come in asymmetrical designs with the columns rotated 30 degrees to allow for interior vehicle access, typically best for passenger vehicles, or symmetrical configurations that provide more drive-through clearance and can lift larger trucks, vans and small buses.
- Forward Lift's I10 two-post lift is a versatile combination. It features Spot-Rite™ 3-Stage front arms to accommodate passenger cars, trucks and vans up to 10,000 lbs. both symmetrically and asymmetrically, which allows a technician to position the vehicle doors in front of or behind the column to prevent door damage. The included adapter extensions make this a great fit for most passenger vehicles on the road today.

Four-post lifts: Four-post, surface-mounted lifts offer simple spotting, loading and set-up to drive efficient lifting that allows techs to get to work quickly. They come in a huge range of capacities from 8,000 lbs. up to 60,000 lbs. and increase in size as their lifting capacity increases, so consider the typical size of vehicles being serviced and the shop's floor-plan space when choosing one.

- Open-front designs are ideal for quick-service shops and high-capacity bays because they allow the technician to move in and out of the lift without ducking under runways, giving easy access to the underside of the vehicle.
- Closed-front designs are available in higher capacity, heavy-duty models to serve as a shop's one-stop workhorse with the addition of add-on accessories like a bolt-on alignment kit or a set of rolling jacks for conducting wheel service.
- The CR14 four-post lift from Forward can lift up to 14,000 lbs. and offers a rise of 79" to provide techs better vehicle access. A heavy-duty performance cable and sheaves system is conveniently concealed under the runway for easy access during quick inspections and clean, snag-free storage when not in use.

Low-/mid-rise lifts: These lift options are ideal for shops with lower ceilings, as a mid-rise lift provides good height for working on tires, brakes and body repairs while low-rise lifts are ideal for tire rotations and other everyday maintenance work on larger vehicles.

Scissor lifts: Scissor lifts may be equipped as a drive-on style with runways or as one that is frame or body engaging. The lift features legs in an "X"-shape that rise vertically and collapse onto themselves under the runways when lowered, requiring less space in front of and behind the lift than other types.

- Scissor lifts can be installed on existing concrete surfaces or in-ground for even more clearance.
- The Forward FS77 lifts up to 7,700 lbs. and stands just 4-1/8" inches tall when fully lowered, using less than 44 square feet of space when extended to maintain a clean look in the shop.

For more information about Forward Lift products, visit www.forwardlift.com, call 800-423-1722, or visit Forward Lift on Facebook and Twitter.

LEGISLATION

OHIO GOVERNOR SIGNS ORDER TO ENCOURAGE AUTONOMOUS VEHICLE TESTING

MOTOR AGE WIRE REPORTS //

Ohio Governor John R. Kasich signed an executive order to authorize autonomous vehicle testing in Ohio and to lay out a roadmap for how the automotive industry can test their technologies in the state.

"Ohio is well positioned to lead in developing the cars of the future, and just as Wright Brothers did at Huffman Prairie, our great state stands ready to once again launch a new era in transportation," said Kasich. "We have the diversity in weather and terrain that are essential to advancing these new technologies. The sooner these vehicles are safely fine-tuned, the sooner they can make a significant reduction in the 40,000 traffic deaths we have in this country every year."

The executive order authorizes researchers to test on Ohio roadways as long as their vehicles meet certain safety requirements and are capable of complying with Ohio traffic regulations. The order also requests that they register their vehicles with Drive Ohio, the state's new one-stop shop for mobility initiatives, by providing information on the vehicle and where they wish to test. Each car must have a designated operator who is an employee of the company performing the tests as well as a valid driver's license. Designated operators will be required to monitor the vehicle at all times and report any accidents that occur.

The order also creates a voluntary Autonomous Vehicle Pilot Program to assist local governments in working with automotive and technology companies to advance technologies in their communities. Municipalities will have the opportunity to work with DriveOhio and create an inventory of testing locations that offer a variety of traffic and terrain scenarios.

GOV. JOHN KASICH

Already a leader in smart vehicle technology, Ohio is investing in infrastructure upgrades that will allow devices on roads and traffic-control signals to send critical travel and weather information to drivers. This infrastructure will also help improve emergency response times and will allow traffic managers to better manage congestion. Current initiatives already underway in Ohio include four smart road projects covering 164 miles of roadway and two smart city projects.

DriveOhio was created by Governor Kasich in January 2018 to bring together those who are responsible for building infrastructure in Ohio with those who are developing the advanced mobility technologies needed to allow our transportation system to reach its full potential.

PUT YOUR MARKETING TO THE TEST

The truth about advertising, marketing and clean bathrooms

DAVID ROGERS // Contributing Editor

Picture your shop's bathroom.

This may seem to be a strange way to start an article about marketing and advertising (or any article, really), but trust me for a moment.

In today's world, small businesses have never had more of an opportunity to reach customers. The growth of social media, the power of Google AdWords and the power of big data all give shop owners effective tools to reach customers that we wish we'd had 20 years ago.

But, it doesn't matter how effectively we can reach customers with our advertising if we're not doing good marketing. In other words, you can spend a small fortune online attracting customers, but if they come in for service and your shop's bathroom doesn't make them feel welcome and cared for, the advertising money you spent was wasted.

All advertising is marketing, but not all marketing is advertising. Knowing the difference is critical, because it's the key to getting the most from your marketing budget and holding your marketing vendor accountable.

So, what is marketing? How is it different from advertising? And how do you maximize both in your shop?

The difference between marketing and advertising

Think through every point of contact

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you have with a new customer. Your advertisement may get them to call or come in, but it's far from the only impression they get from you. The way your service advisor answered the phone to schedule the appointment, the way your parking lot looked, the appearance of the waiting room and the cleanliness of the bathroom, and the community involvement plaques on the walls all impact the customer's impression.

All these things shape the way you're perceived by the people who visit your shop and the people you want to be visiting your shop. It's a long-term game that requires discipline, persistence and vision.

Of course, that's no small caveat.

For your marketing to be successful, it needs to be well-coordinated and rolled out in a strategic manner. Too often, shop owners think about marketing only as the advertising they're doing this week, and it leads to sending out parts and pieces of unintegrated, underdeveloped advertising. If you're not measuring the results of your marketing, and continually improving your campaigns and messages, you're not really marketing.

That's because marketing isn't complete without measurement.

Consider this scenario: the advertisement you're doing this week has led to more cars. Your shop feels busier. Is it working? Should you continue to do it?

If you're not measuring — if you're not doing marketing — it's impossible to say. Perhaps the new customers have a large average repair order and it seems like you've hit the jackpot. If you're not measuring, it's impossible to repeat the success. And what's more, if you're not marketing, you have no idea what the long-term effect is on your business. Do those customers come back? Do they refer others? Will they make loyal, long-term customers? These are some of the most critical questions you should be asking when planning your marketing budget. Typically, none of these questions come up when you are only jumping from one advertisement to the next advertisement.

This is the danger of using an advertising agency that doesn't understand marketing. If they don't understand the big picture and how to create long-term marketing success, the only thing they care about is making you happy with nice-sounding numbers: clicks, visitors, even return on investment. These are short-term numbers for short-term thinking.

Long-term solutions

Of course, understanding your marketing's impact on the health, quality, value and trust of your customer base isn't the only way owners should be thinking long-term.

If you're changing marketing companies frequently, you're never giving anyone enough time to develop and execute campaigns or refine them based on data. The first few weeks of a new campaign won't blow the doors off the shop, but if the marketing company is measuring and reporting the full impact, there's a pretty good chance they're measuring and refining that campaign to improve results. If you never give them a chance to maximize your campaign, you're only hurting your own marketing budget.

Marketing isn't just about attracting customers — it's about attracting the right kind of customers and retaining them. That means your marketing company should know ahead of time what makes a quality customer, what attracts a quality customer, how to target quality customers and how to measure to make sure you're getting quality customers.

None of that is possible if you change direction every few weeks or months.

Measuring for success

What kind of tracking and analytics should you be looking for?

A marketing company should be able to show you whether your customer base is becoming more or less loyal over time. If you start running deep discounts, your car count will probably skyrocket…but so will your lost customer rate. On the contrary, when you start to do marketing that builds relationships (and your customer service and branding and, yes, bathroom cleanliness match), you'll see the rate at which you lose customers drop. Not coincidentally, it usually means less chaos in the shop as well.

This all comes down to your marketing company. Are they trying to feed you meaningless numbers to keep you happy? Or are they invested in your long-term growth? That's not a small distinction, and it can be the difference between another year of scraping by or finally starting to grow your shop sustainably.

When I first joined Keller Bros. in 1997 and started helping Terry Keller manage his marketing vendors, I could rarely tell if those companies were predatory or just ignorant. If that's your experience, too, I have good news: there really are marketing vendors out there who know how to attract quality customers; who will teach you how to hold them accountable; and who will give you the tools, analytics and measurement to understand exactly how well your marketing is performing.

My recommendation? Start by asking your vendor to tell you the difference between marketing and advertising. You'll be able to learn a lot by how much of this they tell you — or don't.

DAVID ROGERS is COO of Keller Bros. Inc., and president of Auto Profit Masters.
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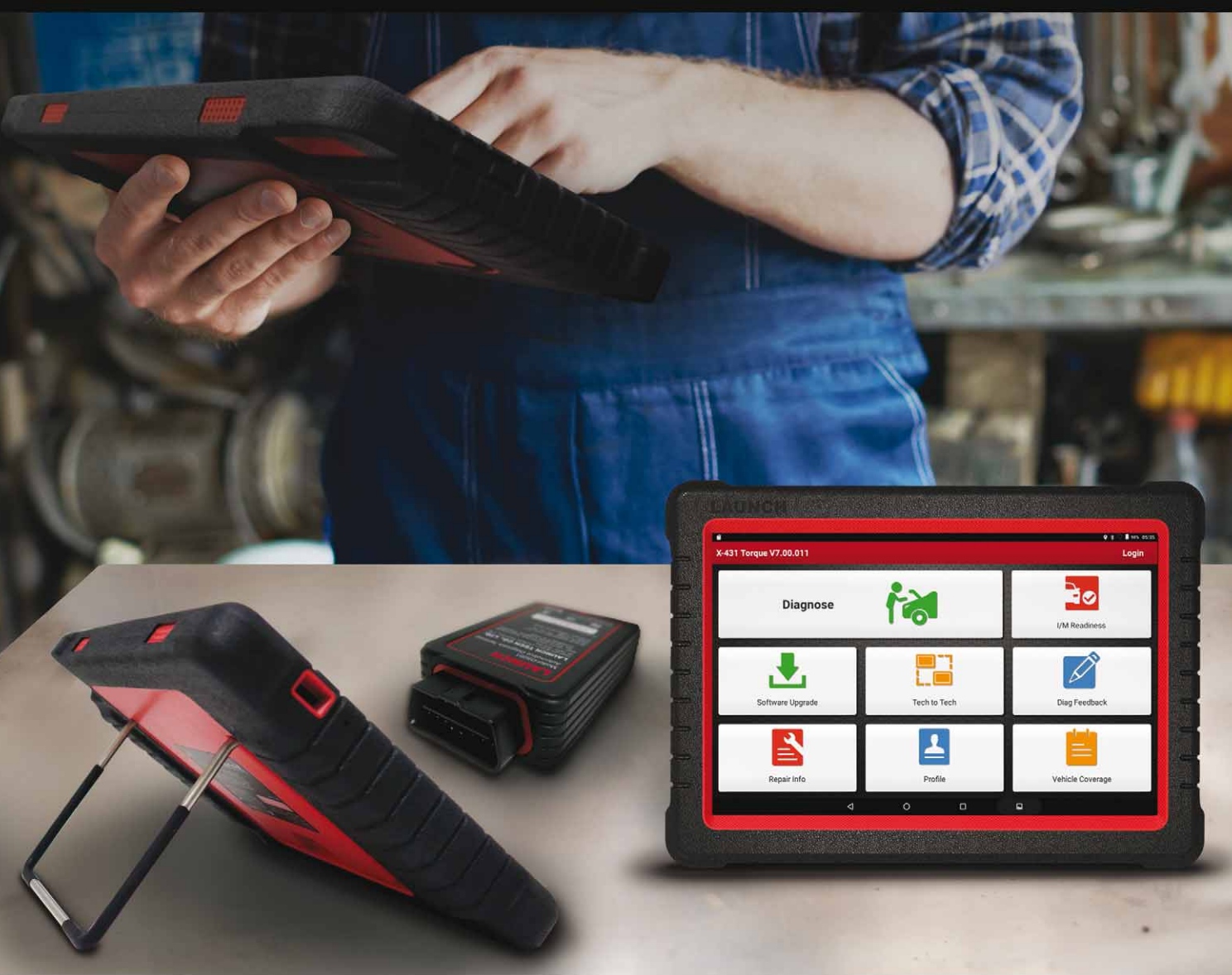

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ONBOARDING NEW HIRES

You've found technicians to hire; now, make sure to bring them on successfully

JOHN BURKHAUSER // Contributing Editor

In my article last month, ("Grow your own techs," May 2018) we explored looking to local secondary and post-secondary automotive schools as a source of new technicians. Now, let's look at bringing those new hires into your shop.

For this article, I called, emailed and stopped into different shops to see if they had an onboarding process or system for bringing in new employees. None did, leaving me to believe that very few shops have anything in place for new hires. If you have a system, feel free to email me the process so that we can share it in a possible future article!

Realize that hiring a person can be a pivotal moment for not only your shop, but also for the individual applying for the job. For you, they may be the technician who changes everything for the better. For the applicant, it may be the start of a new life for them and their family. Quite a bit rests on who you hire, so why not do it right?

If you raised your own tech via the tech school method, you are already ahead of the curve. Anyone you bring in through that method should give you a pretty good idea of who they are, their attitude and their skill level. It's like trying before you buy. It helps weed out those who would never work out in your shop before you invest more time in them.

If you haven't grown your own tech, the first step is the interview. There

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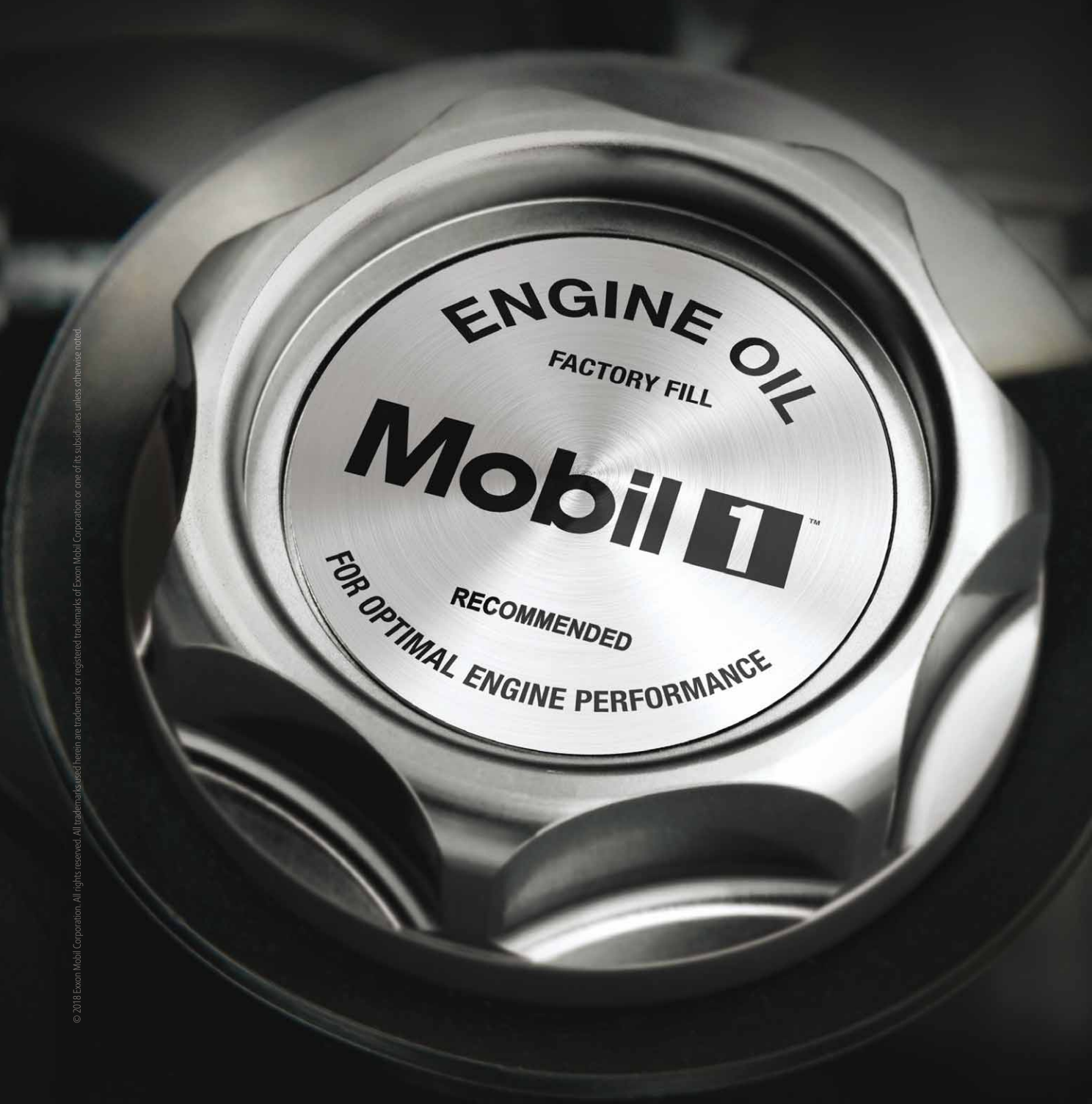

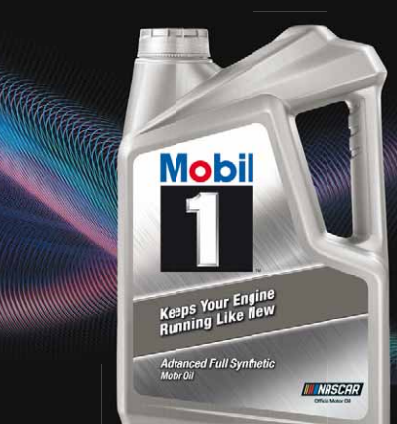

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should be a process for every interview; you shouldn't fly by the seat of your pants. Here are some steps to consider.

Certifications and drug test

Inform the candidate of your certification requirements and drug testing policies when setting the appointment for the interview. Have them bring their driver's license, state-issued licenses, such as safety and emissions, and any certifications, like those from ASE. Let them know that you will be running a background check on their licenses. (I recommend doing this with every candidate. You would be amazed at what you may find. It is money well spent.)

Resume

Have them send or bring a resume. Applicants still in school should bring a report card of their current grades in addition to a resume. When you get the resume, spend some time with it. Write down any observations and questions to use during the interview.

Social media use/personal behavior

Investigate their social media presence. Their behavior online may give you enough reasons to NOT interview them. Look at their posts, see who they are online and see if they're up to any questionable activities. It's also good to note mutual contacts (if any). Reach out to those connections for an unbiased reference.

The interview

On the day of the interview, be sure to note when they arrive, and watch how they spend their time waiting. You can learn a lot from this. Do they fidget? Go outside and smoke? Sit down and do nothing? It could give you a good idea of what they may be like if you hire them.

Have them ask you some questions, too. Make the interview a two-way interaction. Take them into the shop and ask about their experience with any of your shop's specialized equipment. Ask them what they do or don't like about the equipment to gauge their experience and education.

Hiring

If the applicant is a good fit and you want to hire them, get copies of their licenses, have them sign off on the DOT forms, and give them any documentation they need to get a drug test. Give them a time limit for getting the drug test completed while holding off on sending in the DOT request. If they get the drug test done in time, then send in the DOT forms; otherwise save the money and trash the forms.

When they pass all tests and background checks, have them return for a second visit. Discuss your offer and ask any additional questions. If you have an employee handbook or document, give it to them. Then set a date and time for toolbox drop off and employment start.

They're hired!

If you have grown your own tech, I suspect that they have already spent time at your shop and have an idea of how things work. If not, or you are hiring an experienced tech, spend some time orienting them to your shop. Do not just throw them a job and leave them to their own devices! I suggest that on day one, they shadow a senior tech around the shop to see how it all works. (Note: I believe in paying the senior tech for time spent with the new hire. This should be a positive experience for both. Come up with a plan that is fair and doesn't inconvenience the tech.)

Over the next few weeks, the senior tech can start giving the newbie small jobs that are doublechecked upon completion. Also, during this time, they should be trained on the different pieces of shop equipment they need to be familiar with. Have set milestones for them to complete under the senior tech's supervision.

Once they're settled

After 90 days, I recommend having a one-on-one meeting with them. Beforehand, talk to the senior tech and get their input on the progress over the last three months. Take note of any issues or concerns.

The point of this meeting is to let the new hire know exactly where they stand. Don't make the meeting a negative one; approach all your topics as positively as you can. Of course, discuss any concerns you have. Present the issues (if any) to the newbie and work out solutions with them.

If things are going well enough at this point, give them a raise as an incentive to continue improvement. Set up a path for training and ASE testing. Have the newbie pay any fees or costs related to the training out of pocket and reimburse them when they pass. (Later in their career, when they have proven themselves, I would recommend fronting the money for these courses.)

You don't have to do all of this, but the biggest takeaway is that you should have some process in place for new hires. I recommend putting together something that will work for your shop specifically. Remember that this process will have a large impact on your shop and your new tech's life. So why not make it a great starting point for all involved?

JOHN BURKHAUSER is an auto repair specialist with more than 30 years of experience. As the Director of Education at BOLT ON TECHNOLOGY, John coaches independent and franchise repair facilities on how to grow their business using simple best practices and everyday technology, resulting in increased car count, repair order revenue and customer trust.
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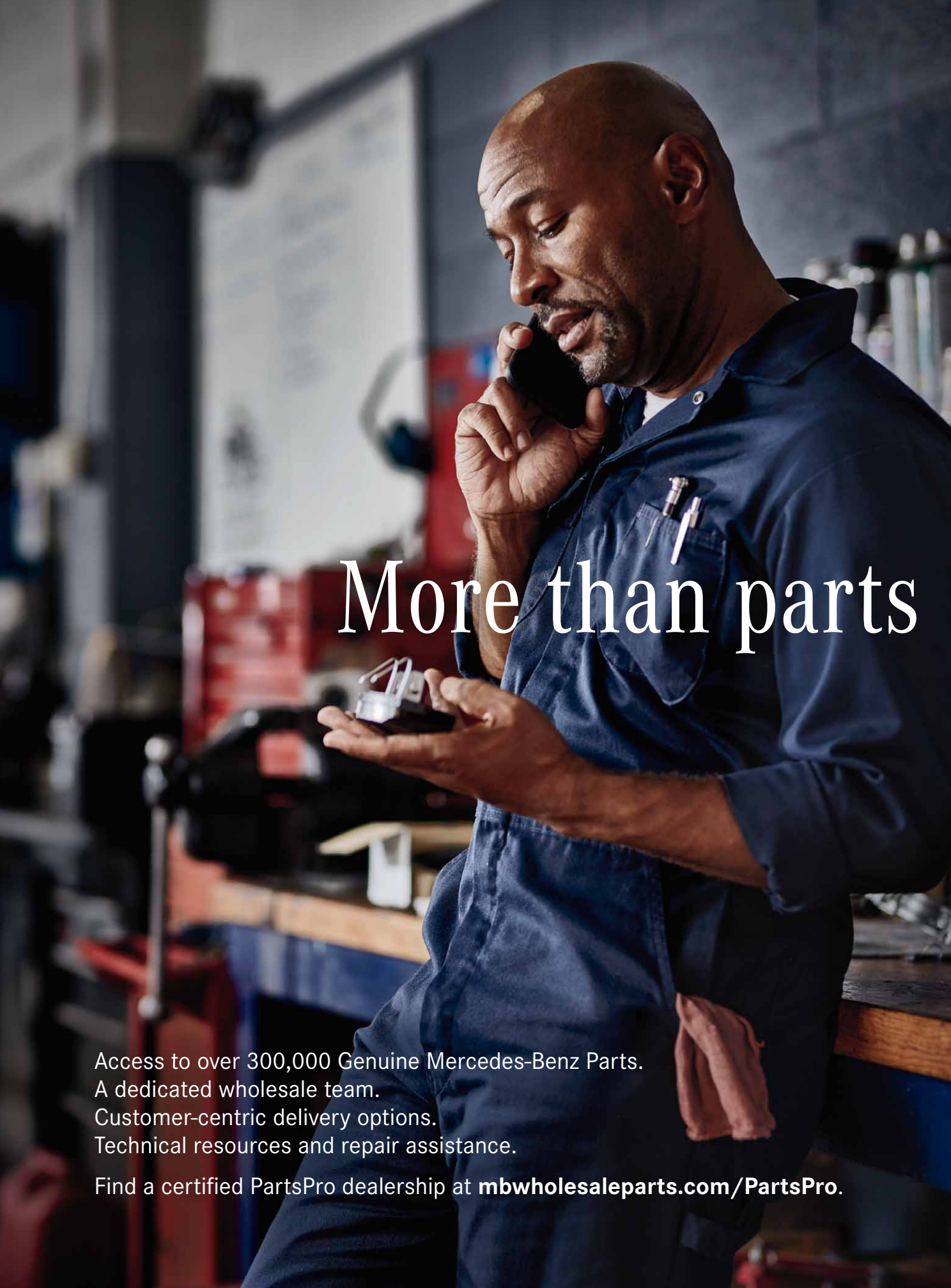

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REWARDING REFERRALS

Incentivize your vendors and the community around you to send top technicians your way

BOB COOPER // Contributing Editor

Without question, it is getting harder and harder to find the really great technicians. We just need to bear in mind that they're out there, and that they're more than likely relatively happy where they are. So how do you reach these superstars? Well, you may want to consider what your competitors would never dream of doing and offer a referral reward that gets the attention of everyone in our industry who resides in your community.

Most shop owners will try offering a referral incentive. These shop owners go to a number of their vendors and tell them that if they refer a tech, and that tech ends up being hired, they'll give them a check for $100 or so. About a month later these shop owners will typically conclude that since they didn't receive any referrals, incentives like this don't work. What they often fail to realize is the reason the vendors didn't send any leads to them is pretty simple — it's because $100 wasn't a powerful enough incentive.

I am unsure what the lotteries are like in your particular state, but here in California we have a weekly lottery, and when the pot is around $20 million or so, not many people seem to be interested in buying a lottery ticket. But as soon as that pot reaches $100 million, people stand in long lines to buy the tickets. What I find comical is that this behavior suggests that $20 million isn't enough of an incentive, but as soon as the pot reaches the $100 million mark, well, in their mind's eye, now we are talking real money! This same phenomena affects your vendors.

So, the secret? Make your vendors an offer that will grab their attention, and put sending referrals to you at the forefront of their minds. I can tell you from first-hand experience that when I was in the auto repair business, I found this approach to be extremely effective. This is why when any Elite client is

PHOTO: GETTYIMAGES / XIXINXING

struggling to find great technicians, we will often encourage them to offer a reward of $4,000 - $5,000, not $100. There is a magic number in every vendor's mind that will get their attention, and when they realize they can earn enough money to buy that boat they've wanted for so long by doing nothing more than sending a really good tech your way, your offer will become very attractive.

Now before I go any further, I suspect I know what some of

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YOU NOW HAVE THE TIPS NEEDED TO GET THE TECHS; BUT WHAT ABOUT FINDING GREAT SERVICE ADVISORS?

If you want to build a successful auto repair business, you need to have a number of things in place, yet nothing is more important than having service advisors who can sell in a professional and ethical way. So here's a guide to help you hire the superstar advisors who will take your shop to the top:

1. Look for talent. When you are looking for the superstars, never forget: talent is king. Talent is something that can't be developed or taught, so you need to make sure that the prospects you are interviewing truly are "people people," and that they naturally smile. Otherwise, you'll spend years trying to develop your advisors into something that they may never become.

2. Look for drive. Every superstar who I have met or hired has been goal-oriented, has had a positive attitude and has been competitive, quick-witted, persuasive and driven. Similarly to talent, these are all personality traits that can't be taught, so be sure to look closely during your interviews.

3. Look for a track-record of success. It's not just what prospective employees have done, but more importantly, what they have accomplished in their careers. For example, the fact that someone has been an advisor for years isn't nearly as important as the sales growth they have brought about. If they have been in the business for a few years, and they can't give you any specific sales accomplishments, then there's a good probability that there won't be any meaningful accomplishments achieved if they work with you either.

4. Look for a win/win attitude and ethics. There are basically three types of salespeople. First, there are the win/lose advisors who care about their own needs, at a cost to the customer. These are the advisors who will drive up your sales and erode your customer base at the same time. The second category is the lose/win advisors, who are overly sympathetic, and who will give your store away in order to please each and every customer. The real superstars are the advisors who fall into the win/win category, because they have the ability to close sales, will make sure your customers are satisfied and make the right decisions, and will help you build a more profitable auto repair business. Ethics is the hardest trait to judge during the interview process, which is why we support pre-employment behavioral testing.

5. Pay close attention to their interests. Service advisors who are looking for an hourly rate, a salary or a big guarantee may very well be looking for a job rather than an opportunity. On the other hand, the advisors who are interested in commission-based pay are typically self-motivated, and will help you drive up your sales.

6. Take them for a test drive. You should hand every applicant an estimate and have them sell you a service. If someone can't do a good job of selling us during a role-play, they won't be able to sell our customers either. You should also have them do a role-play where you act like a first-time caller. I have interviewed many service advisors who aced the interview, and then miserably failed during the role-plays.

7. Take advantage of pre-employment testing. There are a number of tests you should consider, but the three at the top of our list would be pre-employment physicals, drug screenings and behavioral assessments. Behavioral assessments are priceless in that they are inexpensive and quick, they can be taken online, and they reveal many strengths, weaknesses and propensities. These tests can also detect how an employee works under stress, and also irregularities in honesty, which could be an indication of questionable ethics.

Follow these tips, and you'll have a staff full of service advisors who drive up your sales, while always having your customers' best interest in mind.

you may be thinking: With this approach you could spend $4,000 just to meet a tech, or to hire someone who turns out to be the wrong employee. So tell your industry contacts that if they send a tech your way, and if you hire that tech, you will give them a check for $2,000 on the very first day of that tech's employment. If the tech is still with you at the conclusion of their 90-day probation period, you will then pay them the remaining $2,000. I also suspect that some of you are thinking that $4,000-$5,000 is a lot of money to give up, but when you consider what that superstar will produce for you, within a matter of a few months you will be telling yourself that the incentive was one of the best investments you've ever made.

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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What to do when what you want to happen doesn't

Hold yourself and your staff accountable to ensure changes are made

In the coaching business, many times you come across a shop owner who knows what to do but just can't seem to get the strategy implemented. Let's listen to how veteran ATI coach Brian Hunnicutt accomplished this with his members:

At a young age I had the fortune and misfortune to become a district manager for a big chain of tire and auto stores in Houston. Not really knowing what I was doing, I would walk into a store and verbally create a clear level of expectation of what I wanted to see happen. Well, at least it was clear to me.

What would happen? You guessed it: nothing. So I went and got a notebook for each store and wrote my clear level of expectations of what the store needed to get done on the first page. Reviewed it with the manager, and guess what happened? You guessed it again: nothing happened. I went to each manager and the answers varied, but they were basically the same — nothing but excuses. They called them "reasons."

Have them list the obstacles

I had them list each reason they could not get done what I wanted in the back of the book. Then the store manager and I would go through the "reasons." I would start at the front of the book, and I would help him remove the obstacles. When it was all said and done, we would meet in the middle of the notebook with a fixed store.

EVERY SHOP HAS PROBLEMS. THE ABILITY TO RECOGNIZE AND FOCUS ON THEM IS KEY TO SOLVING ISSUES THAT KEEP US FROM BEING MORE PROFITABLE.

What that notebook has evolved into over the last 30 years is a simplistic tool to help with holding your employees and yourself accountable. When it does not work, the owner does not want to be held accountable. Owners are smart enough to figure out that the main person held accountable first is them. This creates an accountability that no one can escape from.

You can control the meetings on your computer with a folder and a Word or Excel document for each player in the folder. You can have a spiral notebook for each one. What I prefer is a big three-ring binder with separator pages. A page for the store, yourself and each employee.

The pages inside of each separator page are as follows: first, what does the store, you or the employee do well? The second page lists what needs to be worked on. Third, pick two things from page two that you are going to work on. Fourth, what are the goals? The fifth page is the overflow from section two, if needed, since you should not have more than 15 items on page two. Sixth is the schedule.

Start with a notepad

You need to take good notes. Drive to your store from every direction and when you are seeing your store, really look at it. What is good about the store? Is the signage good? Does it have good curb appeal? As you pull onto the property, what does the parking lot and store front look like?

You need to always wear at least two pairs of glasses — one that sees the world with a tint of rose and one that sees it with what's wrong. For the beginning part of this, please use the rose-colored ones, the ones that see the good only.

Walk through your store from every

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angle: what is good about it? Write it down and transfer it into the store notebook later.

Now put on the other pair. For most of us, it is a normal pair of glasses. No tint. You see the world as it truly is. Now do the same exercise and what does the store need to work on? It can be cosmetic like a bathroom remodel. It can be courtesy checks. It can be tech productivity, higher ARO. What does your store need to work on?

Now sit down and think about each employee with the pair of good glasses on: what do they each do well? If you cannot think of anything that they do well, we have a problem. The first thing that you need to work on is seeing the world differently.

Last, but not least: what about you? This is where most of us get really antsy; looking into the mirror is not that much fun. You can take it — what do you do well?

Then once again the fun part — what do you and your employees need to work on?

The rule is simple for both good and bad — if it comes out of your mouth more than once or hits your brain more than twice, write it down. Then transfer the notes into the notebook under the store, employee or your section depending on what each note is about and who needs to work on it or who did something good.

The third page is the two things that the store, employee or you are going to work on from page two. That's right, we only work on two things at a time each. You pick a hard item and an easy item to work on. Never pick two hard items because then it feels like we never get a win. Write down the first item, leaving room to have the employee write down what they are willing to do to work on it.

Develop a mentoring plan

You may need to mentor them on what to write down, but they need to write it down in their own words and then own it. Have them date it as well. The critical part is that it has to be trackable and measurable. They cannot just write down that they will work on it. We need a plan on how to work on it.

An example would be a technician who is not doing courtesy checks in a timely fashion or at all. I would have a manual timer ready to give to them. Teach them how to do a courtesy check so that they can start the timer before doing a courtesy check and before the timer goes off at 15 minutes they will have the check done and turned in to the writer.

This way, at a glance during the process you can see if they are doing what they wrote down. If not, then you write down the time and the invoice number and put it in their notebook, along with addressing them at the time of the occurrence, as well. If you catch them doing what they wrote down, then commend them.

Once they are doing a consistently good job, then move it to the front page. They now can do a timely, accurate courtesy check and pick another item from page two and move it to page three. Start the process again.

If they do not do a good job and you give them a failing grade on what they wrote down, you have them reiterate that they are willing to do it. Then have them sign it and write today's date on it. Let them know that this is a big deal.

Make them commit

The next week goes by and if they did not do what we both agreed on, then we get serious. Remember this phrase: as the owner of the store, I need to know that I can count on you for results. Can I count on you for this result? Of course they will say yes, or it is a deal breaker. Once they say yes, have them write it down so that you can count on them for the results. Then have them sign and date it again.

The best part of this process is that only 2 percent of the time do we have to fire someone. This really works. Most people will step up and get the job done. When you run into someone who just isn't able to get it done, they know it even before you do. Now you don't have to fire someone; they will just choose to leave. If we do have to fire them, then we have the perfect paper trail.

Page four is their goals. Have them write down where they see themselves going and the store going. What are the things they want or want to accomplish? It's important that you review this every week with them. Help them get where they are going, and they will help you get where you are going.

Page five is the overflow page from page two. Never have more than 15 items on page two.

Page six is your schedule and the first item on your schedule is these meetings.

Stop the productivity robbers

Every shop has a collection of problems, large and small. The ability to recognize and focus on them is the key to solving the issues that keep you from being more profitable. To get a list of the common issues that rob a shop of its productivity, for a limited time you can click on ***www.ationlinetraining.com/2018-06*** to get our Productivity Robbers Checklist.

CHRIS "CHUBBY" FREDERICK is the CEO and founder of the Automotive Training Institute. ATI's 130 full-time associates train and coach more than 1,500 shop owners every week across North America to drive profits and dreams home to their families. Our full-time coaches have helped our members earn over 1 BILLION DOLLARS in a return on their coaching investment since ATI was founded. This month's article was written with the help of ATI Coach Brian Hunnicutt. ***chubby@autotraining.net***

A SHOP OWNER GUIDE: STAY AHEAD OF YOUR COMPETITION

BOB COOPER // Technical Editor

Not long ago it was easy to beat your competitors. All that you needed was more equipment, a healthy advertising budget and the ability to fix cars right the first time. Well, those days are long gone. Today, cars are being built better and require service less frequently. Customers have more choices than ever before, and they are able to do a tremendous amount of research online before they even pick up the phone. Additionally, this industry is experiencing an extraordinary shortage of qualified technicians, and profit margins are being squeezed every day. To top it all off, the dealerships have their eye on one thing and one thing alone: Your customers. So the question is, during these challenging times, how can you stay ahead of your competitors?

First and foremost, you will need to have clearly defined goals in place, and you'll need to create a plan for reaching those goals. The right goals and an action plan will enable you to make far better business decisions and improve productivity and profits.

Secondly, your success will be predicated on the caliber of people who work with you. We can never forget that whenever someone buys a product, they will always remember the product, but when they buy a service, they will always remember the people who provided the service. How will the top shop owners find and hire the superstars in the coming years? In addition to having an apprentice program in place, they will create a recruiting plan that contains a well-designed compensation program, and they will market to the superstars in the same way they market to their retail customers.

The top operators will also create marketing plans that target their ideal customers, and they will use the right media. The successful shop owners will be brand builders rather than price promoters, and they will invest at least 4 percent to 6 percent of their total sales into their marketing programs. They will recognize that the Y Gens and Millennials hold the key to their future, so they will be investing a part of their marketing budget into campaigns specifically directed towards them.

The successful shop owners in the coming years will constantly analyze every component of their customer process with their crew, and they'll create policies and procedures that better ensure extraordinary service at every customer touch point. They will also embrace the philosophy that keeping their superstars happy, motivated, well-trained and productive will depend on their employee management skills. They'll realize that their brand is their people, so to further develop those skills they will invest in books and courses that are directed towards employee management.

And lastly, the top shop owners in the coming years will not only know their numbers, but will know what needs to be done in order to reach each and every one of their performance goals.

In conclusion, if you want to build a world-class shop, you will need to have clearly defined goals with a written plan and will need to know your numbers. You will also need to have a team of superstars and a well-designed marketing plan that brings in your ideal customers. If you do these things, if you never forget the importance of the people who work with you, and if you live by the principle that you will never put money ahead of people, then you will not only stay well ahead of your competitors, but you will have a far more profitable, successful business in the coming years.

Since 1990, Bob Cooper has been the president of Elite (www.EliteWorldwide.com), a company that strives to help shop owners reach their goals and live happier lives, while elevating the industry at the same time. The company offers training from the industry's top shop owners, service advisor training, peer groups, along with online and in-class sales, marketing and shop management courses. You can contact Bob at contact@eliteworldwide.com, or at 800-204-3548.

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Internal operating statement elements and analysis

If you don't know how to measure your financials, you are missing out on sales

Too many shops do not monitor their business on a regular basis with a full analytical Financial Statement.

Our studies have shown that a shop that produces $500,000 to $650,000 in sales per year but does not understand how to "measure" itself, is missing anywhere from $35,000 to $90,000 in net income (net profit) per year. That amount is truly real money to anyone's business.

A shop under financial duress should produce a management operating statement for at least 24 consecutive months. This allows management to see the trends and understand how the profit is made in the shop.

The basic elements of an Analytical Financial Statement are: (A) Total revenue in predetermined categories for the month and year-to-date; (B) Gross Profit return measurement for each revenue category for the month and year-to-date; (C) Expense categories for the month and year-to-date; (D) Net profit for the month and year-to-date; and (E) full Balance Sheet compared to the previous month.

(A) Revenue Categories: The basic revenue categories measured today include fluids, tires, aftermarket parts, dealer parts (domestic and foreign name plate separately), maintenance labor, diagnostic labor and re-flash labor. Some shops will break labor down even further, such as including fluid labor, tire install labor and vehicle inspection labor. I recommend to start with the eight initial categories mentioned.

By understanding where the shop revenue comes from, it becomes easier to measure performance against industry data. It also allows you to determine what type of customer/client base you are serving. For example, in the measurement of its parts sales, if the shop is averaging a sales mix of 95 percent aftermarket parts and 5 percent dealer parts, traditionally it means the shop is repairing older vehicles. Conversely, if the shop is averaging 70 percent aftermarket parts and 30 percent dealer parts, then the shop is working on more new vehicles. Each scenario has repercussions as to the staff and equipment the shop requires. As the sales mix changes over the course of two to three years, one can judge the future demands of the shop in terms of staff competency levels, staff training requirements and equipment acquisitions required.

MEASURING YOUR BUSINESS ONCE PER YEAR IS TOO LATE TO EMBRACE OPPORTUNITIES. THEY HAVE ALREADY PASSED.

(B) Gross Profit Measurement: Gross profit return is critical to net profit performance. But one must understand where the profit is made. The gross profit return for oil should average a minimum of 45 percent; however, 50 percent is achievable through good management. Tires will average from 10 percent to 26 percent for a traditional independent service shop. Aftermarket parts can be managed to an average of 45 percent. Dealer parts domestic usually range from 18 percent to 22 percent, while foreign name plate can even drop to a low of 8 percent but can be managed in the range of 14 percent to 20 percent. Maintenance/mechanical labor should average 90 percent and higher when technician wages are eliminated from the cost of labor and only sublet costs inserted into the labor cost, while diagnostic, re-flash and the other labor categories would show a 100 percent GP percentage return. Put all the other costs such as freight, supplies, etc. that accountants insert into the cost of labor down into their own expense categories.

Ensure that your gross profit percentage for fluids, tires and parts is calculated using the correct accounting formula for cost of goods sold, which means you insert the correct inventory numbers. Cost of goods sold is calculated by taking the opening inventory + purchases - the closing inventory. Dollar sales less dollar cost of goods sold equals dollar gross profit. Dollar gross profit divided by dollar sales equal the gross profit percentage achieved. When a shop only uses the purchase made, they are wrong in their calculations because without a correct inventory number, the shop cannot account for inventory shrinkage that may have taken place.

The shop should target to produce $1.25 in total labor revenue (maintenance, diagnostic and re-flash

combined) to $1 in total parts sales (aftermarket and dealer parts combined). The shop also wants to target a minimum of 15 percent, but preferably 20 percent of its total labor revenue as diagnostic labor, which is charged out at a higher tier rate.

When these guidelines are achieved and measured, the shop will average 70 percent to 75 percent total gross profit return from total sales of the bays.

(C) Expense Categories: Take the time to customize the operating expenses. What expenses should be measured and are important to you? One of the unique ways of setting up the entire wage expense is to break it out into technician wages, service advisor wages, administration wages, management wages, and shop burden (shop's portion of payroll taxes, Workers' compensation, group insurance, etc.). One of the criteria of measurement is to produce a minimum of $1.20 in total labor revenue to $1 spent on the entire wage package of the shop including management wages and includes shop burden.

The balance of the shop expenses should be monitored and managed answering the real question of whether the expenses are controllable, non-controllable or common-sense expenses in relation to what the shop is trying to achieve in client service and satisfaction.

(D) Net Profit: The shop should measure true net profit after the management wage, drawings and dividends have been factored in. The objective should be to net a minimum of 10 percent of the shops total gross sales. When this is achieved, the capital is usually in decent supply to keep the shop well equipped with top equipment and quality staff.

(E) Balance Sheet: A full balance sheet compared to the previous accounting period allows the management to see where the profit dollars went throughout the shop. Wherever it went, it is important to see how management is handling the profits made in the shop. Only a full comparative balance sheet allows you to accomplish this.

Take the time to measure your business completely and accurately. The biggest obstacle you face to making real change will be your tradition of doing things.

BOB GREENWOOD, AMAM, is president and CEO of Automotive Aftermarket E-Learning Centre Ltd. (AAEC), which provides business management resources for the automotive aftermarket. Bob has more than 36 years of business management experience and is one of 150 worldwide AMi-approved instructors.
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Family transmission

Tackling transmission repairs was the easy part for this father-son duo

ROBERT BRAVENDER // Contributing Editor

Let's face it, while the transmission is a crucial component in "transmitting" an engine's power to the wheels, fixing one is completely unlike anything else on a vehicle. For one, outside of transferring torque, transmissions are pretty much self-contained systems. Secondly, ever since the advent of GM's Hydra-Matic in the 1940s, automatic gearboxes have grown so complex that repairing them has become a specialty. And with automatic-equipped cars now accounting for around 95 percent of sales in the U.S., these specialists have their work cut out for them.

And yet, some of them diversify. Take Total Care Transmissions of National City, Calif., a suburb of San Diego. As the name denotes, they also do general maintenance and repair, even some engine rebuilding. "Being so close to the [U.S.-Mexican] border, you've got to find a way to keep up with how things are changing," says Julio Zambrano, Total Care's owner.

"I think transmission work would be a good 65 percent to 70 percent of what we do, general auto repairs about 25 percent, and the rest being restoration," he reports. "We do have to invest in some diagnostics; (about) once a year we upgrade our scanners to be able to diagnose newer vehicles."

Meanwhile, transmission technology hasn't stood still, either. "It's been harder as the years go by," notes Zambrano. "We started with the CVT, the continuously variable transmission. They're not difficult to rebuild; we had a problem with finding parts, making them almost the same price as buying one from the dealer. It's getting difficult in terms of keeping up, but that's why we go to seminars every year, like ATSG and ATRA."

Transmission fluid must be in the family's blood: Julio's uncle once owned three shops, which his father worked at as a technician, while Zambrano himself spent nearly a decade at another shop as well as a transmission parts supplier before also going to work for his uncle. "I was still going to (college)," he notes, "but I liked working in the shop, especially helping the customers."

So when his uncle decided to divest himself of two of the shops in 2014, he sold one to Zambrano and his father. "My uncle basically just sold us the equipment," he explains. "We created an entirely new (company), with a new name, new phone number. As owners it's 50/50 between me and my dad, but I handle the office and he and my brother handle the whole auto repair part of it."

TOTAL CARE TRANSMISSIONS & CLASSIC RESTORATION

National City, Calif. // www.totalcaretransmissions.com

Julio Zambrano Owner	**3** No. of employees	**$1,500** Average repair order
1 No. of shops	**2,200** Total square footage of shop	**10** No. of customer vehicles per week
4 Years in business	**4** No. of bays	**$230,000** Annual gross revenue

Admittedly, starting from scratch was difficult at first. "A lot of friends and family started sending people our way. That was the easy part," Zambrano explains. "The hard part was getting more people to know about us. In the first couple of months my dad and I would sometimes hand out flyers on the weekends. I would advertise on Craigslist, social media like Facebook, Instagram — sources I didn't have to spend an arm and a leg on in order to get the word out."

Now they count among their clientele three general repair shops. "We had to learn about various things, like how to build a website, how to handle social media," Zambrano continues. "All of that was new to me, but it's been getting easier, and I've been learning so much; that's why I think people started hearing about us and finding us online."

This learning curve was complicated somewhat by the fact Zambrano was working on finishing his Bachelor's degree in

PHOTOS: TOTAL CARE TRANSMISSIONS & CLASSIC RESTORATION

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Akebono rotor-friendly brake pads improve brake system life

Each year vehicle manufacturers seek new ways to improve the durability and efficiency of vehicle parts and systems — braking systems included. But evolving technology also means increased demands on brake pad manufacturers to design pads that are longer lasting, quieter, more durable and easier on brake components. Akebono has responded to the industry demands with a solution that is friendly on brake components, and also helps to extend rotor life.

Fundamentally, there are two ways to generate friction: through adhesion or abrasion. Abrasive pads typically wear down vehicle rotors at a much faster rate. Akebono has perfected the science of brake adhesion and has designed its solutions specifically to combat the problem of reduced performance through abrasion.

Akebono ceramic friction materials work by laying down what is known as a transfer film on the rotor surface and friction is achieved by shearing that transfer film. Akebono materials contain abrasives to control the thickness of the transfer film, but they are both small in size and comparatively soft. The advantage of an adhesive style friction is long wear, for both rotor and pad, and very low dust (by virtue of low rotor wear).

By contrast, using the abrasive method of friction generation, small iron particles are dislodged from the rotor surface using larger and harder abrasive components in the formulation. Since even these abrasive components wear, they need to be constantly renewed by allowing the pad to slough them off as wear. This, combined with the wear of the rotor material, generate large amounts of dust that abrasive friction materials are known for.

By choosing an adhesive style friction such as Akebono Pro-ACT®, EURO® and Performance® Ultra-Premium Brake Pads, your customers will enjoy smoother, quieter and cleaner braking, plus longer rotor and overall brake system life. When it comes to rotor-friendly formulations, Akebono is the brand name OEMs and aftermarket consumers trust.

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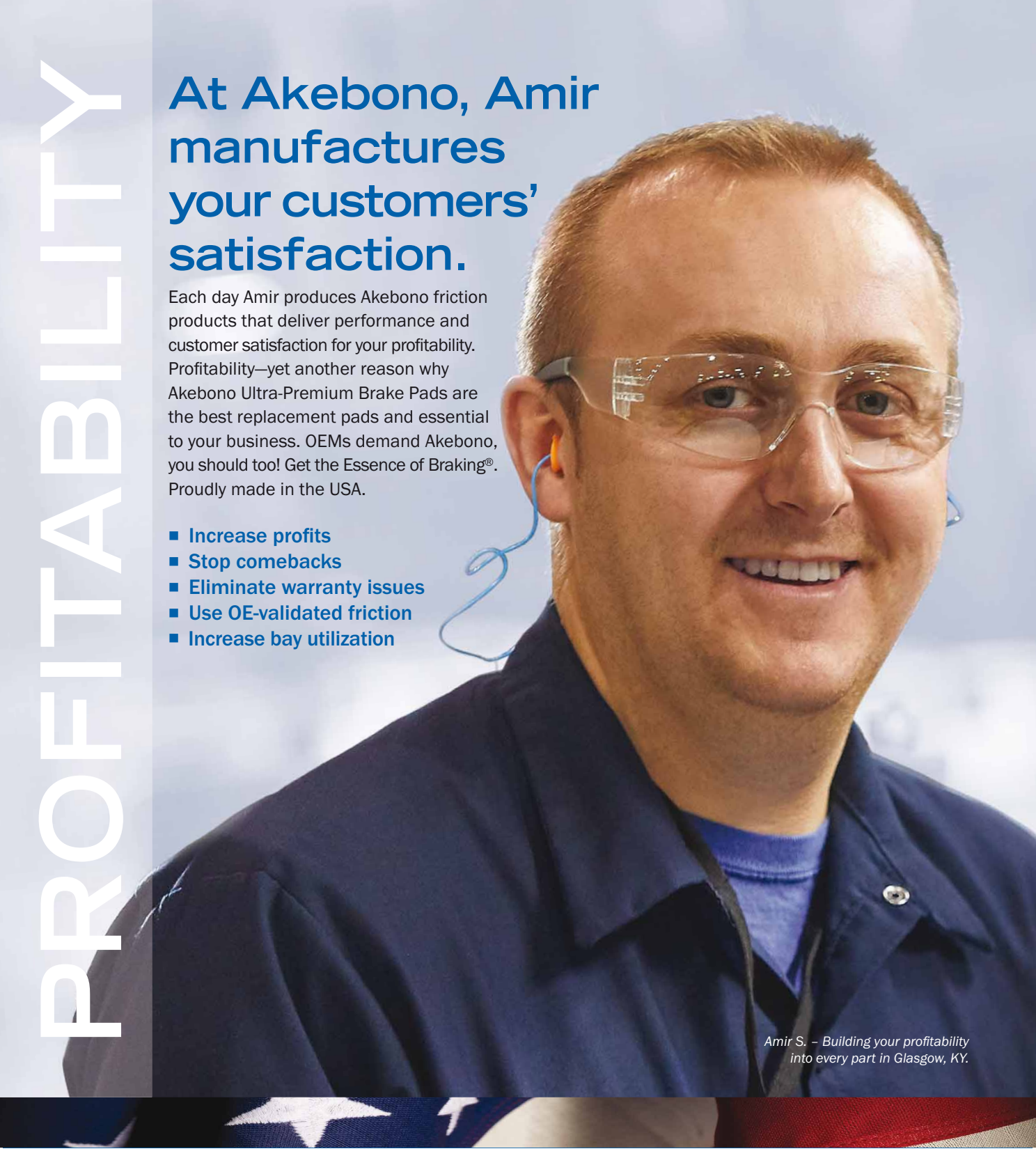

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business management. "I was working full time while also going to school full time, so it was a little bit crazy for those first two or three years," he recalls. Now he's applying everything he learned, like improving search engine optimization (SEO) for their website so it comes up sooner online.

But things never slow down; more than six months ago Zambrano's brother came aboard full-time after his own stint at school. "So I've got to increase sales in order to pay for the extra time he's going to be here," Zambrano reports. "My goal is to increase our sales by about 20 percent in the fiscal year."

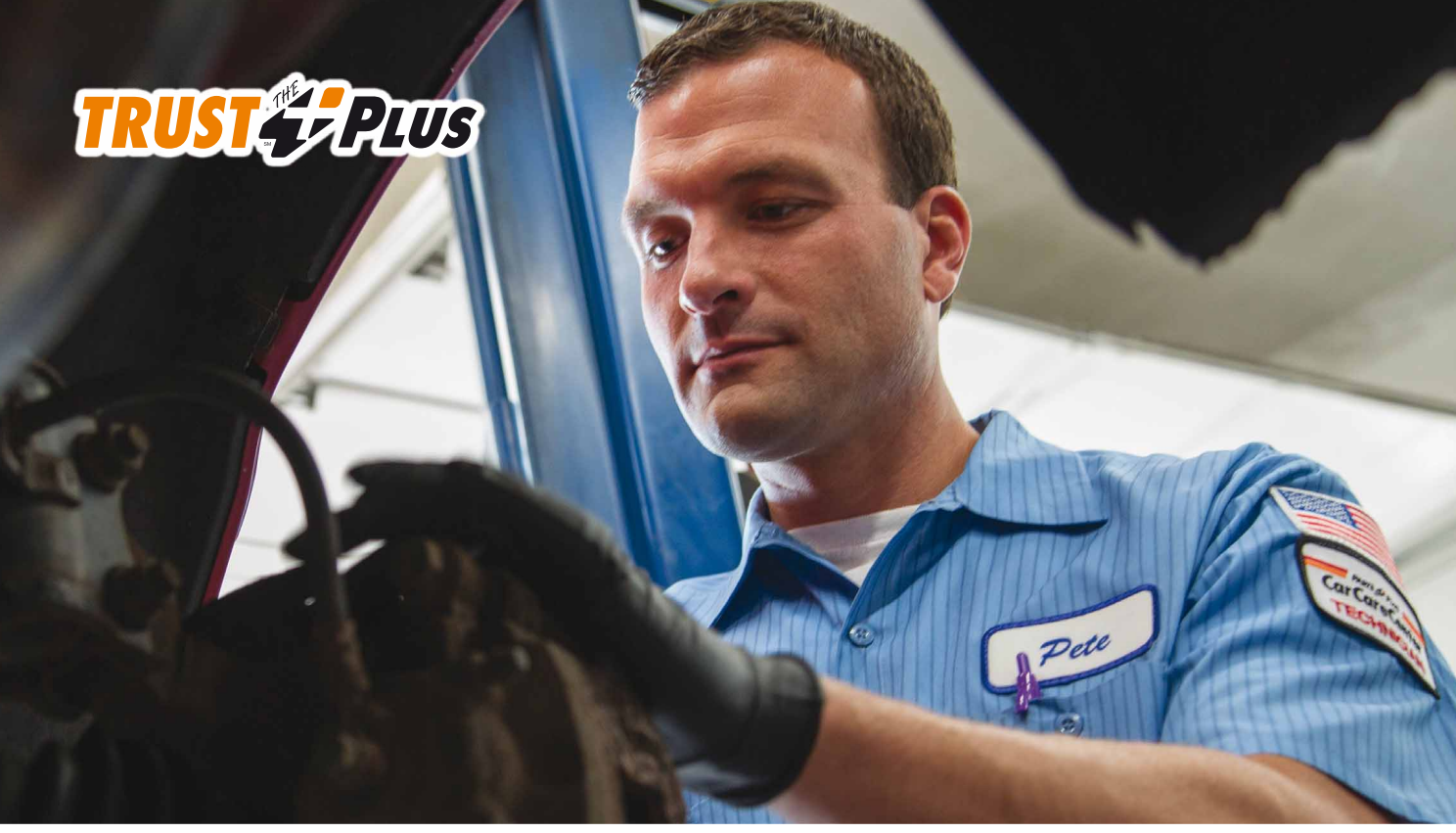
He plans to do that by focusing more on the second half the shop's title, Classic Restoration, which isn't so much getting old vehicles back to like-new condition as it is getting them on the road again. "Maybe in the future," laughs Zambrano, "but at this point we're not, because I don't have a place where I can send a customer to get something painted or anything like that.

"We restore in the sense that we'll replace or rebuild the engine," he explains. "Anything 1975 or older are the only ones we rebuild in-house. We'll also go through the transmission and the differential — sometimes customers want to make them limited slip. A customer might find a really good deal, like a '64 F-100 for $1,000, but the truck has been sitting for 10-15 years. They bring it to us, we'll get it started, and at that point the customer will decide whether he wants to keep it that way or go through the whole thing.

"Even though we work on them continuously, I feel that there's still a market out there for more people who just want to have their old car running in good condition," Zambrano comments. "My dad enjoys working on them, and I feel that when you enjoy what you do it doesn't feel like work. Meanwhile, my brother's building transmissions, and he really enjoys doing that — then maybe I can have both of them happy.

"A lot of people ask if it's really hard working with family," Zambrano smiles, "because we each have our own ways of thinking. But I think we've learned to manage that by strictly treating each other as coworkers when we're in the shop, as if we're working for someone else. After hours we can joke around, we can do whatever we want as a family, but I think it's really helped that we all have that kind of mindset."

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.
rbravender@comcast.net



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Installing a mentorship model into your business

TODAY'S TECHNOLOGY DOES NOT ALLOW US TO LEARN ON THE FLY

CHRIS CHESNEY // Contributing Editor

It has been amazing to watch our industry come together in an effort to solve collective issues, such as the technician shortage and the onslaught of new technologies. No other industry I know of cares about their competitors the way we do. While this is noble and admirable, I fear it puts us in a frame of mind where if we simply support each other and work cohesively, then the technician shortage and technology mountain will soon pass. For some it certainly will; it will pass because they found themselves in a situation that causes them to close the doors forever, while those who are prepared to change their current business model find themselves in an exciting world of growth and longevity. Which group do you identify with?

That's why we need to talk about creating lifelong mentors in our industry. In the past when new technology became available, we learned on the job or by going to a class on the topic. The technology was simple enough that we got away with it; we learned on our customers' time and on the back of our productivity. But what about today? When a new ADAS-equipped vehicle rolls in the door for an alignment, can we afford to practice on a customer car? Can we risk our credibility by not fully understanding these new systems, causing return visits and eroded confidence with both our customers and our team?

We live in a time where technology is so advanced that we can't afford to learn on the job. Instead we must create a structured learning environment in our businesses that enables the growth of each position. This must be done in a way that does not create a burden on your production and your customers' time, but in a way that provides a clear and efficient path of learning from the time someone joins your organization to the time they move on.

Mentorship is a relationship where a more experienced or knowledgeable person helps guide a less experienced or knowledgeable person. The stigma of mentors is that they should be your most experienced, oldest or most productive tech. This is false. The ideal mentor is someone who first wants to pay it forward. This is usually someone currently in the role that the apprentice or mentee is working towards. So, look at your entire staff as a potential mentor. As a personal example, I mentored my first apprentice when I was 24 years old. I was able to benefit from the experience more than I ever imagined because the primary by-product of mentoring is the knowledge gained in preparation to properly serve the mentee. The responsibility of guiding another person to perfect a craft you respect is a heavy burden, lightened only by being prepared to share the truth. This isn't always demonstrated by knowing everything about a certain system or service technique, but is more often seen by your demonstration of how you learn and how you solve problems. It also involves honesty and the ability to encourage and give positive yet constructive feedback. It means becoming an advocate for the mentee by investing in their career.

Let's look at how the business side of a mentorship program might look. First, keep it simple. If the mentor can't figure out their financial benefit, then it won't work. Likewise, if the mentee doesn't see light (money) at the end of the tunnel, they won't last. The first step is to establish that everyone in the company will always be in a position of apprenticeship where they are working with a mentor, and everyone in the company will always be a mentor where they are sponsoring the growth of another. It is a cycle of learning that creates the greatest benefit for all. This means you need to create a significant culture shift in your organization, so it makes sense to work your way toward the above model by initiating a mentorship program for new team members.

The simplest model provides the mentee with a living wage. It should not be based on productivity to start, but should be enough that they can sup-

>> CONTINUES ON PAGE 44

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MOTORAGE.COM/Recruiting

Ford Fusion misfire diagnosis and repair

MOTORAGE.COM/Fordmisfire

How to motivate employees

MOTORAGE.COM/Motivate

MECHANICAL MOMENT

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

JEEP EMISSIONS MONITORS KEEP RESETTING/ ENGINE STALLS

VEHICLE: 2004 Jeep Wrangler, L6-4.0L, VIN S, Automatic Transmission

MILEAGE: 167,000

PROBLEM: The vehicle was brought to the shop because the emissions monitors kept resetting and the engine intermittently stalled.

DETAILS: Another shop had previously replaced the rear B1S2 O_2 sensor due to an O_2 sensor DTC. When it came in, there were no DTCs stored — active or pending. Initially the tech checked all power and grounds to the PCM then checked the connectors at the CKP, CMP and the PCM. He also checked connections at the battery and alternator. The connections were all in good condition.

Next, the tech disconnected the rear B1S2 O_2 sensor and road tested the vehicle. The engine did not stall. The Tech-Assist consultant advised that aftermarket O_2 sensors — especially on Chrysler products — often do not work correctly and can cause problems.

CONFIRMED REPAIR: The tech replaced the aftermarket B1S2 O_2 sensor with an OEM sensor. After the replacing the sensor, the monitors operated normally and the engine stopped stalling — problem fixed!

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.

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Arizona Automotive Training & Expo
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Scottsdale, Arizona

JUNE 24
Automotive Training Institute: 8 Essential Skills for Auto Repair Shop Success
Hotel to be determined
Tampa, Florida

JULY 23-26
2018 ASE Instructor Conference
Embassy Suites
Friscoe, Texas

AUGUST 8
The Advanced Technology & Diagnostic Repair Forum
Georgia World Congress Center
Atlanta, Georgia

AUGUST 8-10
NACE Automechanika 2018
Georgia World Congress Center
Atlanta, Georgia

OCTOBER 13
ASA-Midwest Des Moines — Hands-on Hybrid Training
Williamson's Repair & Tire
Bondurant, Iowa

OCTOBER 30-NOVEMBER 1
AAPEX 2018
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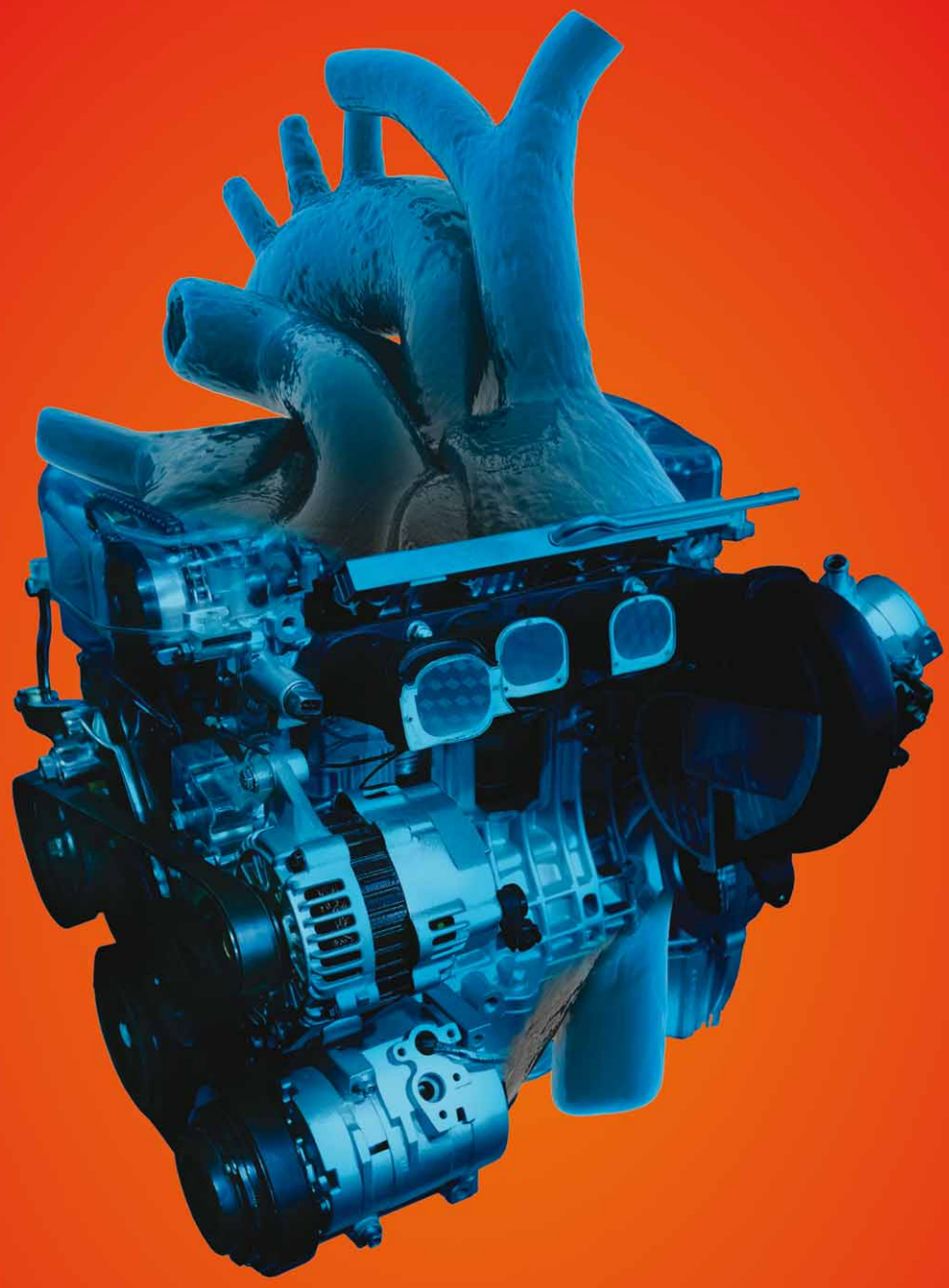
Las Vegas, Nevada

IT'S WHAT'S **INSIDE**...



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Getting ready for A/C season

Warm weather brings the need for updated air conditioning service for vehicles. With the increasing use of R-1234yf refrigerant, there are changes to the recovery, recycle and recharge process. Technicians are now required by SAE Standard J2845 to be trained to recognize which refrigerant is being handled and how to handle it safely, while being equipped with the essential information, proper equipment and tools that are unique to these refrigerants.

Starting in 2012 with 2013 model year vehicles, vehicle manufacturers began introducing vehicles that used R-1234yf. This new refrigerant is different from R134a and new service equipment requirements were created to ensure the refrigerant is handled properly and service is performed correctly. New A/C machines were introduced to work on these new vehicles with unique couplers that only allow a connection to an R-1234yf system. One of the requirements for R-1234yf service equipment is refrigerant identification anytime refrigerant is brought into the A/C machine.

The refrigerant is continuing to become more and more common and technicians will continue to see more vehicles using it. Automakers receive emissions credits for using environmentally friendly refrigerants such as R-1234yf, acting as a further motivation to comply with new standards. While not required, it is recommended that technicians retake the EPA-approved Section 609 certification course to learn about the new refrigerant recovery, recycling and charging equipment and procedures in accordance with SAE Standards and regulatory requirements.

In response to the introduction of this new line of vehicles that are using the new refrigerant, new equipment had to be designed to service the systems. The Robinair AC1234-4 is a premier R-1234yf recover, recycle and recharge fully automatic ACS machine that meets or exceeds SAE J2927 and J2843 standards for 1234yf recovery. The AC1234-4 machine comes with a built-in internal refrigerant identifier that samples refrigerant prior to recovery to ensure the refrigerant is good before it is brought into the A/C machine. AC1234-4 is a highly accurate and reliable machine capable of servicing both standard and high-voltage vehicle A/C systems.

To further aid technicians, the machine is fully automatic, which allows it to be programmed for service, returning when the job is complete. The programmable vacuum function helps to get the necessary vacuum level in any condition quickly. The machine includes an automatic internal tank refill so there is no stopping to fill it during or before service. Refrigerant must be at least 98% pure prior to recovery and recharging. Servicing R-1234yf systems also requires technicians to manually inject oil into the system. Before injecting oil into the system, technicians should review OEM requirements and use the manufacturer-recommended oil.

Robinair is driven by innovation and continues to be at the forefront of mobile A/C recovery. For more information on A/C recovery machines, tools, equipment and accessories, visit www.Robinair.com

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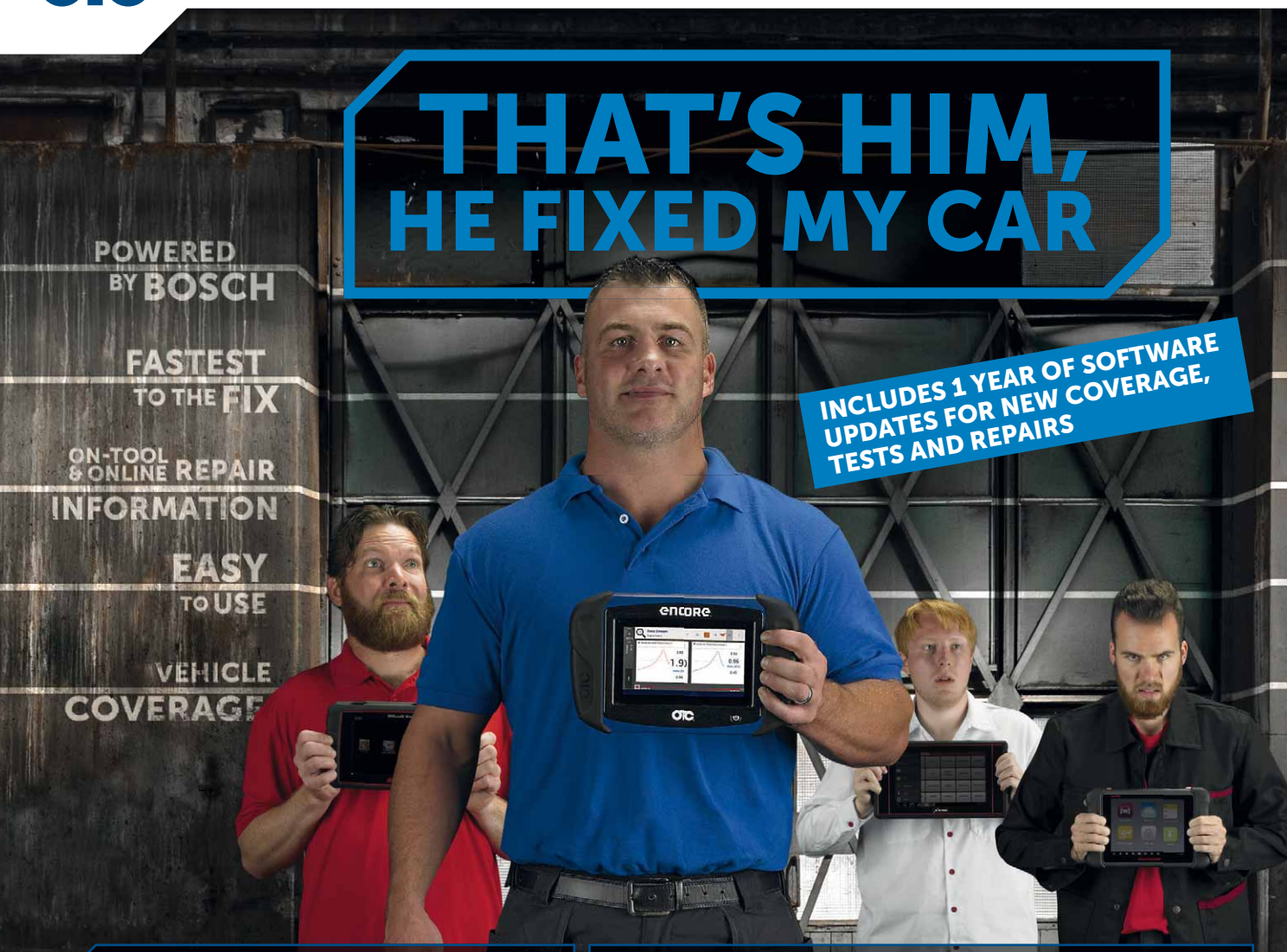

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S/P2, ASE PARTNER TO PROVIDE MENTORING PROGRAM

Earlier this year, the ASE Education Foundation and S/P2 partnered to develop The Workplace Mentoring System, a mentoring program for the automotive industry.

The program aims to help businesses identify and train service personnel to become mentors to students and entry-level employees. This program will be available to the entire industry: automotive service, medium/heavy truck, and collision repair and refinishing.

S/P2 is an organization that provides safety and pollution prevention training for our industry, as well as vocational education that meets OSHA requirements. They have more than 2,300 schools in their program and thousands of aftermarket shops as well.

S/P2 created the Workplace Mentoring System, which offers online courses covering the roles of the three key players — the mentor, the mentee, and the manager. The courses explain the roles and responsibilities of a mentor and a mentee, and lay out the responsibilities of the manager who should oversee the mentor-mentee relationship. It includes content from choosing the mentor and hiring the mentee, to handling business decisions such as pay plans and tooling.

"Mentoring is an essential component of a successful 'grow your own' employee process," said Trish Serratore, President of the ASE Education Foundation. "We see this opportunity as a way to help the industry grow the next generation of technicians, both in the classroom and in the shop."

"To provide a complete mentoring system, we knew we had to provide a framework for the tasks shops should use to train and evaluate an entry-level technician," said Kyle Holt, President of S/P2. "The ASE Education Foundation task lists are used in hundreds of automotive schools, are industry-generated and industry-approved. By teaming up with the ASE Education Foundation, the industry can use the same road map with the flexibility to customize the task list to fit their facility's specific needs.

Next steps for the two groups are to fully integrate the ASE Education Foundation tasks into the Workplace Mentoring System and to develop a pricing model for accredited and non-accredited programs and ASE Education Foundation partners.

>> CONTINUES FROM PAGE 38

port themselves. In most cases, the cost of this wage is shared by the business and the mentor. In a shop that still pays via flat rate, the mentor should flag all the work produced by the mentee. Next, the mentor/mentee team needs enough space to be productive. You can't expect to see an increase in productivity from the increase in overhead if you don't give them the space to learn, produce and advance. If you pay your team a salary with a production incentive, then you might adjust the incentive or salary for the mentor. A successful mentorship program should not cost you in lost production, and if implemented properly, will increase efficiencies and production over time.

The duration of a mentorship program depends on the maturity of your program. If you are just starting out and are growing a recent graduate of a two-year post-secondary program, then two years is recommended. Merit increases for the mentee must be defined, and production incentives for both must be planned as well. Most importantly, you must have a plan that is created as a team and communicated consistently from the beginning. As your program grows, you'll find that the concept of creating mentors for life will allow you to build mentorship into your business model where there aren't any special pay plans or incentives. It simply becomes your business model that supports the continued growth of the company.

How do you become a great mentor? You must first be a great mentee; the best mentor is going to be the best apprentice. A mentor also needs a mentor. In fact, the way we solve the technician shortage in our industry is to create mentors for life. To be a mentor, you must commit to becoming an apprentice for life. It is this cycle of constant learning and sharing that allows us to all stay abreast of the rapid technology growth in this industry. But how do you get started?

I suggest looking at the recent program created by partners ASE and S/P2 to develop and support mentorship in our industry (see sidebar). Hopefully this information helps and encourages you to begin a mentorship program of your own or helps to better define your current program. While we are focused on growing our own businesses, we also must share our successes with our peers so we may all survive. MA

CHRIS CHESNEY is the Senior Director of Customer Training for Carquest Technical Institute (CTI) and Advance Professional.
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Service advisor pay programs that can work for you

THE BEHAVIOR YOU GET FROM YOUR STAFF IS THE BEHAVIOR YOU REWARD

BOB COOPER // Contributing Editor

If you are looking to drive up your profits, you need to ensure you have service advisors who have the right attitude, aptitude and ethics. They will need to have the natural talent to sell, be well trained, and have the proper support systems in place. And lastly, you will need to have the right compensation and incentive plan to help your advisors excel. Here are some tips you can use to drive up your sales, profits and customer satisfaction scores.

1. In drafting any pay program, the first question you should always ask yourself is what are you looking to accomplish? With service advisors, you should be looking for them to generate three things: sales, gross profits and happy customers. This is why at Elite we encourage our coaching clients to implement pay programs that only reward their advisors when all three objectives are met. For example, the advisor can earn a graduated commission on sales, but in order to be eligible for the added income, they will need to meet minimum requirements for gross profit and customer satisfaction scores. With a program like this in place, with each sale the advisor will work toward ensuring that it is profitable and that the customer is pleased. Compensation programs for advisors that only address sales without considering gross profit and CSI requirements are set up to fail, because the shop typically encounters much higher expenses and lower CSI scores. Remember, the behavior we get is the behavior we reward.

2. If you have more than one advisor at your shop, you have a number of options for how you can compensate them. Many shop owners will put each advisor on their own commission program, but unfortunately, this leads to an unhealthy type of competitiveness, and there is no incentive in place for them to help one another. This is why we recommend a shared commission whenever there are multiple advisors, especially when they have to cover for one another. If you have a more experienced and more productive advisor working with a less experienced and less productive advisor, you can easily adjust by either giving the more productive advisor a larger percentage of the shared commission, or you can provide them with a base pay that is supplemented by the sales commissions they will earn. These pooled commissions incentivize the teamwork you need to grow a successful auto repair shop.

3. One of my best-kept secrets is implementing daily car count goals and daily sales goals. If your monthly sales goal breaks down into a daily goal of $4,000, and if your ARO is $400, you would need to bring in 10 cars a day. When your advisors come to work in the morning they can write the amount of $4,000 on a note pad, and next to that dollar amount they can write the number 10. As soon as they write up the first repair order that day they would strike a line though the 10, and write "9" (the new, revised goal) underneath. As soon as they sold the first job that day they would strike a line through the $4,000, and write the new revised sales goal underneath. If you apply this procedure to your company, you will be amazed at how it will help keep your advisors focused on the vehicles they need to generate the sales, and the sales they need to reach their goals.

When I first applied this procedure to the shops I owned, our sales went straight up. If you don't have clearly defined car count and sales goals in place, your advisor may go home tired, and they may say they were busy, but there is no way they can say they were "successful" when the definition of daily success has not been established. On the other hand, if you have these goals in place, then you can reward your advisors at the end of the day by congratulating them on reaching the goals, and letting them know how much you appreciate them being a part of your company. That in itself is a reward they all need, and one that money just can't buy. It's called recognition, and you have my promise — it's a reward that every superstar needs.

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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JOHN D. KELLY // Contributing Editor

Have you ever had a problem vehicle with a vibration that just seemed to be impossible to fix? Have you performed repair work or installed parts, in an attempt to correct a vibration and it ended up being a complete waste of your time and the customer's money? I have, and I know that I am not alone.

As you may already know, correcting a vibration concern has been much easier than diagnosing the source of a vibration. Correcting a vibration concern can be as easy as balancing a tire or as difficult as correcting a backlash variation problem on a ring and pinion gear set. You cannot correct a vibration concern without first diagnosing the source.

There have been many vibration diagnostic tools over the years, some mechanical and some electronic. Most of them are bulky and time consuming to setup. To make things worse, almost all of them are difficult to understand without hours of technical training because there were no definitive results. You had to decide what was wrong with the vehicle based upon the measurements displayed on the tools.

Today I suspect that almost all of you have a smartphone within an arm's reach

PHOTOS: JOHN D. KELLY

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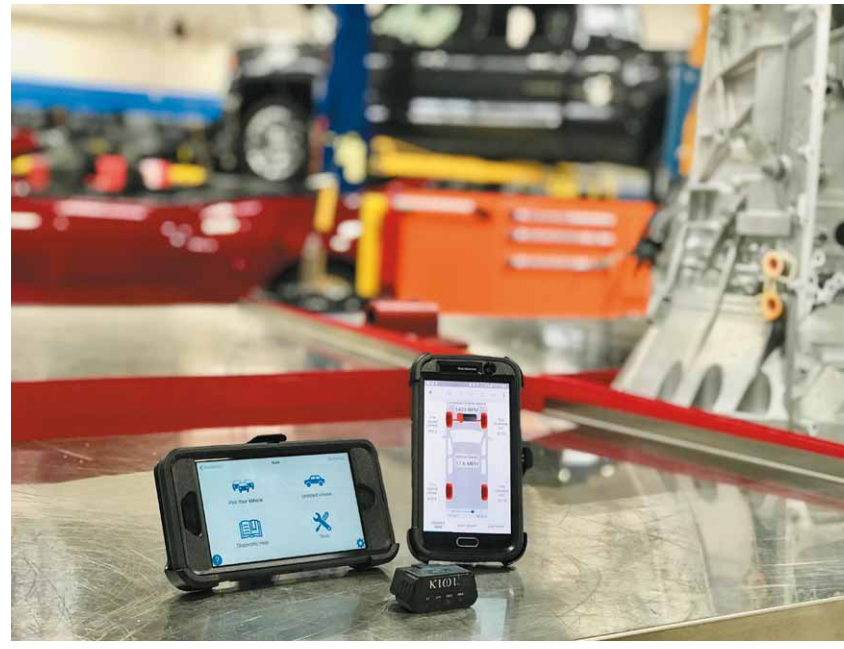
at this very minute. That smartphone (with its amazing internal sensors) along with a unique smartphone app, can turn your smartphone (and some tablets) into an easy-to-use-and-understand vibration diagnostic tool. The smartphone app I am referring to is called "NVH" on the Apple App Store, and "NVH for Android" on the Google Play store. Since both apps have slightly different names, we will just refer to them as "the App" in this article. By the way, NVH is an industry standard term for Noise, Vibration and Harshness. The App currently measures vibration and harshness; noise measurements may come in the future.

This is a very sophisticated professional diagnostic app. This App incorporates all of the vibration diagnostic experience, knowledge and expertise I have accumulated over the last 27 years teaching vibration correction at Weber State University.

The App can help you diagnose the source of a vibration on almost any car, light truck or commercial truck. It can automatically tell you the exact type of vibration the vehicle is experiencing (there are at least 10 different types of vibrations on a typical vehicle) and will lead you to find the exact cause of the vibration by following step-by-step diagnostic and repair procedures. I have identified at least 276 different causes of vibrations on a typical vehicle.

I have had many people laugh at me in disbelief when I tell them we have identified 276 causes of vibrations. I ask them "What are you going to do when the typical repairs (balancing the tires and driveshaft) have already been performed and the vibration is still there?" At that point you typically have several options: 1) Search the internet for help; 2) Start replacing or swapping parts; 3) Admit defeat and send the customer to someone else; or 4) Try to get some help. This App is an excellent source of professional help; it is as close to having me in the shop helping you as you are going to get (unless you are one of my current students).



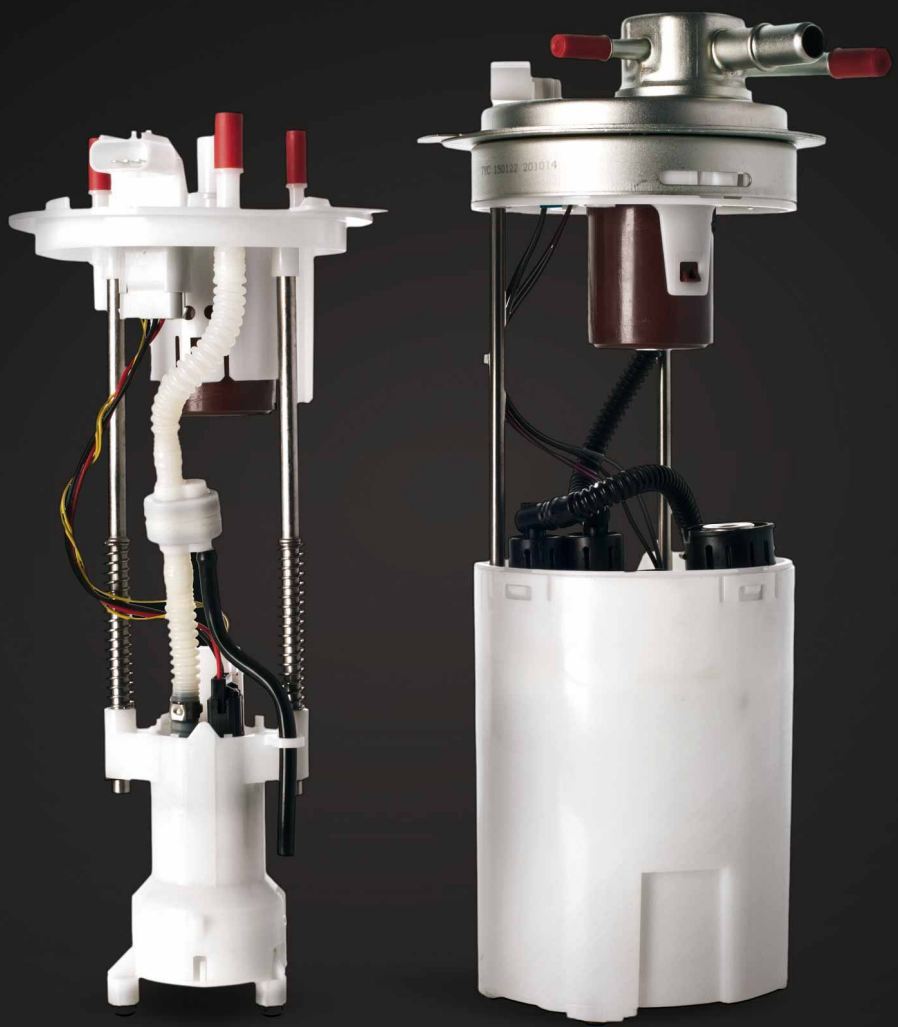
THE NEXT GENERATION IN VIBRATION DIAGNOSTIC TOOLS, the "NVH" app (Apple) and the "NVH for Android" app (Google).

MOUNTING OR PLACEMENT OF SMARTPHONE

Warning: Educational content!

Before discussing the automatic diagnostic capabilities of the App, we need to define three boring, but helpful-to-understand, technical terms:

Frequency: *The number of times per second or number of times per minute a vibration is detected.* The App uses Hertz (Hz) as the default unit of measure, but can be changed to cycles per minute (CPM) or RPM in the app settings. Any part on the vehicle that rotates can cause a vibration. Each of these parts has its own unique rotational



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speed. The App uses the vibration's frequency to identify the type of vibration.

Amplitude: *A measurement of how hard or harsh a vibration is.* The unit of measure is g-force (the force of gravity). Low amplitude vibrations usually cannot be felt or heard, while high amplitude vibrations can be heard, felt or both depending on the frequency of the vibration. Decreasing the amplitude of a vibration is the primary objective of any vibration repair procedure. The App uses amplitude to identify the harshness of the vibration.

Order: *The number of disturbances or shakes in one revolution of a rotating part.* Each order of vibration can only be caused by certain failures. For example: Anything that is out of balance will only cause a first order vibration. In other words, balancing a tire with a second order vibration is a waste of time. Understanding this concept can be very helpful when diagnosing the source of a vibration. Each rotating part on the vehicle can have many different orders of vibrations. Obviously, there are many rotating parts. The App uses the order to identify the type of vibration and to guide you to the correct repair procedures contained in the help file.

Four easy diagnostic steps

Now that we understand the technical terms, let's get back to the App. Using the App requires four easy steps.

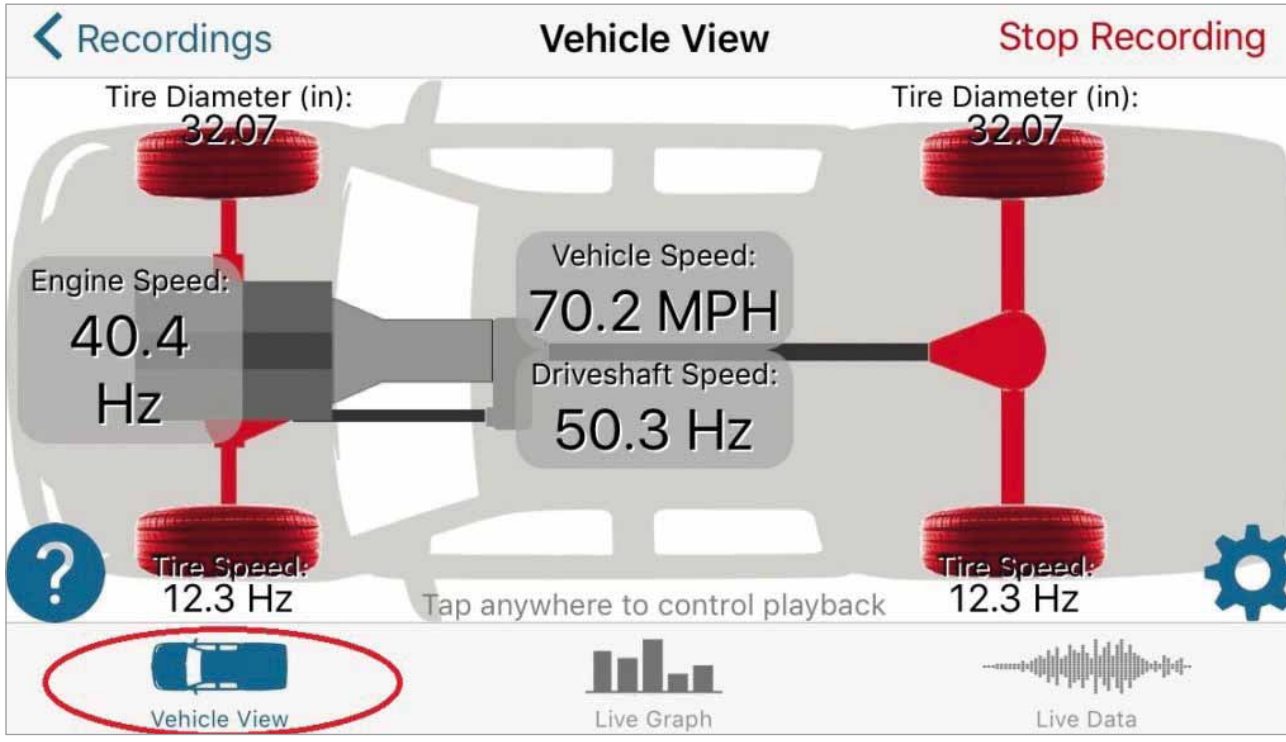
Step 1: Identify your vehicle. First, the App needs to know some technical information about your vehicle. The App uses that information to determine which vibrations to pay attention to and which to ignore. For example, we would not want to confuse evenly spaced joints in the road with a tire speed-related vibration. Determining which vibrations to pay attention to on each vehicle is a complicated process. Depending on the vehicle, the app will use up to 31 different pieces of vehicle data while performing vibration analysis.

There are two ways to identify your vehicle:

1. **Pick your vehicle.** The easiest method is to select "Pick Your Vehicle" from the main menu. The App will display a list of the top 28 vehicle manufacturers in North America. Just select your vehicle from the list, enter the tire size(s) and press "Start." The App has a built-in database of more than 12,400 vehicle configurations and is updated each summer with newly released models.
2. **Unlisted vehicle.** If your vehicle is not in the database, select "Unlisted Vehicle" from the main menu and supply your own vehicle information. This method works on any car or truck, including custom cars and hot rods. If you do not know your vehicle information, select "Find My Gear Ratios." Once you have entered the vehicle information, press "Start" to continue.

Step 2: Go for a test drive.

LEGAL STUFF: Distracted driving is a safety concern for all of us. The preferred way to use the App is to get another person to drive the vehicle while you observe the App. If you



THE VEHICLE VIEW

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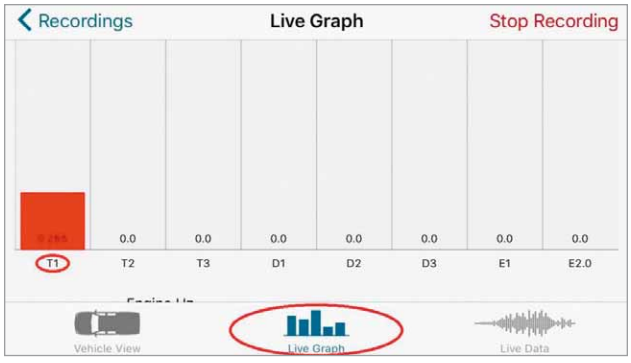
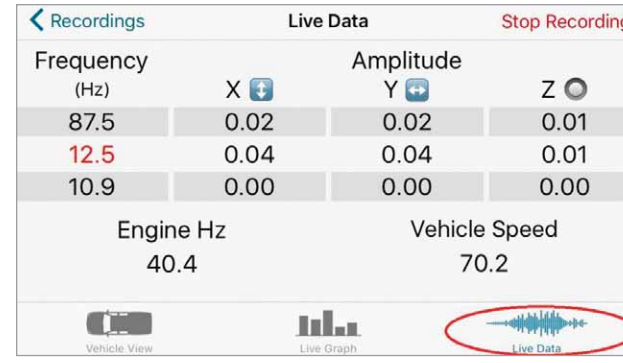


THE LIVE GRAPH VIEW



THE LIVE DATA VIEW

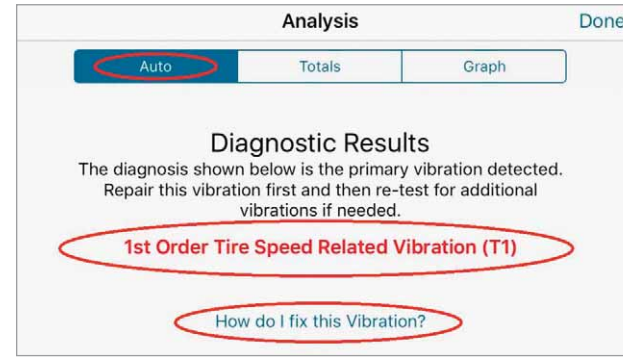
cannot get another driver, no need to worry, the app will record the entire road test for you to review when you get back to the shop.

The App is now ready to record and analyze vehicle vibration data. If you purchased the optional Kiwi3 (for cars and light trucks) or Nexiq (for commercial trucks) Bluetooth datalink adapter (to read engine RPM instead of having the App calculate it), plug it into the data link connector (DLC) under the instrument panel. Notice, you must pair the Nexiq Bluetooth adapter to your smartphone before it will communicate with the App. The Kiwi3 does not need to be paired — it just directly connects.

Next, press "Start Recording" and set or mount your smartphone on something solid in your vehicle like the dashboard, a window or a cup holder in the center console, and go drive the vehicle. The orientation of the smartphone does not matter because the internal three-axis sensors will detect vibrations in any orientation. While performing the test drive, bring the vehicle up to the speed where the vibration is the most noticeable and then hold a steady speed for a few minutes while the App gathers data. It is very important to hold a steady speed while the vibration is occurring.

If you are able to get another person to drive the vehicle, there are three screens you can observe while on the road test.

1. Vehicle View — This screen shows you an outline of the vehicle powertrain as you drive. Any parts with vibrations detected will glow red as you drive. Obviously, this will give you an indication of which parts are causing trouble. There are three different groups of rotating parts: tire speed-related parts; driveshaft speed-related parts; and engine speed-related parts.



DIAGNOSTIC RESULTS

2. Live Graph — This screen shows you a bar graph of the different types of vibrations on your vehicle. Each group of rotating parts is color-coded: red indicates tire-speed-related vibrations, blue indicates driveshaft-speed-related vibrations, and green indicates engine-speed-related vibrations. The taller the bars on the graph, the higher the amplitude (harshness) of the vibration. The tallest bar over the duration of the road test indicates the type of vibration the customer is most likely experiencing.

3. Live Data — This screen shows you four columns of data in table form. The first column shows the top three vibration frequencies arranged from highest amplitude in the top row to lowest amplitude in the third row. The next three columns show you data from the smartphone's three-axis accelerometer. The text on the live data screen is color coded with red indicating tire speed-related vibrations, blue indicating driveshaft speed-related vibrations, and green indicating engine speed-related vibrations. If you are an engineer concerned with which axis (direction) the vibration was coming from, you may like this screen. Most of the time, I do not use this screen unless I want to know the exact frequency of a particular vibration.

Step 3: View the automatic road test results. When you are satisfied that you have duplicated the vibration concern with the App recording, return to your shop, park the vehicle and press "Stop Recording." The App will take anywhere from a few seconds to a few minutes (longer recordings take more time) to analyze the data recorded on your road test. When the analysis is complete, the App will automatically display the "Diagnostic Results" identifying the primary type of vibration detected. The primary vibration is the one that had the

highest average amplitude (harshness) over the entire length of the road test.

If you want to see even more details of the analysis, select the "Totals" button and the App will show you the number of times each type of vibration was detected on your road test. This is sort of like an engine misfire counter, except these counts are for vibrations detected. In the example below, you can see that the first order Tire-Speed-Related Vibration was detected 226 times during the duration of the recording.

If you want to see even more details, select any one of the types of detected vibrations to see the number of counts broken down by vehicle speed in 5 mph increments. In the example above, you can see the first order Tire-Speed-Related Vibration was detected 146 times from 65 mph to 69 mph.

Step 4: Follow the diagnostic procedures. As we discussed at the start of this article, you cannot correct a vibration concern without first diagnosing the source. In the previous step, the App identified the type of vibration the vehicle was experiencing, so you are now a lot closer to finding the source of the vibration. Equally important, you also know what types of vibrations the vehicle is NOT experiencing; every other type of vibration on the vehicle has now been eliminated.

What you may not know is that each type of vibration is only caused by specific malfunctions or adjustments that are out of specification. The App contains detailed diagnostic and repair procedures and information for all 276 possible causes of vibrations I mentioned earlier.

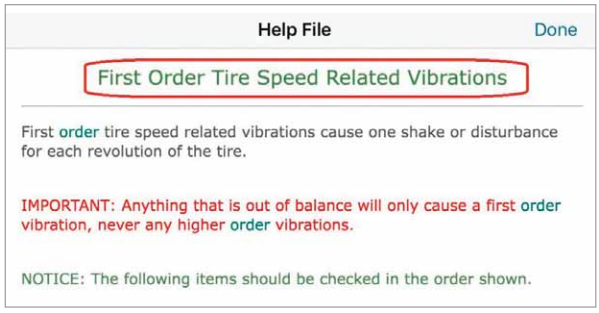
Vibration type example: As you may know, the most common type of vibration on any vehicle is a first order tire speed-related vibration (T1). This type of vibration causes one shake per revolution of the tire. There are at least 9 other types of vibrations on a typical vehicle.

Vibration cause example: Think of the number of items that rotate at the same speed as the tire. We have identified 77 items or conditions that can cause a first order tire speed-related vibration. An out-of-balance tire is only one of the 77 possible causes.

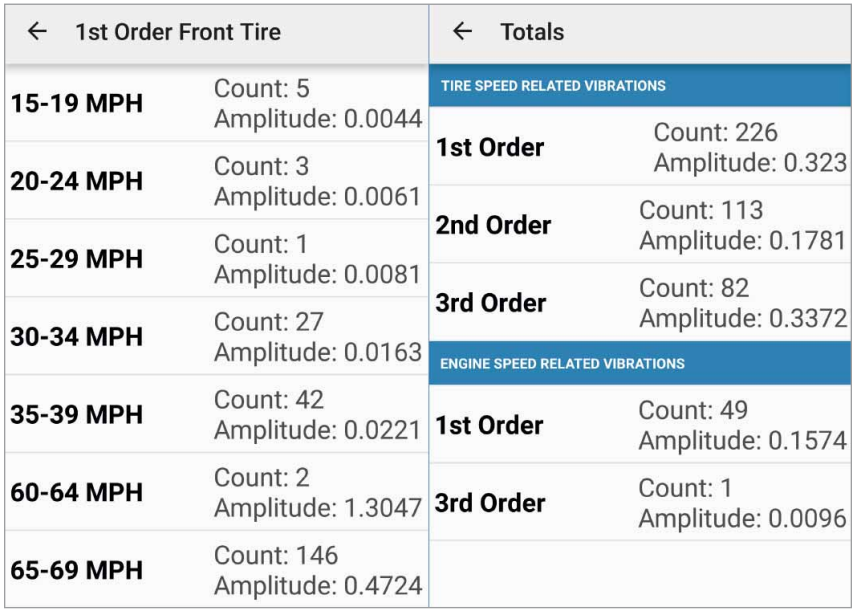
To access the diagnostic procedures for the type of vibration identified by the App, select "How do I fix this Vibration?" at the bottom of the Analysis screen.

The App will open a specific help file with a list of step-by-step diagnostic procedures for the type of vibration identified by the App. This list of procedures is arranged in order from the most likely cause to the least likely cause. The help file also includes hundreds of photographs of diagnostic procedures as well as detailed videos of common diagnostic procedures.

From this point forward, you just follow the step-by-step diagnostic procedures outlined in the App until you find anything that is out of specification or found to be defective. Make the appropriate repair and repeat the road test procedure with the App again. This is a process of elimination, but it is based upon proven diagnostic procedures I have successfully used and fine-tuned for many years. This App is the next generation NVH diagnostic tool, and now you can always have it within an arm's reach at a moment's notice. Best wishes!



STEP-BY-STEP PROCEDURES



COUNTS AND COUNTS AT VEHICLE SPEEDS

JOHN D. KELLY is a professor of automotive technology at Weber State University in Ogden, Utah, and a former technician. He specializes in automatic and manual drivetrain and NVH diagnosis and hybrid and electric vehicle technology.
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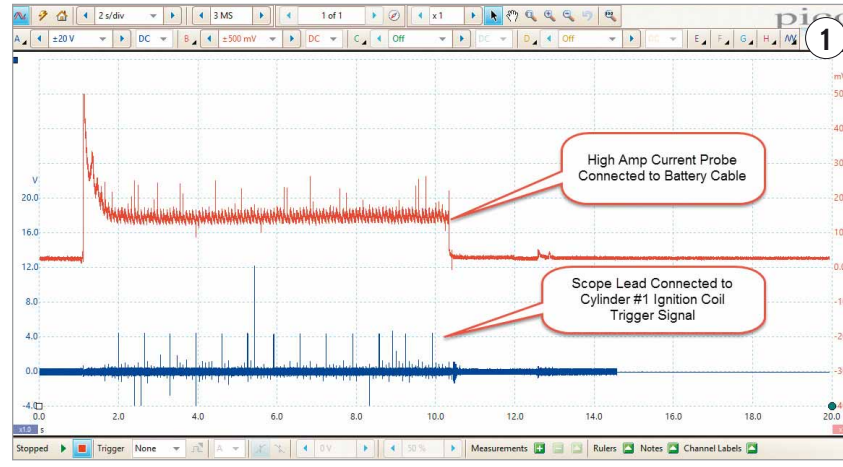
ENGINE MECHANICAL TESTING: GOOD, BETTER AND BEST

WITH INCREASING ENGINE COMPLEXITY, THE NEED TO QUICKLY DETERMINE IF AN ENGINE IS MECHANICALLY SOUND HAS NEVER BEEN MORE IMPORTANT

SCOT MANNA // Contributing Editor

In this first of two articles on engine mechanical testing, we will introduce two fundamental engine mechanical tests that will be performed with electronic tools. This first test is the relative compression test performed with a scope and high amp current probe. The second is the cranking vacuum test performed with a scope and pressure transducer. In the next article, we will look into the engine with in-cylinder pressure transducer testing.

Let's look into the fundamental tests that have traditionally been performed to determine engine mechanical condition to see how times are changing. For decades, technicians have used vacuum gauges to measure intake manifold vacuum to help determine engine-sealing issues. If there was a cylinder power contribution problem suspected, the compression gauge and cylinder leakage gauge were used to determine the root cause of failure. The shortcomings of analog vacuum gauges are their inability to pinpoint a cylinder-specific problem. A vacuum gauge measures the average vacuum inside the intake manifold, and some gauges are so damped they may mask a valve sealing problem. A scope and pressure transducer will display individual cylinder vacuum "pulls" or vacuum events, so more detailed analysis is possible. As engines have evolved, more elaborate intake manifold designs have been incorporated on V-style engines, which can make access to spark plugs difficult and thereby render gauge-style cylinder compression testing a last resort. There must be an easier way to determine base engine mechanical health. The good news is that there is a simple yet powerful mechanical test: the relative compression test. The relative compression test is not new; big-box engine analyzers performed cranking and running tests and used input from a current clamp around the battery cable to ferret out base engine mechanical problems. These large analyzers are all but gone in most shops, and many younger technicians have never seen one used at all. Many shops today have high-quality digital storage oscilloscopes available and by adding a few inexpensive probes, the scope will do a great job at displaying relative compression tests.

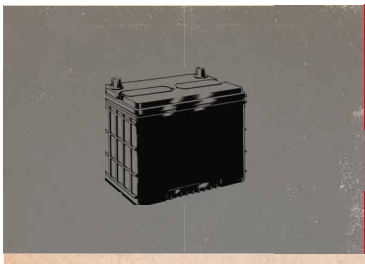


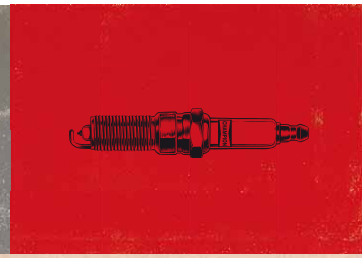
RELATIVE COMPRESSION TEST from a 2012 Chevrolet Suburban, 5.3 V8 engine. The engine was cranked over for 9 seconds.

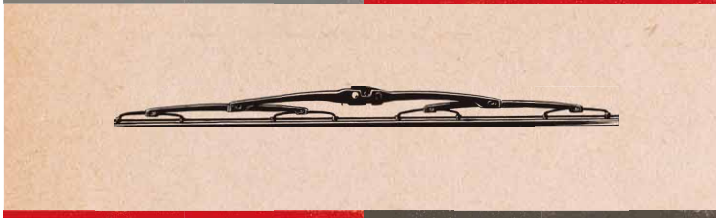
Inside relative compression

Let's start with some basic theory and

PHOTOS: SCOT MANNA







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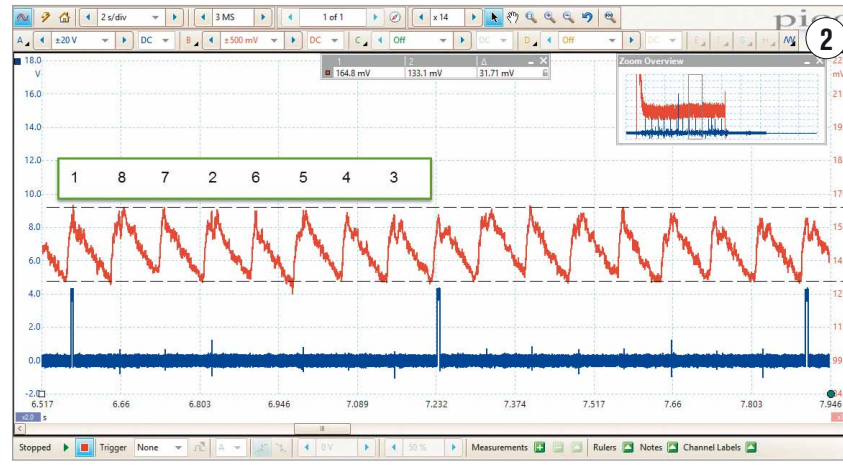
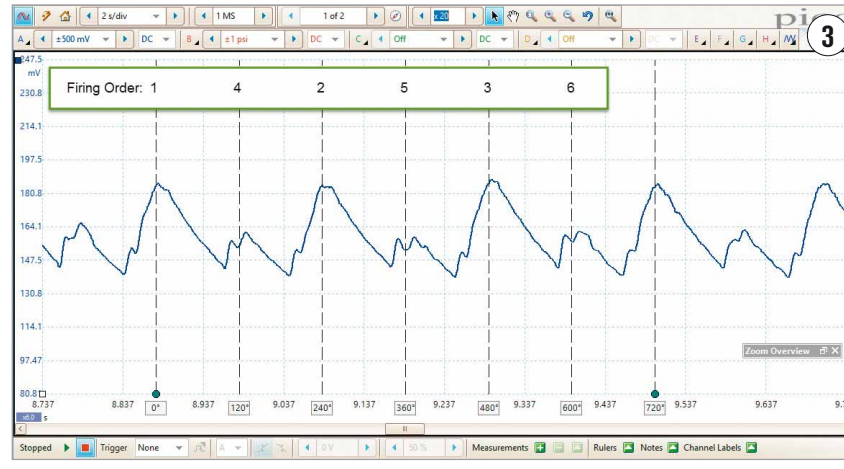
build on how this test will expand your diagnostic capabilities. A relative compression test relies on the fact that as a starter motor turns over a normal engine, as each cylinder is pushed to top dead center on the compression stroke, the force required to compress the trapped air increases and hence the current required by the starter motor to overcome this force increases as well. An old-style analog battery/starting/charging system tester would show the ammeter needle wavering during a cranking test, so we know the current is varying in the circuit. A scope and good high-amp current probe is so fast that this changing current can be displayed on the scope. I will mention here that if the current to the starter motor is oscillating, the voltage in the circuit changes as well. It is possible to do a simple voltage test at a battery-positive voltage point and ground with a scope and see this voltage oscillation during cranking, but the current probe will give a clearer picture and will be used as the test tool of choice for this article. When you perform this test, it may be done either synced or un-synced, meaning you can add a second scope channel to an ignition trigger signal so that individual cylinders can be identified. If the engine has spark plug wires, you may need a sync probe for your scope to trigger from a specific cylinder. Sync probes are inexpensive and readily available. Let's look at a normal relative compression test and point out the basics of how to use the test for engine diagnostics.

The first waveform (Figure 1) shows a good relative compression waveform captured from a Chevy Suburban with the raw scope settings I used during the test. The scope is set to a slow time-base, and the entire test is captured. A Pico scope has very good zoom capabilities, so the capture will be manipulated to show much greater detail for the analysis. If you use a scope such as a Snap-on product, you will want to perform this test at a faster time-base and then use the zoom out function to look at the entire test. The Pico scope was set to two seconds per division, but a Snap-on scope setting for this test may be 50 milliseconds per division and then let the scope buffer fill up. This capture is a synced relative compression test because the ignition-firing event was captured. If you only use a current probe or do a battery voltage test without the ignition trigger, you can see a problem, but you would not be able to identify a particular cylinder, so you may as well just get used to connecting two leads and do synced tests. The next waveform is the same capture but with heavy manipulation of the stored patterns for better viewing.



KNOWN GOOD SYNCED RELATIVE COMPRESSION WAVEFORM. The current waveform in red shows a peak to valley amplitude of 31 amps, which is okay.



THIS UN-SYNCED RELATIVE COMPRESSION WAVEFORM was captured on a 1998 Ford Explorer with a 4.0 VIN E engine. The timing chain had jumped on bank 2, causing low compression on that side of the engine.

In Figure 2, the original capture has been zoomed in, filtered and annotated to show the engine firing order. There is a lot of data on the screen to be analyzed. Most techs are generally looking for a low current event and not much else, but there are many items to discuss about these captures. The first item to discuss is the current waveform in red. The saw tooth pattern is what we should see and each peak represents

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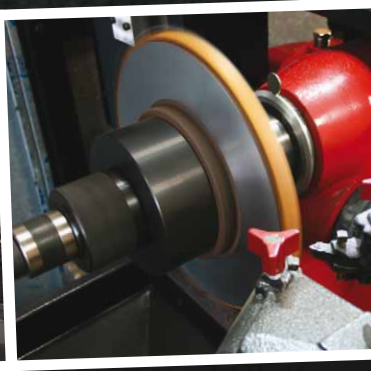

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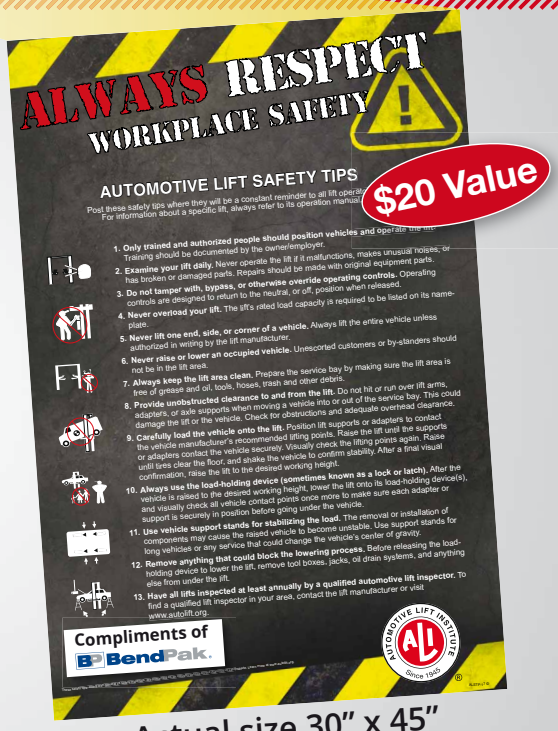

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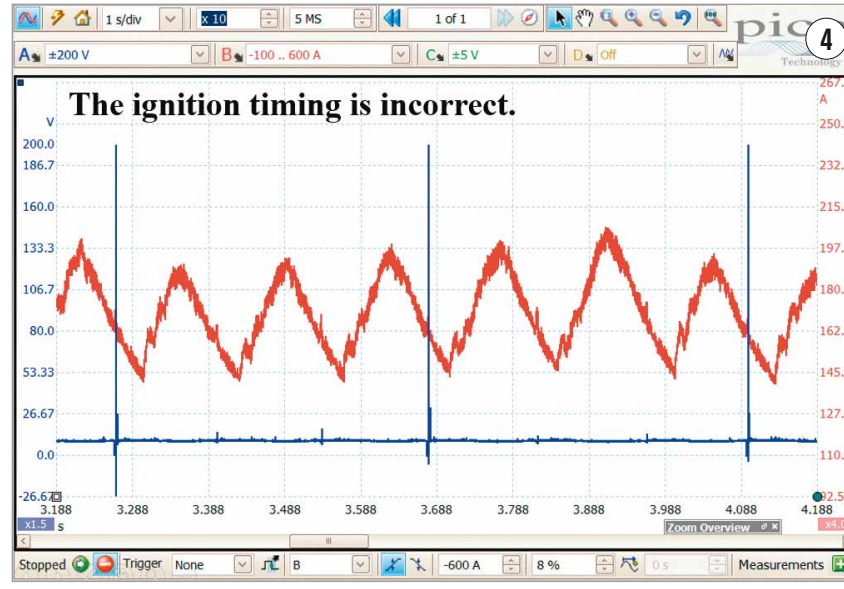
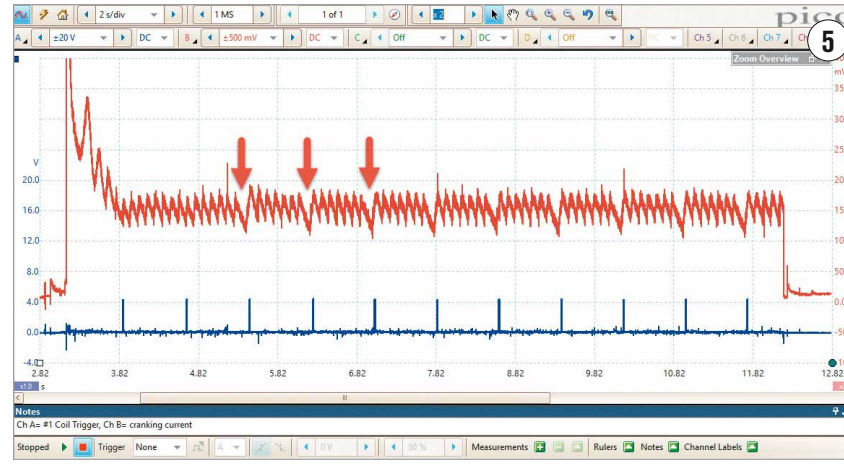
a piston reaching TDC as the starter current increases to push the piston to TDC and past, then the current drops quickly until the next cylinder in the firing order comes up on TDC. This is a "relative" compression test so it only displays each cylinder relative to the other cylinders in the engine — it is not an actual compression value. If all the cylinders have too much or too little compression, the overall test may look normal. If the engine had a valve timing problem causing high or low compression, it would affect all the cylinders unless the engine were an OHC V-style and the valve timing was off on only one side. In that case, you could have three or four high peaks and three or four lower peaks, as shown in Figure 3, depending on the number of cylinders in the engine, and the test would point you in the direction of valve timing right away. Normal relative compression waveforms typically show a peak to valley current between about 30 to 70 amps. If the current is too low, suspect an engine with low overall compression and do a cylinder compression test to verify. If a chain jumped on one side of a Ford 4.6 or 5.4 V8, think of how quickly this test would lead you to verify camshaft timing.

The next important item in the known-good synced relative compression waveform is the location of the ignition pulse in comparison to the current waveform. A typical engine cranks with ignition timing very close to TDC, sometimes slightly ahead or possibly slightly retarded if the engine uses a catalyst heating strategy. Most technicians do not have a go-to test to verify proper ignition timing if a vehicle is a cranking no-start, but a synced relative compression test will help verify good ignition timing on late-model vehicles with no timing marks. As seen in the known-good synced waveform (Figure 1), the ignition trigger pulse lines

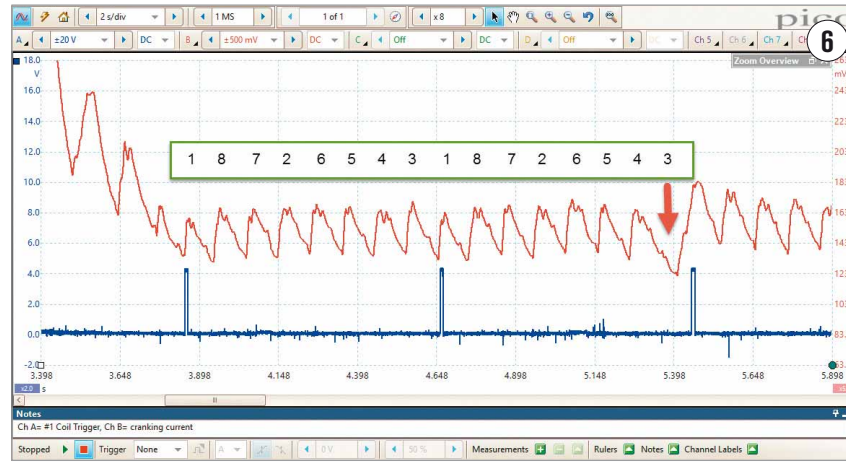


THIS SYNCED RELATIVE COMPRESSION TEST from a 2002 Ford Escape 3.0 shows very retarded spark timing causing a no-start condition. The engine cranks in DIS mode, so two firing events are seen in 720 degrees. The crankshaft sensor trigger wheel has two keyway slots, and the wheel was installed in the wrong slot.

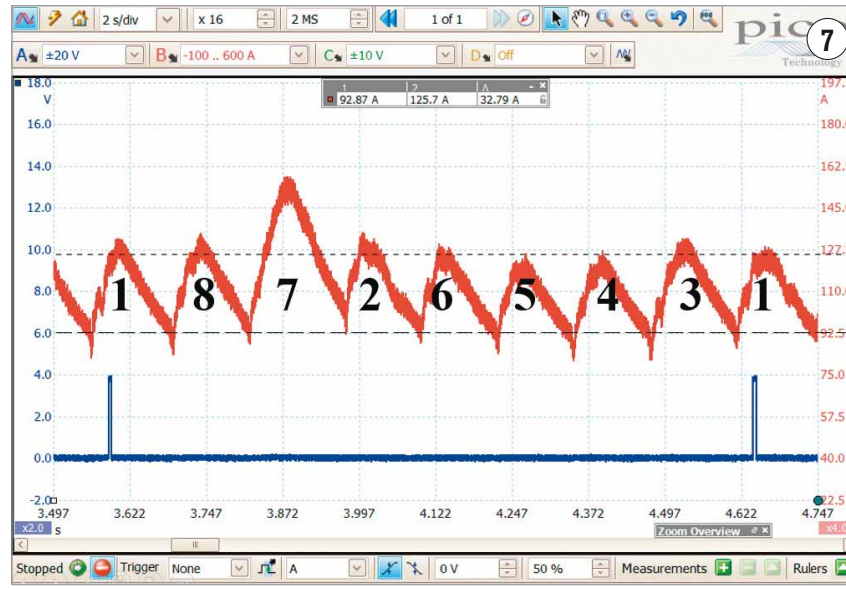


RELATIVE COMPRESSION WAVEFORM from a 2005 GMC, 6.0 V8, showing a normal pattern at the beginning, but a problem occurring as the test continvues. The arrow shows a loss of compression that repeats for the rest of the test.

up with a current peak, which we will consider cylinder #1, indicating good spark timing. Compare that to Figure 4, where the timing is obviously incorrect. The only caveat here is if the engine has a distributor and the distributor is installed incorrectly, this ignition pulse could occur in sync to a current pulse, but the pulse is not cylinder #1. An in-cylinder compression waveform would uncover this problem and will be covered in the next article. Keep in mind that if cylinder #1 is not accessible due to intake manifold design you can always use the sister cylinder to #1 as your ignition sync input, which will be on the other bank of the engine. Also consider that when performing this test, you will need to prevent the engine from starting. Do not disable the ignition system if you are triggering off a spark event. Remove power to the fuel pump or injectors when performing a synced relative compression test.



THE ZOOM IN OF THE 2005 GMC capture shows cylinder #3 changing from good compression to no compression as the engine turned over.



RELATIVE COMPRESSION WAVEFORM FROM A 2009 PONTIAC G8. Note the high current seen on cylinder #7. This indicates there is increased effort needed by the starter to push cylinder #7 to TDC on its compression stroke.

BROKEN EXHAUST VALVE SPRING ON 2005 GMC YUKON. This was found in less than five minutes of testing with a relative compression test after several days of testing and parts swapping by other technicians.

When it's wrong

When viewing a relative compression test on an engine with low compression in one cylinder, the problem will be fairly obvious; there will be a low or missing peak depending on how low the compression is. Typically, the cylinder following a low compression cylinder will have a slightly higher peak due to the starter speeding up when the low compression cylinder pushes past TDC and then slows down when the next cylinder with good compression comes up to TDC. The next two waveforms

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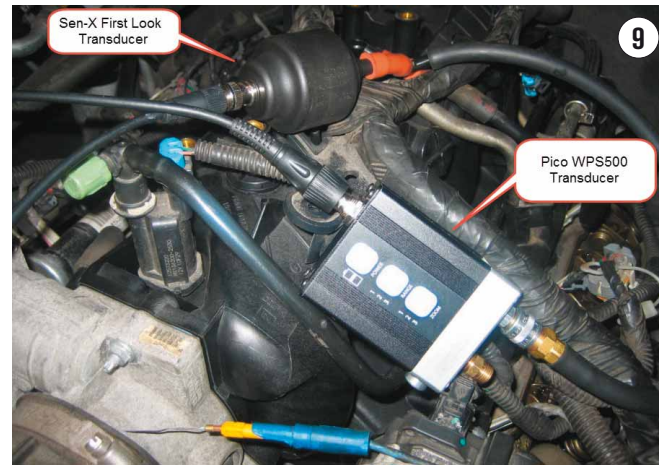
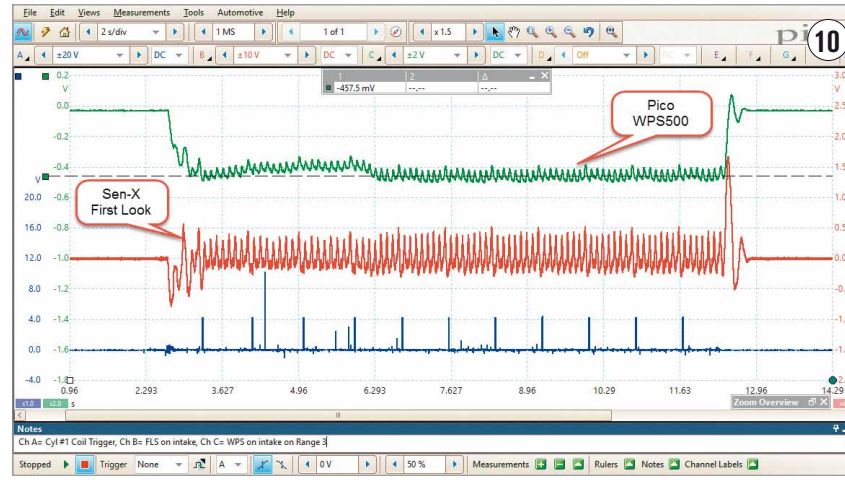
(Figures 5 and 6) were captured from a 2005 GMC Yukon with a rough-running, low-power complaint that was diagnosed as a bad catalytic converter at a GM dealer. As the relative compression test displays, the first 4-stroke cycle showed good compression, but then the #3 cylinder lost all compression as the engine continued to rotate. The first cycle proves the cylinder can seal and a gauge-style compression test was done at the dealer and the tech saw good compression on the gauge, but the gauge captures pressure due to the Schrader valve in a compression test hose. As the engine rotates, the cylinder seal is lost. This can only be a mechanical problem, most likely caused by a valve sealing issue due to the complete lack of compression pressure seen on the relative compression waveform. A broken valve spring was suspected and confirmed when the valve cover was removed; the exhaust valve spring was broken (Figure 8).

Sometimes it may not be a low or missing current event that is seen while performing a relative compression test; sometimes it may be the opposite. The next waveform capture (Figure 7) is from a 2008 Pontiac G8 with a 6.0 V8 with GM's AFM (Active Fuel Management) system, which can cancel four cylinders during light-load operation. The engine is logging a cylinder #4 misfire code and this is an AFM cylinder. A synced relative compression test was performed. The waveform shows almost twice the level of current needed to push cylinder #7 to TDC on the compression stroke. Can one cylinder have higher compression than the rest without a high domed piston or longer connecting rod? Not possible or likely, unless an engine builder is playing games. This is not a carbon issue either, as the current is double the other cylinders.

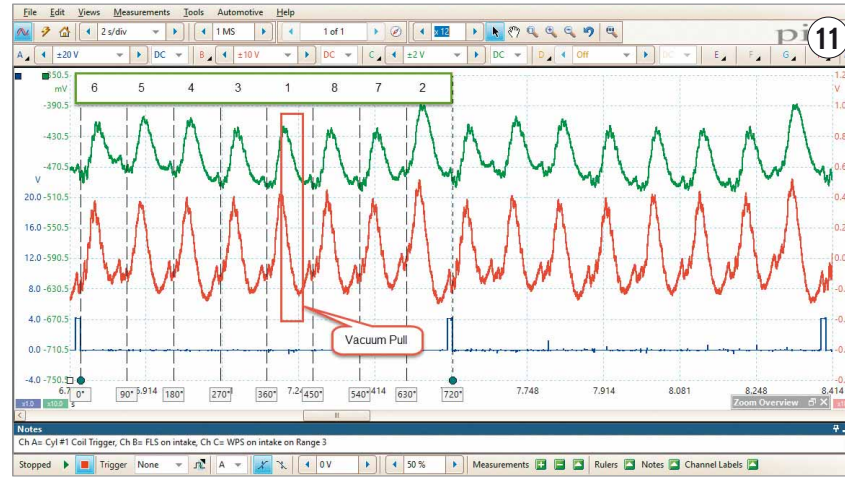
The problem is easily explained:



CONNECTING PRESSURE/VACUUM TRANSDUCERS TO A GM V8 ENGINE to perform a cranking vacuum test. Connecting to a centrally located vacuum port and keeping your hoses short will produce the best test results.



CRANKING VACUUM WAVEFORM WITH BOTH A PICO TRANSDUCER and a First Look transducer connected to the same test port. Note the Pico waveform pulls down from zero volts due to it being an absolute pressure transducer, while the First Look transducer's signal oscillates above and below the zero voltage reference. Both transducers display vacuum events or pulls.



THIS CRANKING VACUUM WAVEFORM FROM A 2005 GMC YUKON, 6.0 V8 IS CONSIDERED GOOD. The individual cylinder vacuum events are labeled. There should be the same number of vacuum pulls as the number of cylinders, and they should be relatively even.

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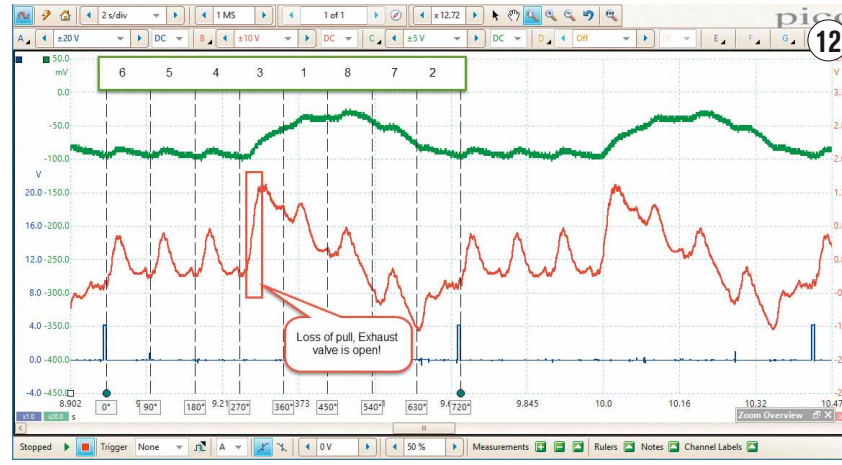
there are two cylinders on compression at the same time, #7 and its sister cylinder #4. The exhaust lifter has collapsed on cylinder #4, so when it should be on its exhaust stroke with the valve open, the valve is closed and both cylinders are compressing air, hence the misfire code for cylinder #4 and the high current event on the sister cylinder #7. It should be clear by now the importance and capabilities of this simple yet effective mechanical test.

"Seeing" cranking vacuum

The second test mentioned was cranking vacuum. To perform this test, a pressure transducer will be required, and there are two types. Absolute pressure transducers like the Pico WPS500, shown in Figure 9, can measure both actual vacuum levels and display what are called vacuum events or pulls created by each cylinder in the engine. There are also differential pressure transducers like the Sen-X Technologies First Look sensor. This transducer displays the change in vacuum or pressure seen by the sensor and not the actual level, but it is very sensitive and well suited to this particular test. Figure 10 shows both sensors connected to the same port and you can make your own decision if you want one or both. There are other companies making high-quality vacuum transducers; I am only mentioning units I have personal experience with. Whatever brand and style transducer you use is not important, only that you actually own them and perform the test.

As with the relative compression test, the cranking vacuum test should produce a clean, oscillating pattern with good uniformity. Again, it is important to identify which signal event is created by which cylinder in the engine, so I will illustrate the procedure in a captured waveform. There will be a vacuum event every 180 degrees in a four-cylinder engine, every 120 degrees in a six, and every 90 degrees



BAD CRANKING VACUUM WAVEFORM from broken exhaust valve spring on cylinder #3.

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in an eight-cylinder engine. A vacuum stroke occurs 360 degrees after the cylinder fires on the power stroke, so you need to capture an ignition event when performing a cranking vacuum test to properly identify the events on the screen. In the annotated waveform shown (Figure 11), I have used rotation rulers found in the Pico scope software to break up the waveform into eight evenly spaced intake events. The numbering order on top is the firing order, but it is overlaid on the vacuum events, not the ignition event. The vacuum pull happens 360 degrees after the ignition coil firing signal.

Once you capture a cranking vacuum waveform and ID the events, you can begin to make conclusions on what you see relative to the problem on the vehicle. Remember we are looking at mechanical engine sealing with electronic tools, so keep in mind what could go wrong in an engine when analyzing an abnormal pattern. Valve leakage, valve timing, ring sealing and intake or exhaust path restrictions can all have an effect on these patterns. The 2005 Yukon with the broken exhaust valve spring was tested with cranking vacuum. The pattern in Figure 12 shows the effect of the sticking open exhaust valve on cranking vacuum.

When this pattern is looked at by itself, it is difficult to say the problem is a broken exhaust valve spring, but it is easy to see there is a problem with the engine and the problem is mechanical! When the intake valve opens on cylinder #3's intake stroke, there is a loss of vacuum in the engine; the top Pico trace shows this because it is an absolute pressure transducer. Both transducers are momentarily connected to the exhaust manifold through the open intake valve in cylinder #3 and the First Look sensor clearly shows a pressure rise as exhaust pressure connects to the intake manifold when the intake valve opens. This is only the beginning of what can be seen when pressure transducers are connected to the engine. We will continue the discussion in the next article with in-cylinder pressure testing. Once you add these tests together on the same scope screen, the operation of the internal combustion engine becomes much clearer. I am sure you will not be disappointed if you acquire the necessary tools and begin using these tests in your diagnostic routine. Practice is important and testing good engines first should be a priority. Remember, an engine can only operate properly if its base mechanical condition is good! The quicker you can determine this, the better. Best of luck!

SCOT MANNA is the owner of MB Automotive Inc. He is a contract trainer for the State of Illinois Emission Program, WORLDPAC and Autowares. He is ASE Master Certified with L-1 and L-2.
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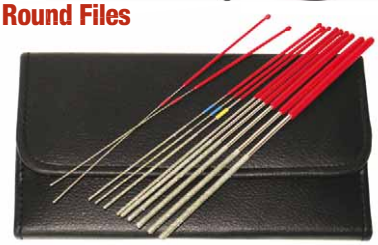

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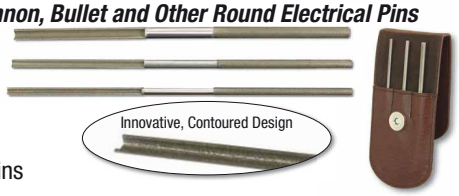

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SECURING THE CONNECTED CAR

CONNECTED CARS ARE AN INTEGRAL PART OF OUR DIGITAL LIFESTYLE, BUT IS THE DATA THEY GENERATE SECURE?

TRACY MARTIN // Contributing Editor

Imagine driving along and your refrigerator sends a message to your connected car letting you know that you are out of milk. The car's onboard GPS automatically directs you to the nearest grocery store. But cyber criminals, parked across the street from your house, have hacked your home WiFi network and now have access to your car's computer. You receive a message on the car's display telling you, "Looks like you're on your way to get some milk. I will shut the engine off unless you pay a ransom — follow the prompts to pay now."

Sound too creepy to be true? As dis-

GENERAL MOTORS PRODUCED the first connected cars in 1996 with OnStar for Cadillac DeVille, Seville and Eldorado models. Today connected vehicles are common and the sheer number of things they connect to is increasing at a rapid rate.

PHOTOS: TRACY MARTIN

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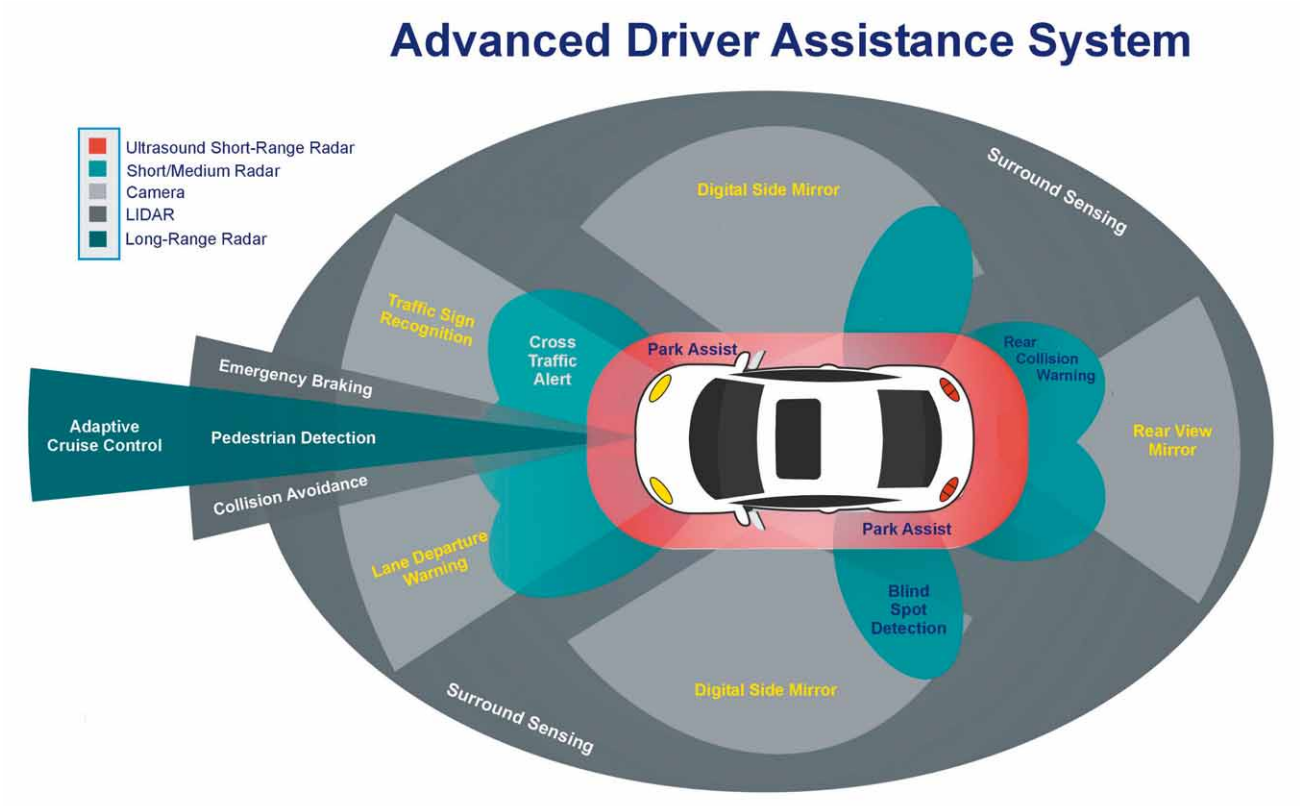
turbing as this scenario is, it could actually happen. As more vehicles become digitally connected, securing networks and vehicle cybersecurity is not an issue for the future — it's a problem now that affects independent repair shops. The telematics technology component of a typical shop's daily workload will continue to increase, and they must be aware of, and adapt to, this constantly changing cyber environment by securing their networks to protect themselves and their customers from cyber hacking.

Vehicle telematics affects many components. For example, a simple windshield repair that normally would take an hour is further complicated by the presence of a vehicle's Advanced Driver Assistance System (ADAS). The ADAS windshield, equipped with sensors and a system camera, may take another hour to calibrate and could require access to the onboard computer or OEM's computer network. In addition, pre- and post-repair scan procedures may be required to perform the repair. ADAS systems from Audi/VW, Fiat Chrysler, Ford, Nissan and others require a programming reset after replacement of windshields, wheel alignment adjustments and repair of other components. Knowing how to calibrate a vehicle's ADAS isn't just a safety concern, but a cyber safety concern. If a shop's network isn't secure, it could lead to a cybersecurity breach impacting customers.

In addition to the growing presence of ADAS, another major concern is the diagnostic reports generated from aftermarket OBD-II interface adapters. This market is becoming a rapidly growing player in the telematics industry, and OBD-II connections between repair shops and customer's vehicles are another avenue for cyber attacks to occur. In the near future, the issue of automotive cybersecurity will become paramount as connected, self-driving vehicles will offer consumers unprecedented new options related to personal transportation. Risks range from access to the vehicle owner, driver or passenger's personal and financial information to loss of physical control of the vehicle.

Is your network secure?

In the future, independent repair facilities that plan to perform extensive diagnostic work or vehicle reprogramming will have to address network concerns and partner with OEM and third parties to provide cybersecurity. Shops will have to engage with cybersecurity experts and consultants to evaluate their networks, ensuring that they and their



ADVANCED DRIVER ASSIST SYSTEMS from Audi/VW, Fiat Chrysler, Ford, Nissan and others require a programming reset after replacement of windshields and other components. When performing a reset, repair shops that are not cybersecurity aware can unwittingly provide criminals access to networks and data.

customers are protected. Cybersecurity could include customer-accessed WiFi in the waiting room, separate WiFi in the shop work area, servers, worldwide internet connections and data stored in the cloud. Some owners of small repair shops are of the mindset that cybersecurity only applies to large repair chains or OEM dealerships, but the possibility of a cyberattack affects everyone.

The Automotive Service Association is actively exploring how to "lock down" aftermarket service and repair facilities from potential cyberattacks that can originate from digital resources the shop connects to including: online diagnostic services, customer vehicles via connections to shop diagnostics tools, customers using WiFi in waiting rooms, employee smartphones and others. Repair shops cannot afford to be the weakest link in the chain that makes up automotive cybersecurity.

Automotive cybersecurity is an ongoing war against criminals who have access to data and new tools over the life of any vehicle. Unfortunately, there are many examples of digital breaches, including radio amplification of keyless vehicle entry systems, remotely controlling key encryption and using pirated software to exploit vulnerabilities in security systems. Motivations for criminals to hack automotive systems are numerous. Lifting personal information from payment systems, taking control over vehicle functions, accessing data from onboard sensors and using a vehicle as a gateway to access other connected systems are but a few of these temptations.

In May 2017, the ransomware crypto-worm WannaCry was launched against several versions of Microsoft Windows operating systems. Ransomware criminals compromise a computer's data and demand ransom payments to release the data back to the user. During the attack, automakers Honda, Renault and Nissan had to temporarily shut down vehicle production lines at plants in Britain, France, Japan and India. Think that this type of attack can't affect a small shop? Think again. Imagine a customer driving a connected car receiving a pop-up message that states, "Pay me $600 or you won't be using your car for a while." Or, a scan tool in a shop displaying a similar message —"Trying to connect with this Ford F-150? Pay up or it's not going to happen."

Here is a quote from Olivier Rabiller, Honeywell Transportation Systems president and CEO, which illustrates the urgency of becoming cybersecurity aware: "There are more than a dozen clearly defined attack surfaces that can provide points of entry for hacking into a passenger vehicle, and the number is growing fast. We are supporting our OEM customers with our differentiated software platform to address the cybersecurity challenge inherent to connected and autonomous vehicle development."

AUTOMOTIVE CYBERSECURITY IS AN ONGOING WAR against criminals who have the motivation, knowledge and tools to access data from connected vehicles. The automotive service industry needs to develop a culture that places great importance on software, networks and computer security.

Automotive cybersecurity standards

Performing vehicle diagnostics is essential for nearly every service and repair, and the independent repair industry has relied on aftermarket scan tool manufacturers to provide them the means to accomplish these tasks. In fact, scan tool companies often create some of the best diagnostic software — sometimes more functional than OEM software and hardware. Aftermarket companies that develop scan tools, and their diagnostic capabilities, have in many cases used reverse engineering of OEM vehicle computer systems and software to produce the computer code for their diagnostic software. With OEMs becoming more cybersecurity aware, the ability to use this practice will become more difficult, if not impossible in the future. The importance of receiving complete and accurate data and diagnostic routines from OEMs to create this software is a benefit to both the OEM and the aftermarket and will be an important part of future cybersecurity.

If you're of a certain age, you may remember when labels like, "Made in Japan" or "Made in the USA" made a difference to consumers. Today, a vehicle sold in the U.S. could have components that were designed in Germany or France, with parts manufactured in Mexico or Austria and all assembled in Japan. Globalization of the automobile industry is possible because of international global standards that these countries adopted so part "A" made in one country will fit into part "B" made across the world. Having global standards for automotive cybersecurity is no different than standards used for other components. Creating international standards will be a partnership between OEMs, their suppliers, aftermarket scan tool manufacturers, providers of repair information and data, and the independent repair industry.

The Society of Automotive Engineers (SAE) and the International Organization for Standardization (ISO) have been working closely to develop and harmonize cybersecurity standards. They have formed a joint working group intended to house experts from both organizations to work together to develop international, joint SAE-ISO standards. When adopted, the standard for secure, authorized access to vehicle data, by legitimate stakeholders, will change how diagnostics are performed in the industry. For example, the 30-year-plus OBD-II Assembly Line Data Link (ALDL) has outlived its originally designed intent as a port to access onboard computer diagnostics and check emissions. As it exists, the ALDL is now a potential gateway for vehicle security breaches, and organizations are considering ways to harden and/or replace it.

TRYING TO CONNECT MY SCAN TOOL and I can't find the ALDL. According to ASE, it should be located in the driver's side foot-well, no higher than the bottom of the point where the steering column exits the instrument panel. It's got to be here somewhere — cutting-edge automotive technology can be frustrating!

Other examples of cybersecurity standards could include Secure Vehicle Interface protocols that require a hierarchy of permissions to gain access to data and the Extended Vehicle concept. The Extended Vehicle concept provides safe and secure third-party access to vehicle data by means of a remote and secure server. Access to vehicle data is only provided in accordance with clearly defined data protection security protocols through a set of rules governing data interfaces, thereby reducing security and liability risks. To ensure worldwide interoperability, these interfaces must be standardized. An ISO standard (20077-1) is being developed and is known as the "Extended Vehicle" concept that consists of a vehicle with external software and hardware that is ultimately developed, implemented and managed by OEMs.

The SAE has published the world's first automotive security standard — J3061 — that would serve as the foundation for automotive cybersecurity. J3061 provides guidance on how to integrate best practices including: building security into the product development lifecycle, establishing desired relationships between cybersecurity and safety, and establishing a foundation for further security standards development. Future standards will impact legislation on the federal level. "We're on the cusp of a transformation, and the auto industry is at the front of that transformation. We can't make the mistake again of not building in cybersecurity by design on the front end and preventing espionage or loss of life," said John Carlin, Assistant Attorney General for National Security at the U.S. Department of Justice.

Right to repair

Today a vehicle's onboard computers have control over vital systems like brakes, ignition keys, airbags, steering and more, and their diagnosis and repair are high-tech operations with diagnostic tools often replacing a technician's observation. These ongoing developments have made OEMs the gatekeepers of advanced information necessary to repair or supply parts for repairs. Right to Repair (R2R) is the name for related

federal or state laws that require automobile manufacturers to provide the same information to independent repair shops as they do for their network of dealerships. R2R has implications for automotive cybersecurity as well.

R2R reached an important compliance juncture in 2018. As of model year 2018 (MY2018), all vehicles and resources, with the exception of "recall" tools, must be compliant with the Massachusetts Memorandum of Understanding. Massachusetts was the state that adopted the first Right to Repair bill in 2012. OEM diagnostic systems must be made available to anyone for a reasonable price, at the same "content level" that dealerships have using a "Pass-Thru" interface developed by the SAE or ISO. Scan tool data must be available via a license and vehicle immobilizer programming also made available.

R2R and future automotive cybersecurity industry standards illustrate the importance of the partnership between OEMs and the independent service and tool/equipment providers. This relationship is unique compared to other industries, as both are working toward the same goal: to give customers a great service experience and keep them loyal to OEM and repair shop branding.

The Transportation Security Administration (TSA) has a mantra regarding aircraft security: "TSA has to get it right every single time. Terrorists only have to get it right once." And the same is true of cybersecurity — attackers only have to be right once, whereas defenders have to be right all the time. This does not imply that hacking is easy, but it does illustrate how massive the task is of defending the automotive industry from cyberattacks. As vehicles become more software defined with the increased use of telematics, advanced safety systems, connected transportation and autonomous driving, expect complex encryption protocols to become the primary defense mechanism. The connected automobiles of today have around 100 million lines of embedded software code. Self-driving cars within the next 10 years will have more than 500 million lines of code. That's a lot of risk exposure to defend for an industry that has little or no history and culture of cybersecurity. Only time will tell if we are successful in this endeavor.

TRACY MARTIN has covered the powersports industries since 1998. He is also the author of six Motorbooks Workshop Series books published by the Quarto Publishing Group and is a regular contributor for *Motor Age*.
tracy.martin@yahoo.com

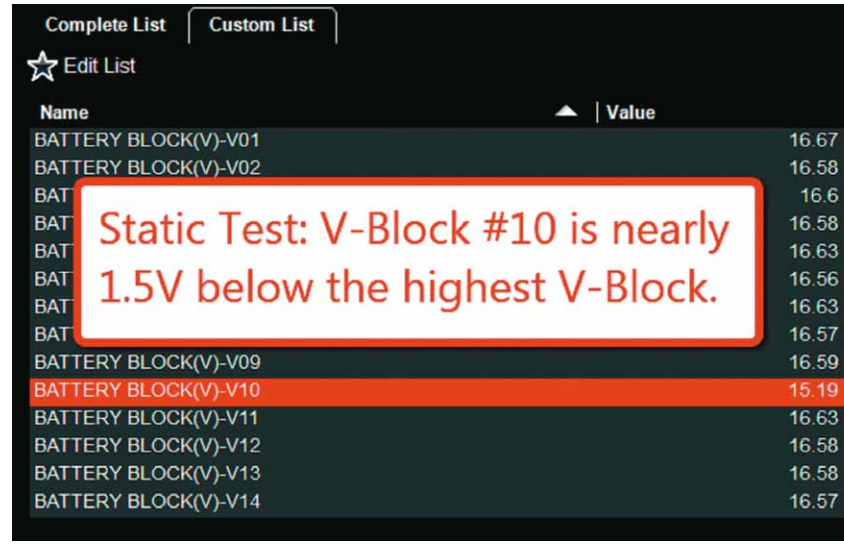
FIRST THINGS FIRST!

BEFORE YOU CAN DEFINITIVELY DIAGNOSE A TROUBLE CODE, YOU MUST UNDERSTAND WHAT IT TAKES TO SET THAT CODE IN THE FIRST PLACE. CODE SET PARAMETERS ARE A CRITICAL COMPONENT OF ACCURATE DIAGNOSTICS.

JEFF MINTER // Contributing Editor

This article will review what code set parameters are, as well as how they can be used as part of the diagnostic process. The information included in those parameters should also be part of the repair validation to help ensure the vehicle is repaired right the first time. Ideally, the customer should not be a part of your repair validation process.

All diagnostic trouble codes are triggered because something went wrong. I know that seems like an obvious statement, but it's the rules used to determine that something went wrong that are important for diagnostics. Those rules are what are known as code set parameters. I'm sure you know a technician who has pulled a vehicle into the bay, scanned it to see what codes were present, and then cleared them to see which one(s) came back as part of their diagnosis (or maybe you do that yourself). Hopefully before the "clear all" function was chosen, the codes that were present were documented. Even if they were documented though, what is the purpose of going through that process? The most common reason I've heard is to determine which of the codes they should chase when there are multiple codes. I would argue that code set parameters are a much better (and more accurate) way of doing the same thing, and hopefully you will too after reading this article (if you don't already agree).



PRIUS BATTERY V-BLOCKS being monitored with the vehicle running but no load.

Code set parameters include information such as, but not limited to:

Conditions required for the code to set

- Minimum or maximum engine temperature
- Engine load conditions
- Fuel tank level

Interaction with other codes/tests

- Codes that may trigger with it and which is the "primary"
- Tests that are disabled when the code is set
- Codes that can't be present for this code to set

Data ranges that will cause the code to set

- What is acceptable/normal
- What will exceed that limit and trigger the code

Monitor strategies

- Frequency of test being run
- Continuous monitor
- Once per trip
- Frequency of failure required to trigger the MIL/Code
- One-trip code (sets immediately upon failure)
- Two-trip code (sets after two failures within a given time frame)
- Required sensors/components

Building your diagnostic process

So how can this data be helpful in a diagnostic process? To start with, honestly ask yourself if you have a diagnostic process that you are using. The basic definition I've used in the past for a diagnostic process is simply a series

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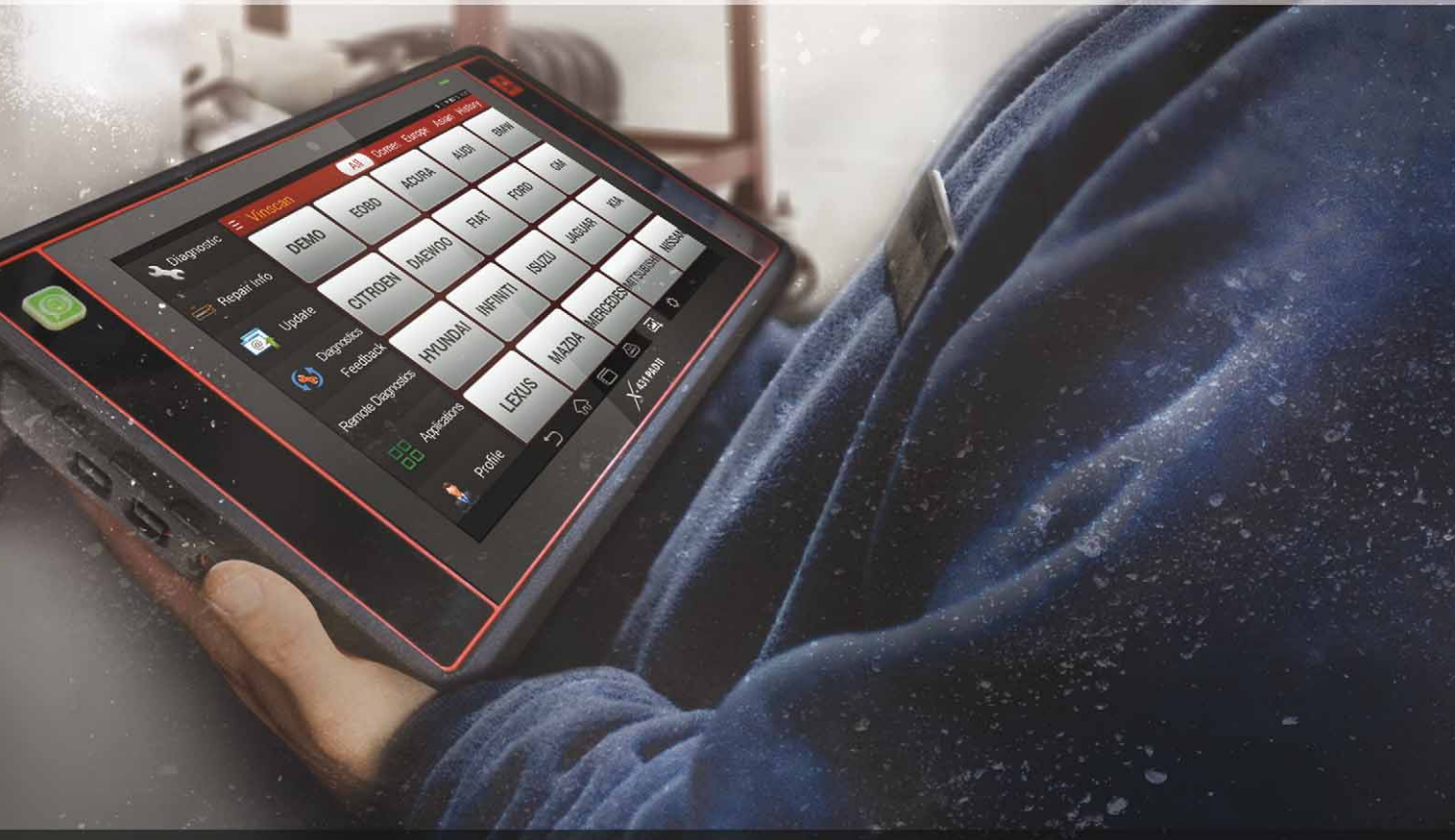

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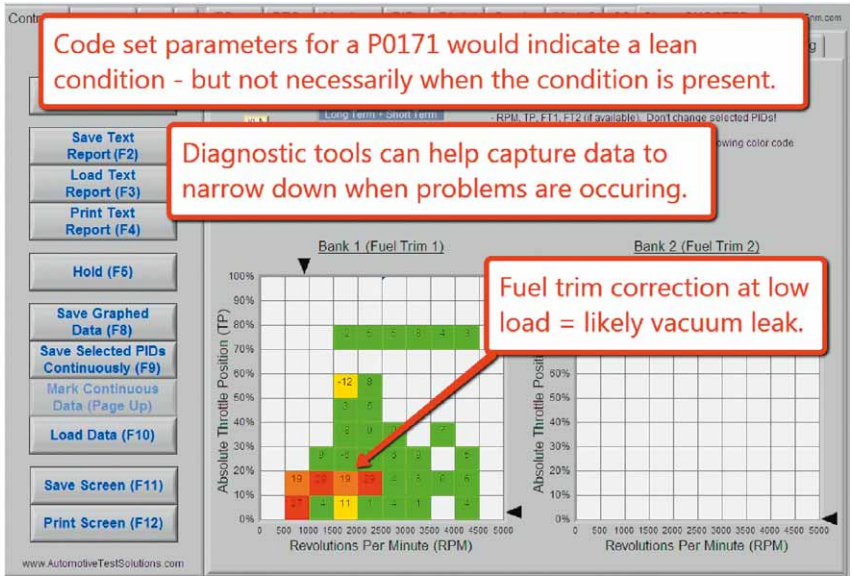
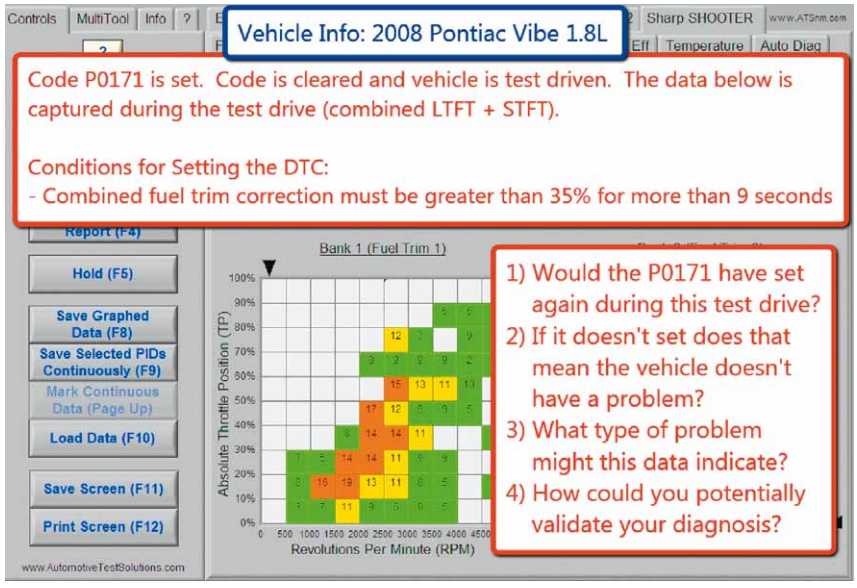
of steps used to locate the source of a problem. That's a broad definition and realistically, the method used by each technician is likely to be somewhat different. If you haven't thought about your diagnostic process, I'd recommend taking a few minutes to write it out step by step. Does it include some of the following steps? These are the steps that I've taught over the years that I feel are a good starting point to build a diagnostic foundation.

1. Gather information from the owner and/or driver of the vehicle. (This is typically gathered by a good service advisor, but technicians need to keep them accountable to get the data.)

- When did the problem start?
- Did they notice any performance changes?
- Has any other work been done recently to the vehicle?



GRAPHING OUT DATA can help identify where problems occur, such as this vacuum leak causing fuel trims to increase only when under little or no load.



CAN YOU ANSWER THESE QUESTIONS using the data provided along with service information you have available?

2. Scan check the vehicle. (This should include documenting any codes, current or pending, and related freeze-frame data, if available.)

- May turn up codes beyond the initial complaint (related or unrelated) that could prove important
- Freeze-frame data may help you determine how to duplicate the problem.
- Documents the condition of the vehicle BEFORE you start working on it to help prevent the "ever since you" discussions after you return the customer's vehicle. Verify the monitors have all run to be sure your repairs don't allow the vehicle to start running a test that hasn't been run for a long time, which may turn the check engine light back on shortly after it leaves your shop.

3. Research information related to the concern.

- Check for relevant TSBs, open campaigns and/or recalls.
- Check the service information related to any codes, including the code set conditions (parameters)

4. Attempt to duplicate the problem.

- Requires the vehicle to be operated under the right conditions
- If you can't duplicate the problem, do you continue?
- If you can't duplicate it, can you accurately validate your repair?

5. Don't get tunnel vision.

- Pay attention to the entire vehicle while test driving. The customer concern may be caused by something related that they haven't even noticed (for instance, a check engine light caused by a leaking exhaust.)

6. Define when/how the problem occurs.

- Provided you can duplicate the

problem, make notes related to Load; Speed (engine and/or vehicle); and Temperature

7. Perform a visual inspection looking for things like:

- Signs of previous work
- Accident damage
- Loose/broken parts
- Leaks

8. Narrow the problem down as needed.

- If multiple codes are present, which one should you diagnose first?
- Attempt to eliminate potential causes of the problem one at a time. Changing more than one thing at a time can cause confusion. Typically start with the easiest item to eliminate as a potential cause, then work toward the ones that are more difficult to rule out.
- *Note – if you have access to third-party information sources that help determine frequency of various failures, you may want to start by testing the most common failure first, even if it's not the easiest one to test.*
- Continue testing until you're relatively confident you've found the root cause.

9. Verify your diagnosis.

- If possible, bypass what you think is the root cause to see if everything works properly.
- Replace the suspected failed part with a "known good." (I'm not a fan of this one!) Be careful; if the part you substitute with a known-good one wasn't the root cause, you could potentially damage it as well.

10. Perform the repair.

11. Validate your repair.

- Be sure to operate the vehicle under the conditions that allowed you to duplicate it previously
- Don't rely on the check engine light to verify your repair.
- Utilize your scan tool and the information you already know related to what conditions must be met for the codes to set.

I know that seems like a long list of things to do, but realistically most of the steps don't take that much time to complete. It is critical that you have access to good diagnostic tools and good service information. If you can't trust one or both of those that you have access to, you are starting out behind in the diagnostic game and are likely to end up losing too often. There are a lot of good resources and tools out there, including those available directly from the OEM. If you are using aftermarket diagnostic tools, I recommend having more than one, and they should be from different manufacturers. With two different scan tools at your disposal, if you have something displaying on your scan tool that doesn't make sense, you have a way to double check it.

Putting it to work

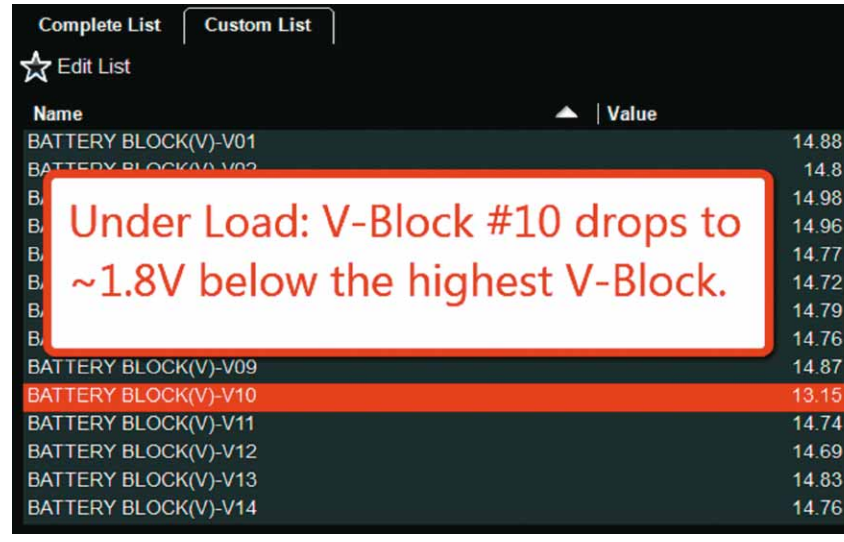
Let's look at a real-life example of a hybrid vehicle to see how important code set parameters are in this process, even when the information isn't necessarily as complete as we may like it to be. The vehicle in this example is a 2005 Toyota Prius. The customer complaint was that the check engine light recently came on, the fuel mileage had dropped noticeably over the last several months, and the internal combustion engine appears to be running more frequently than it used to. Upon scanning the vehicle, a code P0A80 was present with the scan tool showing a code description of "Replace Hybrid Battery Pack." There's not much to go on from that description alone, and it would be an expensive repair to make without being confident it will solve the problem (current OEM list as I'm writing this is slightly over $2,500 plus a core charge of just over $1,300).

So, what can you learn from the code set parameters that might help confirm the vehicle does in fact need a battery pack? In this instance, there are two primary pieces of information that could be helpful. First, the "DTC Detection

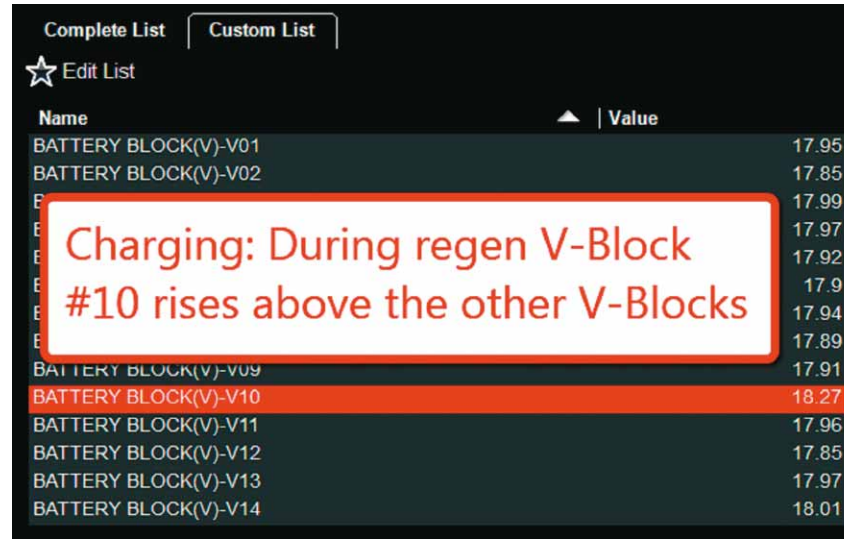
Condition," as Toyota refers to it, will tell you this code for this vehicle uses two-trip detection logic. Second, it tells you that the code is triggered when there is too large of a difference in the voltages of the V-blocks within the battery. V-blocks in this case are simply two hybrid battery modules that are monitored in pairs. This pack consists of 28 modules that are monitored as 14 v-block pairs. Given that information, I know for a fact that when I clear the code, it won't immediately set again even if the failure is still present. I also now know which data PIDs I want to focus on to determine if the failure is likely to reset (V-blocks 1-14). Lastly, I know that if the failure is currently present, to get the code to set again I would need to complete at least two drive cycles.

Of course, that doesn't mean the code set parameters always provide all the information I would like. For instance, Toyota doesn't provide information on how much of a difference in voltage between the V-blocks is too much. In this case, Toyota lists the battery voltage difference under a section called "Typical Malfunction Thresholds." Rather than providing an actual value, they simply say that the threshold is when it exceeds the standard level. Then under the component operating range that standard level is listed as "Toyota's intellectual property." They also don't define what exactly is required to meet a "drive cycle" for this monitor to run, nor do they provide details on the enabling conditions.

The monitor information provided can sometimes help with what constitutes a drive cycle, though. For instance, with this code it's listed as a continuous monitor. That means the test is always running whenever the vehicle is operating. Given the nature of the potential malfunction (battery voltage variance), and that this is a continuous monitor, you could likely assume this wouldn't require a warm-up cycle to satisfy the drive cycle criteria (unlike a thermostat test, for instance). That means it's likely that simply performing two ignition cycles with the vehicle running between them would suffice (key off to engine running = first trip; key off to engine running again = second trip). Of course, to set the code that would mean during each of those trips the code set thresholds (which aren't defined) would need to be met. Since those aren't provided, you need to use your existing knowledge and/or other information available to determine how to best potentially duplicate the conditions to set the code. If you have freeze-frame data available, review it to see what conditions the vehicle was under when the code set. If you don't have freeze frame data, use your own existing knowledge. In this case, it's battery voltage we are concerned about. We should all know that to



PRIUS BATTERY V-BLOCKS being monitored with the vehicle accelerating (under load).



PRIUS BATTERY V-BLOCKS being monitored with the vehicle decelerating aggressively (charging using regenerative braking).

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FINDING THE RIGHT DIAGNOSTIC PATH

PETE MEIER // Technical Editor

It seems like yesterday when you graduated with your Associate's degree in Automotive Technology but it's been three months, and you've successfully landed a job at ABC Auto Repair in your hometown. The boss, though, has been slow in cutting you loose, feeding you a stream of oil changes and tire repairs as you become accustomed to the workflow and your fellow technicians.

Then the day comes! The boss hands you your first diagnostic ticket — a customer concern that the "Check Engine light is on" — and he tells you he wants to see what you can do. You're excited about the opportunity to show what you've learned over the last two (or more) years of study, and you've handled more than a few Check Engine light complaints under your teacher's guidance. This should be a piece of cake!

Four hours later and you still have no clue why the light is on or what to do about it. Now you're feeling discouraged and you're wondering if you've chosen the right career. Before you cry "Uncle" and throw in the towel, let's talk about the process you're using in your diagnostic method. That is, if you're using one at all!

Don't run before you walk

How should you proceed when you get a ticket with a Check Engine light concern? Often, that's all the information you're going to get and unless the car is totally running like — well, you know — you may not know right away whether or not there are any drivability concerns to go along with it.

My first step after bringing the car into the shop is to connect a scan tool using the Global OBD II option. The standardized format makes navigating through the data I want easy, no matter the make, and all "live" data is actual data free from substitute values that you may see in a more manufacturer-specific mode. The first stop, of course, is to see what codes are stored or pending and you'll find that in Modes $03 and $07. I'll record all the code designators I find and then move over to the "Freeze Frame" records to learn a bit more about the conditions the car was being operated under at the time the code(s) set.

A word, though, on Freeze Frame data. If the code is part of a continuous monitor (Comprehensive Component, Misfire or Fuel Control), then the data I find there is relevant to my diagnostic approach. Looking for the cause of a misfire at idle is different than one that occurs only under load. However, if the code is part of a non-continuous monitor (pretty much all the others), I'm not going to be as concerned about the data. In these cases, it is only telling me about the test conditions required and not so much about the conditions leading to the fault.

To clear or not to clear

I'm guessing that many of you reading this follow a similar process up to this point. And I'm also guessing that most of you clear the codes right about now, too.

That, my friends, could be a mistake. When you clear the codes, you remove all traces of the problem, and you may want to go back later to check on data that no longer exists. Once you hit that "enter" key, you wipe out not only the codes and related freeze frame data, you also clear and reset the Mode $06 data and the monitors.

So wait until you've completed the repair before you clear the codes. Another common mistake is to rely on the code description to provide your diagnostic direction. Most code descriptions are pretty good, but they don't tell you what failed or why — only what component and/or circuit is involved. Once you've retrieved the codes, your next stop is your service information system. Time to do a little reading.

Research before you wrench

Even the simplest services today require interaction with an onboard computer. Tire pressure monitoring systems and battery replacements come immediately to mind, and oil life monitor resets have been around for even longer. So thinking you can apply the same operational knowledge across the OEM lines is a serious mistake that will lead to frustration, comebacks and lots of lost effort.

To avoid all that, invest the time up front to learn all you can about the code(s) and the system(s) affected. Start by reading the code description, focusing on the criteria required before the ECM can record the fault. Often, multiple codes will set when only one code is the actual culprit. The reverse can also be true. If some codes are recorded, other tests may be suspended until the fault is corrected.

To continue reading, go to MotorAge.com/diagpath.

test how well a 12V battery maintains terminal voltage, you can load it down with a carbon pile tester (assuming you haven't only been taught how to test batteries using a conductance tester, that is). These hybrid battery V-blocks can be load tested too, but you can't exactly hook a carbon pile tester up to them. Hybrid batteries are used to help launch a vehicle by supplying current to the hybrid drive system's electric machine(s). That means you can load them by simply doing a hard acceleration (or multiple in a row if you really want to load them down). You also likely know from experience that if a battery isn't accepting a charge well, it will have a relatively rapid increase in the terminal voltage compared to a battery that is accepting a charge well.

Now that we have enough information to attempt to duplicate the problem, we are almost ready to try to get the code to set again. There's one last thing that I'd highly recommend you get in the habit of if you aren't already doing, and that's flight recording your test drive. Depending on your scan tool's capabilities, you may want to reduce your data PID list for recording down to the minimum needed, as this will increase the sampling rate of those PIDs. Just be sure you don't forget a PID you might want to look at if you use a custom list. In this case, we'd only need to record the V-block data PIDs (1-14).

To attempt duplicating this code based on what we know, we would need to do the following:

1. Clear the codes
2. Start the car
3. Start data recording
4. Perform multiple hard accelerations, each followed by an aggressive braking event that comes to a complete stop before starting the next acceleration (I'd recommend 4-5 acceleration/braking events)
5. Stop the vehicle
6. Save the data recording
7. Shut the vehicle all the way down
8. Repeat steps 2-6 a second time (remember this is a 2-trip code)
9. Check for codes

If the variance in the V-block voltages was high enough, it should have reset the P0A80. If the code did not set again, all hope is not lost. Even though we don't know the exact code set threshold, we can use the data captured to look for a trend that would indicate the code is likely to set again if operated under the right conditions (unfortunately you couldn't be 100 percent certain). For one or more V-blocks to set this code, they would likely drop more than others during the accelerations, and then spike up higher during the braking events. You'd want to review your data recordings to look for that type of trend on one or more V-blocks.

I used the example of a hybrid vehicle because I wanted to point out that even these advanced drive systems really aren't any different to diagnose than any other problem, but this information is just as relevant on other systems. In fact, typically in other systems you are likely to get better-defined parameters than in this example! Things like fuel trim-related codes, misfire codes, etc., can be attacked using the same type of information and concepts. As vehicles continue to get more complex, ensuring you have access to high quality service information becomes even more critical. Get familiar with where to access this data in your service information system of choice and be sure to use it as part of your routine diagnostic process and repair validation!

JEFF MINTER is currently serving as the service director for a group of dealerships in the heavy-duty vehicle industry. He is an ASE certified Master/L1/L3/F1 technician with OEM training from numerous manufacturers.
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MAKING IT LAST

PREVENTATIVE MAINTENANCE IS SUPPOSED TO PROLONG THE LIFE OF YOUR CUSTOMER'S VEHICLE, NOT SHORTEN IT!

PETE MEIER // Technical Editor

Imagine laying on the operating table. There you are, the bright lights bearing down on you and focused on the thought of someone opening you up like a sandwich bag so he can rummage around in your innards. The last thing you remember is the anesthesiologist telling you to count backwards from 100. "100, 99, 98, 97…", and the world turns dark as you fade off to la-la land.

You awaken some time later in the recovery room and the doctor stops in to tell you and your family that everything went well and you can expect a full recovery. But the doctor failed to follow the correct processes and an infection caused by that oversight results in your untimely demise just a few short months later.

Not a pretty picture, is it?

Ignorance is no excuse

I'm sure the lawyer handling your family's wrongful death and medical malpractice suit will be sure to tell that to a jury of your peers as he describes how the doctor's negligence robbed them of the best years of your life. And while we don't spend our days working on people, many of the lessons learned in cases like this do apply to us.

For example, I'm willing to bet that nearly everyone reading this works or owns a shop that offers oil changes to their customers. Now — and be honest here — how many of you grab the hose from the bulk oil container and fill every car with the same 5w30? Don't be shy – I've worked in those shops same as you.

REPAIR PROCESSES, just like the systems you're working on, have changed over the years. Are you "doing it right?"

I think by now that we all know the importance of using the right oil for the application, as well as the consequences if we don't. We know from all the articles written, videos produced and training sessions attended, for instance, that using the wrong oil can cause a variety of problems in the variable valve timing systems used by so many OEMs, and that premature failure of the control solenoids could lead to costly repair bills down the road for our customers. But we also know that the problems won't surface immediately, don't we? Is that part of the rationalization for still failing to perform this most routine of services correctly?

As the title of this month's column suggests, the whole idea behind preventative maintenance is to help the customer extend the life of their vehicle. The fleet (the statisticians' choice of wording for describing the collective body of vehicles on the road today) is growing older, indicating two things. One, the OEMs are building cars that last longer than ever and two, consumers are taking advantage of that and keeping them on the road as long as they can.

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nance processes we do (or don't do). Consider a few more examples.

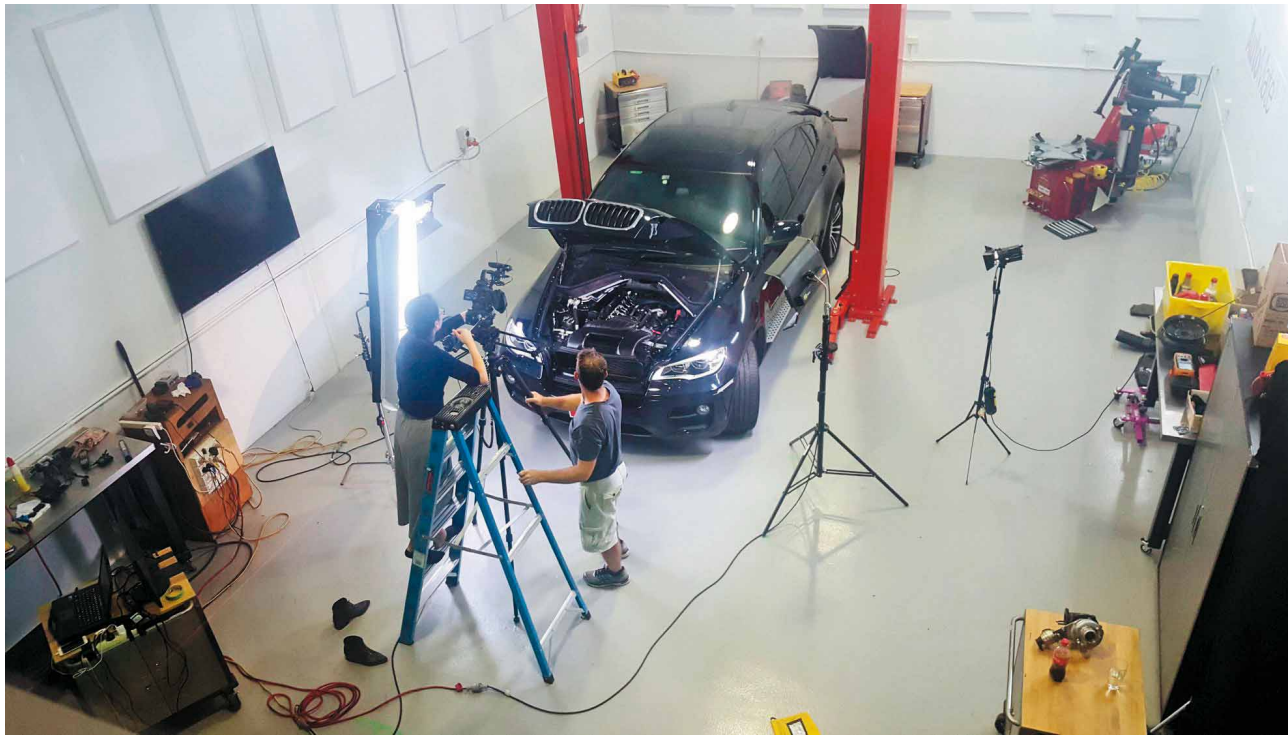
You've heard me harp over and over about the need to perform (at the least) a safety inspection on every car you touch for a number of reasons. You owe it to your customer because he or she is depending on your knowledge to keep their family in a safely operating vehicle. You also owe it to yourself, as failure to do so could result in a lawyer coming after you for failing to meet your professional obligations. Granted, you may win any lawsuit in the end, but at what cost to you financially and personally? And God forbid that someone is hurt or dies because a system you could have, and should have, inspected a day or so earlier fails due to what would have been an obvious fault.

So, with all that in mind, can you honestly tell me you inspect every tire on every car that comes in? Do you adjust the tire pressures? Do you at least peek through the wheel to eyeball the brake pads? Are you sure that ALL of the brake lights are working?

And when you do perform a routine repair, are you performing that repair properly? Consider a basic disc brake job. How do you clean the rotors after you've machined them? Are you cleaning them at all? For that matter, are you machining them properly, with the proper final finish? Or do your rotors' surfaces look like an old vinyl LP record?

Recently, I did a few videos on another routine service – serpentine belt

TRAINING ISN'T LIMITED TO CIVILIANS. Here, I'm leading a class on air conditioning service and helping this group of airmen earn their Section 609 certifications.



THERE IS NO EXCUSE for not knowing the "right" way to service or repair your customers' cars. Good training is only a mouse click or short drive away.

inspection. Neoprene belts haven't been made for nearly 20 years now, but how many of you rely on looking for visual cracks or damage as the indicator a belt needs replacement? Do you have the proper belt inspection tool in your tool box? If you don't or you're not using it, you're doing it wrong – period.

All of the following have been simple processes, surely. Now consider the impact the same attitude towards performing a repair or service properly has on more complex systems. I saw a YouTube video, for example, where a supposedly professional technician was showing how to shortcut an ADAS (Advanced Driver Assist System) calibration using a printed target and a step ladder. Yes, he got the computer to accept the calibration BUT THE CALIBRATION WAS WRONG! The computer has now learned an inaccurate value that is going to drastically impact how that system (as well as any other system that uses the same camera) operates. And it's a safety system!

CHECKING THE CONDITION OF A VEHICLE in order to prolong its life may require more than a quick visual.

WHAT IS YOUR PASSION outside of work? For my wife, Chris, and I, it's helping stem the tide of abuse against children.

I can come up with more examples if you wish, and I'm sure many of you have seen others you could share (and please do), but the whole point of my tirade is this – we are better, as a whole, than this. If you're a tech working in a shop that handcuffs your ability to do a job properly, walk. There are plenty of opportunities out there where you can do your job the way you know it should be done — the way you want to do it. And if all of us who turn the wrenches adopt a "do it right or don't do it at all" attitude, the shops that are doing less than the proper repair or service won't have anyone to do the work for them. And that puts them out of business. And that's not a bad thing. OK, end of rant. Thanks for listening!

And now, for something completely different!

OK, if you recognize the reference of that last subheading, you've got to email me at pete.meier@ubm.com! It's an old reference to an old comedy series that I know some of the younger crowd still enjoys. I'm really curious who gets it!

But that's not what I want to end this month's column with. A few recent events have had me reflecting on a variety of things, and I really wanted to share those thoughts with you.

You, faithful readers, are more than just professional automotive repair technicians and shop owners. You have other passions as well. For my wife and I, it is a passion to end the abuse of children in our world, a passion that led to our founding a non-profit devoted to that mission. For another of our team here at *Motor Age*, it's a passion to offer hope to those contemplating suicide. What is yours? Do you have one?

If you don't, get one. And I'll tell you why. Nothing, and I mean nothing, will help you gain perspective on whatever life challenges you face then to volunteer in helping those who face issues so much more severe. I've had a six-year-old child show me the port used in her chemotherapy and share with me in excited tones how she's finally completed the treatment. I've had sexual abuse victims who weren't even teenagers yet hug me with a love that cannot be described, thankful that I was there for them when they were facing their darkest hour. I could share stories of abuse that you wouldn't believe possible, yet they happened and are happening again even as I write this column.

I'm not sharing this to win accolades or get pats on the back. I share this because we, as a community, need more people to take the time to act on the wrongs of this world. Somewhere inside each and every one of you is a similar passion and I want to encourage you to find a way to put that passion to action. The same internal drive that makes you a professional technician or successful shop owner can perform wonders if you let it loose.

You can make a difference. If you don't think so, remember that one mosquito in the room when you're trying to go to sleep. It sure did!

Again, thanks for listening.

PETE MEIER is an ASE certified Master Technician with over 35 years of practical experience as a technician and educator, covering a wide variety of makes and models. He began writing for *Motor Age* as a contributor in 2006 and joined the magazine fulltime as Technical Editor in 2010. Pete believes in the mission of the magazine to "advance the automotive professional" and provides resources to working techs around the country through print, social media and YouTube.
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RELYING ON TIME AND CHANCE

WE RELY ON THESE ELEMENTS TO DRIVE REPAIR WORK THROUGH OUR DOORS

RICHARD MCCUISTIAN // Contributing Editor

One particularly cold day, I was on my way home from work and I saw a couple of women standing by a black Cadillac crossover that was parked in the grass beside the road. I pulled over to see if I could lend a hand. I was in my uniform, and I assessed their situation. Quite simply, they had a flat tire on the right front. I opened the hatch on my Explorer, got out the small jack and four-way lug wrench I carry and went to work changing the tire. I do this kind of thing regularly when I see people beside the road with flats, because almost nobody knows how to change a tire any more, and rural Alabama isn't as dangerous as a big city. I was about half done when a wrecker arrived. The wrecker driver watched me finish changing the tire and said something about the donut and how it should be installed on the back. I pointed out that this donut was the same diameter as the regular tire, so the gears in the differential wouldn't suffer. I heard the driver tell the women he was on the other side of town when he received the call and wished he had been able to get there sooner.

It was about that time that I realized I had accidentally bumped the wrecker guy out of a roadside assistance call. I would never have changed the flat had I known he was on the way, but they didn't say a word about having called anybody. It was then evident that they thought I was their roadside guy because of my uniform — and the wrecker guy showed up in jeans and a bomber jacket. As I was putting my tools away, one of the very confused women asked in her crisp British accent if they needed to sign any paperwork.

"Nah," I told her as I closed my hatch. "I'm just on my way home from work."

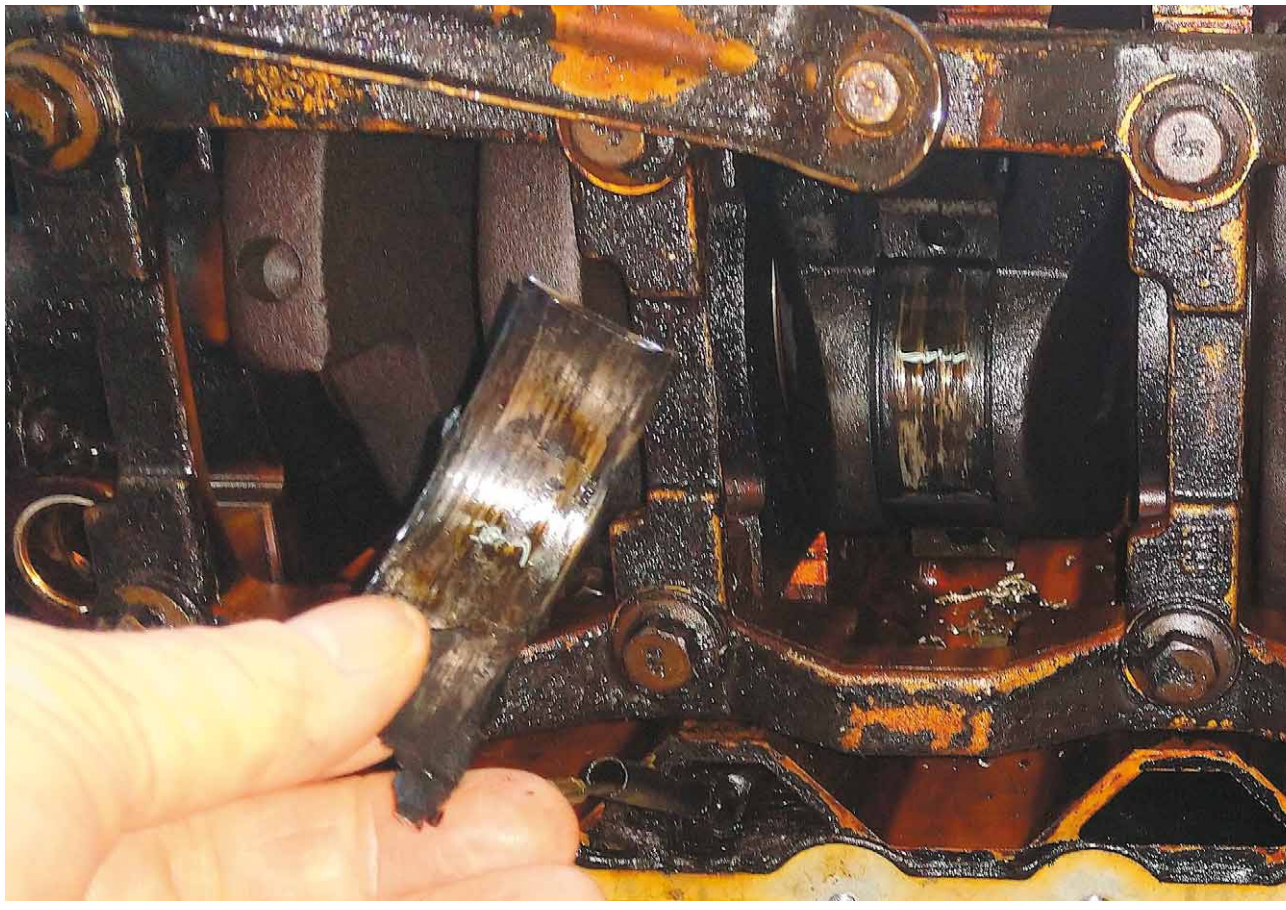
The 2004 Trailblazer

A customer came walking into my office asking if we could put an oil pump on the engine in his Trailblazer. He was an older fellow who had convinced himself that a new engine heart would

THE 2008 IMPALA

WHEN WE GOT THE PAN OFF THE TRAILBLAZER, we saw this dreadful mess. Running an engine short distances, too cool, or without necessary oil changes comes with a price.

PHOTOS: RICHARD MCCUISTIAN



THIS WAS THE ONLY ROD that burned out on the Trailblazer — interestingly, the rest of them looked good.

silence his suddenly noisy powerplant. Out of respect and diplomacy, I spent more time discussing his request than was necessary. Semi-knowledgeable customers like this usually need their thinking gently redirected, and I convinced this fellow that, before we spent the time and effort fiddling with the timing chains and everything we'd have to hurdle on the way to installing the oil pump he had already bought, we needed to do some exploratory surgery, and after a short dialogue, he saw my point.

I wrote a work order, and we removed the oil pan to find large slivers of at least one rod bearing swimming in the pan-sludge — some of which was still clogging the screen. We pulled the rod caps one at a time until we found that #2 had burned out and shed the metal that had wound up in the oil pan. He'd need an engine, and that was that.

This reminds me of another fellow a few years back who was doing some contract work with a group of builders on a local campus. He came to me one morning and told me his Ford Ranger 4 cylinder had begun to rattle a bit, and that the oil light had come on just that morning. I told him his oil screen was likely clogged with sludge. In the parking lot, that character drained the crankcase oil into a large-mouthed jug and used a little flashlight to examine the oil pump screen through that tiny hole, and sure enough, it was clogged. He got some kind of aerosol spray from the parts store, along with oil and a filter. Working through the oil drain plug hole, he cleaned the clogged screen and then did what he could to flush that stuff out of the oil pan — all by just removing the drain plug. And he fixed his Ranger — at least, temporarily.

The 1999 Mazda 3.0L, a Caravan and a Freestar

Nick is one of my guys, and he told me his truck was losing water and running hot — it had a leaking hose, but he had added water and had driven it until he had damaged it to the point that the compression was pushing its way into the coolant. Blown gaskets prevailed, and it was his only ride, so we got started yanking the heads off. If he was fortunate, head gaskets would be all he'd need, but he wasn't fortunate. As it was, he needed a cylinder head, and that ran the bill up a bit. He finished the truck, paid the bill and got his ride back.

The local college owns a 2005 Dodge Caravan with nearly 200K on

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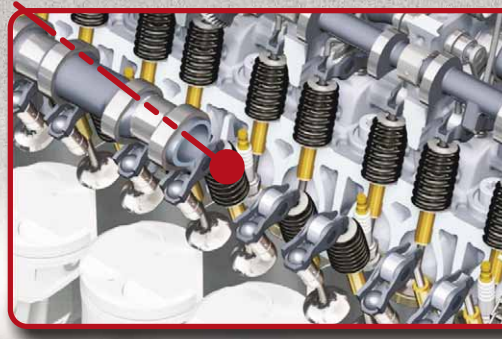

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the clock. The vehicle's status changed from being driven every day to being driven about once a week, and a parasitic drain suddenly raised its ugly head. About half the time whenever a driver would obtain the keys to use that vehicle, the battery would be dead. With the PICO connected via an inductive clamp, we discovered a significant drain that evaporated when the accessory relay was removed, and when we'd remove that relay, we'd feel the "click" of the relay coil releasing — that relay was remaining energized constantly after it should have gone dark, and that was keeping the radio, power windows, etc. up and running even after the driver had exited the vehicle. It wouldn't do this every time, but we caught it doing this during our diagnostics. On this vehicle, the front control module energizes the accessory relay, and that module is part of the TIPM — the smart fuse box, if you will. With the scan tool connected and the problem present, we saw no reason why the accessory relay should have been remaining energized, and we were lucky enough to find the right replacement TIPM for $100 at a local salvage yard. Game, set and match on that one.

The 2005 Freestar wasn't overheating, but it was an occasional no-crank. We found that we could bypass the secondary terminals in the relay socket and the starter would spin, but that there was no juice at all making it from the ignition switch to the starter relay coil. The theft light wasn't blinking and there were no related codes, so we checked connections between the ignition switch and the starter relay and found a time-corroded set of chalky terminals at TR sensor pin 12 that turned out to be interrupting the current to the relay coil. Had this been a high-current circuit, this oxidized terminal would have melted the connector. That one was an easy fix.

AFTER MISFIRING ON A PARASITIC DRAIN diagnosis the first time and replacing the BCM with a used one (which changed the odometer reading; we had to straighten that out), we finally caught the Caravan's intermittent in the act and pinpointed the FCM in this TIPM as the problem. It was keeping the accessories fired up even after the door was opened.

THIS GUY BOUGHT A LAND ROVER for a hunting truck. Not sure why he went so far out of his way to locate one of these, but he did. There aren't many of these around here, either.

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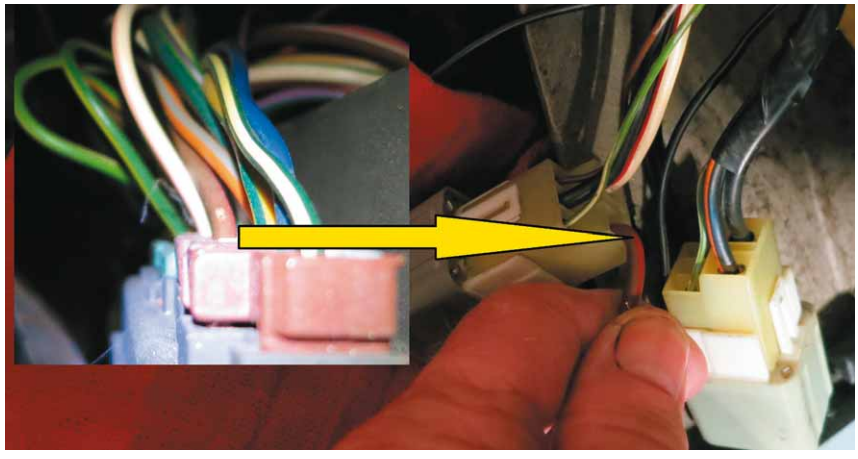
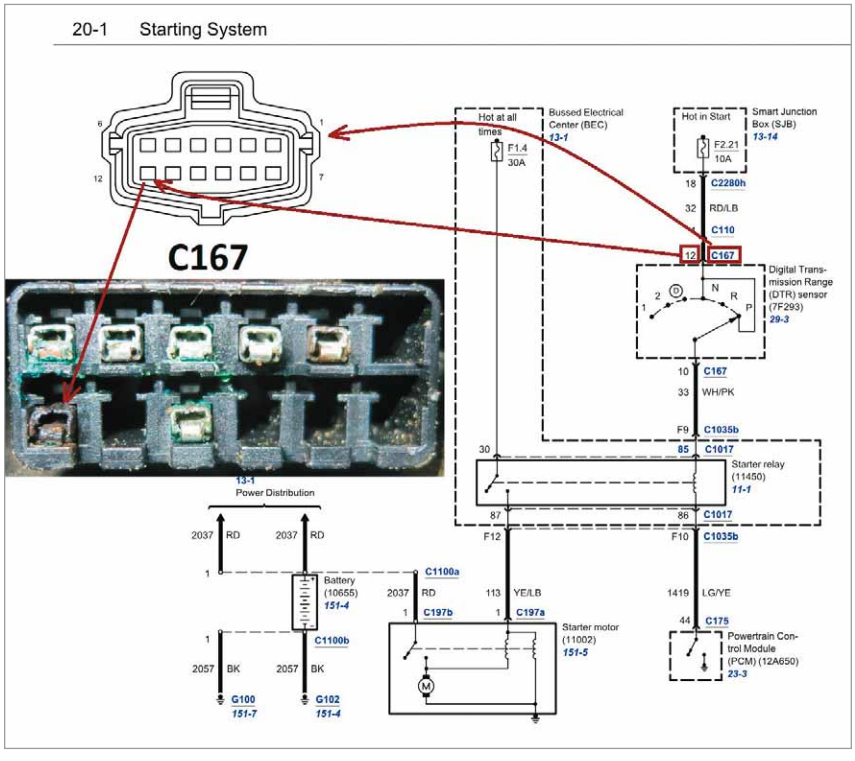
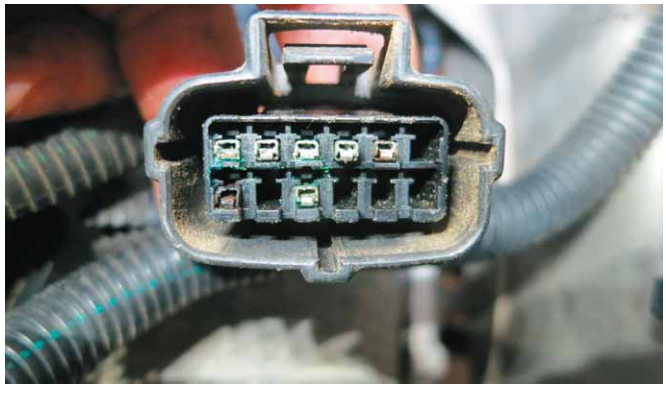


WHEN WE BACKTRACKED FROM THE RELAY to the fuse panel output terminal on this circuit, we found that the fuse panel wasn't feeding the relay, so we ran the overlay.





THE FREESTAR'S TR SENSOR had a time-oxidized pin 12 — that was the reason for the stubbornly intermittent no-crank. There are pigtails and terminals to be had — at a cost. But that's the best fix for a problem like this.

The 2004 Land Rover

A guy came to us with a 2004 Land Rover that was leaking brake fluid and had a no-blow problem with the A/C — the blower was dead, and one of my guys did some Googling, as young guys with smartphones are wont to do. It seems that half the people who owned a Rover of this generation had a dead blower motor and nobody seemed to know the root of the concern, but everybody was running overlays. With a desire to know why, we dug up the schematic. In the panel, the fuse was good, and power was passing through it, but when we finally found the blower relay (which was annoyingly difficult, but Identifix® has the information, albeit for an RHD vehicle), we discovered that there was no power at the relay common terminal — it had nothing to deliver to the blower motor.

Backtracking to the fuse panel connectors, we found the wire that was supposed to be feeding the relay, and it was dark. It turned out that the innards of that fuse panel had gone open, and now failed to deliver voltage to the motor. The fuse panel was the weak link in the chain, and it had fallen prey to time, chance and obsolescence. But rather than launching a nationwide search for a salvage yard replacement fuse panel for a 2004 Land Rover, and rather than having the guy get a title loan just to buy a new fuse panel, we opted for the workable fix that would strengthen the chain rather than simply replacing the weak link. An overlay isn't a bad fix in cases like this.

This blower situation isn't that uncommon and never has been, because blowers pull a heavy load. Back when Ford vans still had glass fuses in the panel under the dash, they would develop a similar problem — they wouldn't necessarily blow the fuse, but the fan would fail because the solder would melt out of the end of that glass fuse due

THE '99 MAZDA GOT HOT ENOUGH TO CRACK THIS HEAD, and a new one was in order. A few hundred dollars later, the B3000 was back on the road, at least until its next breakdown.

to heat and resistance within the panel. Ford had us cut the wires at the panel and install a 30-amp breaker.

In the Land Rover's case, we got an inline blade fuse holder and a 30-amp fuse, and beginning at the battery junction under the hood, we fed a 12-gauge wire through a loom back through the bulkhead grommet to the relay common terminal. The blower was resurrected with a solid, lasting repair. I showed the owner where the new blower fuse was and how we had run the overlay through loom along the harness, and he was a happy camper.

The Land Rover's master cylinder was leaking at the reservoir grommets, and we replaced the master cylinder, reservoir and all, to stop the fluid leak — that was a straightforward fix.

A problem two years in the making

The title vehicle for this article is a 2008 Chevy Impala with a 3.9L V6 and 124,654 miles on the odometer that came in on the hook with the report that it was making a horrible racket and couldn't be driven. What we found was that the #1 spark plug had blown out of its hole. That's the one under the alternator. Now, this is one of our company cars, and while I didn't dig into my records when the vehicle first came in, I didn't remember us ever replacing the spark plugs on this one — not in recent history anyway. It was also sporting a set of replacement wires, which I didn't remember us replacing.

The problem was that when we tried to install another spark plug in that hole, we found that the plug would tighten down to a certain point and then pop loose again — over and over. Using the Autel inspection scope's magnified image, we saw threads that didn't really look that damaged, but the fact remained that a spark plug wouldn't screw into that hole and tighten up. Looking more closely at the actual spark plug that had blown out of the hole, it appeared that there was some kind of gray material in the threads. What I later realized was that the gray stuff in those threads was probably due to the fact that the spark plug had originally been screwed all the way in, but it hadn't been properly torqued, and that it had spent a long time bouncing in the threads and slowly screwing itself out of that hole until it was dislodged by compression and combustion.

My initial take on this situation was that no matter how, where or why this happened, we needed to come up with a fix. The alternator had to be removed, and we had to decide what we were going to do about that situation. Another close-up scope shot revealed threads that looked fairly normal, and the threads on the spark plug didn't look stripped, but I opted (right or wrong) to put a thread insert in that hole for good measure. Of course, when tapping threads in a spark plug

YOU CAN SEE THAT THIS CALIPER PISTON had worn the pad and its metal backing to powder, and all that was left was this silencer shim. It got this caliper replaced, all the rear brakes, two rotors, and…

…BEFORE WE WERE DONE, it got a replacement fuel line and some new brake lines — this was a New York nightmare. The wet area is from the rusty fuel line gas leak.

hole, it's wise to first force air into the throttle body and turn the engine over until positive pressure is blowing out the spark plug hole, and that's what we did. An entire new set of plugs was installed and torqued, and at the time of this writing, the car is still on the road.

But when I researched the work we had done on that company car over the years, I found that somebody under my supervision had replaced the spark plugs some two years ago — almost to the day — but I couldn't find a record of who did the work, only that we had purchased spark plugs and wires for that vehicle back then. The fact that the errant spark plug stayed in place for two full years before leaving its hole was amazing — that car has gone tens of thousands of miles with multiple drivers. And there was no evidence that the spark plug had overheated, either. Time and chance had struck again.

Rust-ravaged by time

Speaking of Impalas, a 2006 model came to us needing brake work (scrubbing in the rear), and this one had spent its prime years in New York. With that in mind, the readers who live in those northern road-salt climates know what time and chance does to cars up there. One of my students made the remark that cars in the South rust from the top down and cars in the north rust from the bottom up. Down on the Texas coast, some of the shops used to regularly spray the underside of cars with oil to protect them from the salt air. I'm not sure if anybody does that anymore.

The left rear inner brake pad was long gone on this Impala and the caliper piston was kissing the rotor with every brake application. If that wasn't enough, the car was blessed with enough rust — particularly on fluid-carrying lines — to make it very dangerous to drive. The fuel return line had even rusted through back near the gas tank and was leaking, and the brake lines were one heavy application away from a sudden death situation. It would have been a matter of time before the brakes failed, and it was only by chance that this vehicle wound up on our lift before it happened.

The brakes got replacement rear rotors, a new left rear caliper, and brake lines to the rear, which we built with bulk tubing, complete with ISO and double flares as required. The leaking fuel line was replaced from stem to stern with a new steel line, but I had to cut an 8mm return line pipe off an old fuel pump and compression-union it to the replacement fuel line so the plastic quick-connect would work back at the tank. Oh, and we also replaced the rusty fuel filter that looked just about as bad as everything else under there.

That encounter was a victory — time, chance and entropy had done their best to render this vehicle undriveable. But with some of our time, we undid enough of the entropy to hopefully remove chance from the equation.

RICHARD MCCUISTIAN is an ASE-certified Master Auto Technician and was a professional mechanic for more than 25 years. Richard is now an auto mechanics instructor at LBW Community College/MacArthur Campus in Opp, Ala.
rwm19@mail.com

AAPEX 2018 features technology learning for repair shops

Following successful changes to its tech-driven features in 2017, AAPEX 2018 returns with a continued focus on emerging technology for maintenance professionals.

This year's educational sessions present leading technology insights and information, helping attendees explore new ways to increase profit by anticipating customer needs.

The Let's Tech stage provides quick-hit presentations on technology-related products, tools and mobile apps. Within 20 minutes, attendees will get concrete ideas for implementing options like interactive inspections, enhanced shock technology and fuel management systems to optimize service and drive new ways to connect with customers.

AAPEX also sets the standard for excellence through AAPEXedu sessions, which are accredited by the University of the Aftermarket and apply toward the AAP and MAAP professional designations. Attendees can receive Continuing Education Units in courses addressing the future of mobility, advanced vehicle technologies, technical training, disruptive technologies, and battery and start/stop technology, to stay ahead of challenges and take advantage of opportunities.

In addition to the expo floor, where attendees can see a showcase of the latest solutions from 2,500+ suppliers from 43 countries, they can also visit the Technology Intersection, which provides a preview of tech products not yet available on the market, allowing for conversations about what's to come and helping repair shops prepare for the future.

The 2017 debut of a mobility-dedicated area was well-received. "This is my 17th time to AAPEX and I always gain knowledge that I bring back to my business. This year was the best with the addition of the Mobility Park," said one attendee.

In 2018, this popular show feature returns as Mobility Garage, located in the Venetian, where attendees can experience hands-on tech demos, see new technology and visit the "shop of the future." By visiting specialized sections, including the Electric Expo, Scan Tool Theater, Underhood Training and the Mobility Garage Car Display, they can get a better understanding of how diagnostic technology and techniques can help their shop proactively support customers.

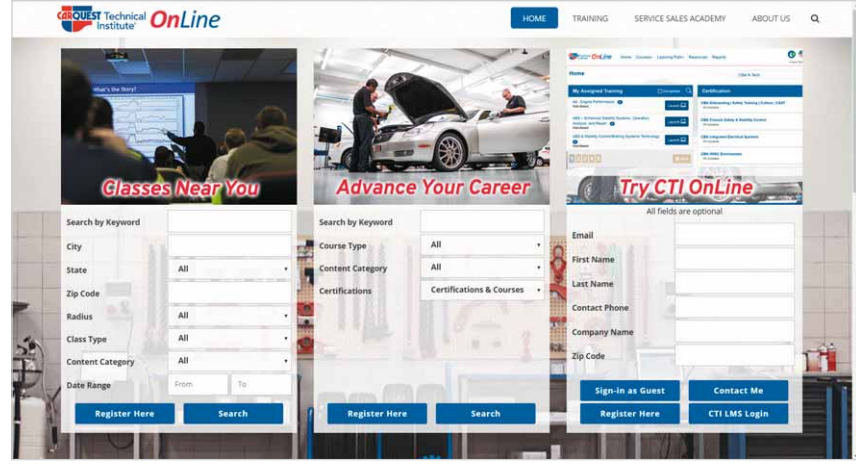
Increased technology programming has been a hit with AAPEX regulars. One 2017 attendee stated, "I have been attending AAPEX for 25 years and it honestly is getting better! It is just not about 'products' now, it is about the future and how technology is going to transform the market—and this is the best place to learn and get a pulse on the market."

AAPEX 2018 presents an opportunity for repair shop owners and operators to connect with over 70,000 other industry professionals to exchange ideas and expand their network.

AAPEX, which represents the $740 billion global automotive aftermarket industry, takes place October 30 - November 1, 2018, at the Sands Expo in Las Vegas. Learn more and register at aapexshow.com.

Certify your team for long-term success

One of the most talked about topics in shops today is the acquisition and retention of talent to help grow and sustain your team. Faced with an aging workforce, while also preparing for the tidal wave of technology changing our industry, you can't afford to wait until it gets here to build the teams and skills needed to service your customers. That is why Carquest Technical Institute and Worldpac Training Institute are partnering to create the most comprehensive automotive education program in the industry. One particular of this partnership is a new Learning Management System (LMS) designed to guide our shop owner partners in growing and retaining talent.



Currently, the CTI OnLine platform provides typical elements found in an LMS, including online content and the ability to register and track classroom records. Any technician, service advisor or shop owner who have attended a CTI event can find their record on CTI OnLine, and soon all WTI students will be able to access their transcripts as well. However, the traditional model of accessing online and classroom content is being totally remodeled. Instead of selling classes or online course packages, our primary goal is to sell and deliver certifications.

A certification is defined as a credential that is earned to show an individual has knowledge of a specific skill. The CTI-WTI OnLine platform will offer a series of Certifications that emulate the National Automotive Service Task Force career path framework. For each job role a technician holds during the course of their career, we will offer a certification path that includes online and classroom content ensuring the student has both the knowledge and necessary skill to warrant being awarded each certification. Coupled with ASE certifications, this new structure and trackable/reportable program will allow a shop owner to create accountability in their organization's learning paths. The structure of these certifications alternatively gives a shop owner the ability to grow a team that enables them to provide the services their customers require. At the end of the day, it's all designed for them.

How do you find out more? First visit the new portal for CTI-WTI at www.CTIOnLine.com; please note the new branding for this new partnership has not been finalized as of this article's creation, so keep your eye on this publication for announcements. On the new CTI-WTI portal, you'll find three ways to search for information. First, you can search for classroom events using our new search tool. Use keywords such as a topic or instructor coupled with a state or zip code filter to find a class near you. Next, you can use our new LMS online training Guest registration that gives you the ability to create a guest credential that allows you to experience our very robust online content. Finally, you can search for Certifications that meet your need with details about the courses and content as well as the expected amount of time it will take to complete.

Our industry is advancing rapidly, and you can't afford to go looking for talent when you need it. You must have that talent on your team, growing and preparing for new opportunities BEFORE you need them. CTI-WTI is your best source of help to get prepared.

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How to tackle Toyota TPMS Relearn

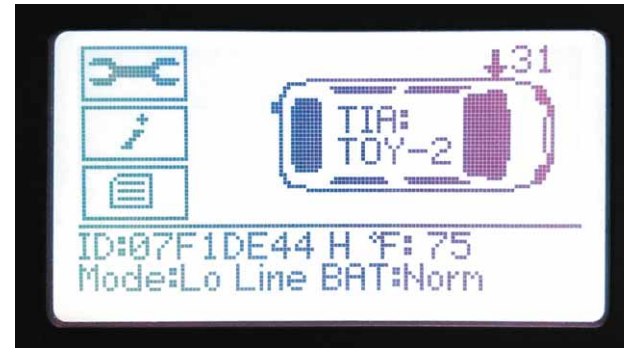
If you're feeling disheartened when a Toyota owner comes in with a flashing TPMS dash light, you're not alone. Many pros have tackled the Toyota TPMS Relearn with confidence only to have it return 20 minutes later with the light on again. Here are some troubleshooting tips to help prevent those comebacks.

1. Evaluate and note the status of the TPMS light — in vehicles prior to 2008, the light may not behave as stated in the Federal mandate.
2. Test all four wheels and the spare for sensor issues — many Toyotas come with a full-size spare that probably has a sensor.
3. Pay attention to the tool — hearing a beep may confirm a working sensor, but your scan tool's display will tell you more, such as a low psi in drive tires or in the spare.
4. Visually inspect the sensors — check the stems for cracks or corrosion. Best preventative maintenance practice is to replace!
5. Choose the right Relearn — get a reliable source for Relearn procedures.

If you diagnose a bad sensor, replace with a quality OE-validated sensor such as the VDO REDI-Sensor. It is a good idea to replace all of the sensors since they have been through the same conditions and have similar battery levels. So, if one is weak or dead, the others will likely follow. TPMS should be treated the same way as other vital consumable parts such as brakes and tires. Replace all at the same time and conduct one relearn. You'll save your customer the added cost and inconvenience of repeat service and eliminate any hassles.

Basic Relearn Steps:

1. Do not drive vehicle prior to Relearn, unless directed by the procedure.
2. Install sensors and set tires to placard pressure.
3. Select correct vehicle on the scan tool.
4. Trigger each sensor starting with the LF position, moving to RF, and so on. Include spare as required.
5. Place ignition in ON position. Do not start.
6. Connect scan tool to the OBDII port and upload sensor IDs. Follow tool prompts.
7. With ignition in ON position, unplug tool from OBDII cable.
8. Trigger each sensor a 2nd time.
9. Turn the Ignition OFF.
10. Safely test drive vehicle above 30mph for at least 10 minutes.
11. Monitor TPMS telltale to ensure it does not illuminate or blink.



SCAN TOOL DISPLAY ALSO INDICATES TIRE PSI STATUS

Variables that can impact the Relearn Process:

1. Some Toyotas use a SET button to set the baseline tire pressures. If pressed at the wrong time, it is possible that an Unlock ECU procedure will have to be performed. Major TPMS tools have this feature.

TOYOTA SET BUTTON FOR BASELINE TIRE PRESSURE

2. Certain Toyota models, especially SUVs, can store two sets of sensors (i.e. Winter/Summer tires). A button is located in the lower dash or glove box and usually labeled MAIN/2ND. Make sure this is in the proper position. Major TPMS tools reference this button in the Relearn procedure.

These helpful tips are brought to you as a 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: redi-sensor.com or contact: salessupport-us@vdo.com.

VDO

The disc brake system analyzer: If you don't have one you are just guessing!

If a customer comes to you with uneven brake wear and you just assume it is a bad caliper and replace it, you may be guessing. Imploded brake hoses and stuck proportioning valves produce hidden symptoms that are not easily diagnosed.

Symptoms of an imploded brake hose occur when the inner nitrile tube of the brake hose ruptures. Using vice grips to crimp off a brake hose when changing calipers is a bad practice since many times, it will break the inner nitrile tube, setting the stage for a hose rupture and implosion. Some manufactures clamp the brake hose to the fender wall. Over time, there is a warring effect between the point where the hose is held tight in the clamp and where it flexes. Over time, the inner tube will rupture again, setting the stage for an implosion of the inner tube.

Once the tube rupture occurs and the brakes are applied, the brake fluid is pushed past the rupture, actuating the caliper. However, when you release the brake, the implosion acts like a one-way valve, not allowing the fluid to find its way back to the master cylinder or the caliper to release. This has all the indications of a stuck slide or frozen piston, but it is only the hose that needs replacement. It is a hard lesson to learn when the car comes back with the same symptoms after replacing all the brake hardware, i.e., rotor calipers and brakes.

Uneven brake wear can also be misdiagnosed very easily because there are no tools to detect its hidden cause. Here is a very common scenario that shop owners face because of uneven brake wear. A customer comes in with one side brake pads worn down to the metal and the other side in good shape. The first reaction is

to replace the calipers, rotors and brakes. Then test drive the car and return it to the customer. Two weeks later, the customer comes back and describes the same noise and problem as before, but this time, they're not so nice! As soon as you pull the car into the shop and hear the metal scraping again, you will immediately know what the problem is, but may not know why it's happening again. At this point, some techs will install a second set of parts hoping the first caliper was bad; maybe replace the proportioning valve, the master cylinder, or the brake hose.

This is where IPA®'s Disc Brake System Analyzer can save the day. It can accurately detect exactly where the problem is and allow the tech to fix it the first time, saving time, energy, guess work and embarrassment when the customer comes back.

The Disc Brake System Analyzer is a must have for the professional brake technician. It is the only tool that can quickly identify an imploded brake hose and quickly diagnose a proportioning valve imbalance.

For more information on the #7884 and other IPA® products, contact your professional tool distributor or visit www.ipatools.com

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Gum and carbon deposits affect engine performance

BY LARRY HAMMER // Technical Services, Mighty Distributing System

It was a busy morning with multiple vehicles arriving on roll-backs with no-start symptoms. The vehicles ran perfectly the previous day, only to encounter a no-start condition the following morning. The symptoms were that of loss of compression. Each vehicle shared two things in common: 1) They were low mileage vehicles with tight tolerances. 2) The vehicle owners had purchased fuel from the same fuel distributor.

Gum residue

A compression test revealed low or no compression on some cylinders. Removing the valve covers and observing valve movement revealed some lazy moving valves or no valve movement on some cylinders. Pulling the cylinder heads and removing the valves revealed a gum-like residue, which was restricting valve movement. This contamination is especially a problem on low mileage engines with tight tolerances. A high mileage engine with excessive wear may not be affected. The condition is more pronounced once the engine cools down and the gum-like residue solidifies, forming a sticky, gummy like substance. The problem with the fuel was determined to be a lack of anti-oxidants and deposit control additives necessary to prevent the formation of gum. This is common with fuel that has been in storage too long or blended improperly. Some of the engines required major mechanical repairs as they were interference engines.

Carbon build-up

Another issue that is becoming a common problem is carbon build-up. Detergents and deposit control additives are added to the fuel to help prevent the formation of carbon deposits on the intake valves. This condition is especially a problem with Gasoline Direct Injection (GDI). With this system, fuel is injected directly into the combustion chamber instead of on the face of the intake valves, which provides a fuel wash for any contaminates. Valve overlap further promotes the accumulation of deposits, as some combustion gases are forced past the intake valves promoting carbon build-up.

Carbon deposits promote misfires, rough idle, long crank times and no-start conditions. In some cases the engine will run rough for a few minutes and then perfectly until the next cold start. The reason is the carbon accumulates in a porous form and initially absorbs the fuel, creating a lean condition. Once the carbon becomes fully saturated with fuel, the engine will run perfectly. These deposits can collect on the fuel injectors, affecting their spray pattern, resulting in hard starts, misfires and excessive levels of hydrocarbons and carbon monoxide.

The carbon deposits can cause an increase in the compression ratio, often requiring a higher octane fuel to prevent spark knock. This can be a problem with turbocharged engines as the boost pressure increases the compression ratio to a level resulting in violent detonation. Higher compression ratios can result in pre-ignition of the air-fuel mixture, resulting in detonation. Carbon knock can also result due to the pistons making contact with the carbon deposits.

Top tier fuel

Eight automotive companies including GM, Fiat Chrysler Automobiles, BMW, Honda, Toyota, VW, Audi and Mercedes-Benz worked together to develop stringent gasoline standards known as Top Tier Detergent Gasoline and they recommend it for use in their vehicles to reduce intake valve deposits. The required detergent level in this fuel contains 2-3 times more detergents than the minimum standard set by the EPA and Canadian General Standards Board (CGSB). This fuel is not to be confused with higher octane fuels commonly sold at fuel outlets. It is all about detergent levels, not octane ratings. Top Tier Fuels cannot contain metallic additives, which can harm the vehicle's emission system and create pollutants. Often these additives are used to raise the fuel octane rating. This is a voluntary program and not all fuel suppliers will offer Top Tier Detergent Gasoline, which is considered the premier standard for gasoline performance. For a list of gasoline brands that meet the Top Tier standard visit www.toptiergas.com and click on Retailers.

Damage to engine components can occur when large chunks of carbon are dislodged. Performing an induction cleaning annually or every 15K miles can help prevent the formation of heavy carbon deposits. Ask your Mighty representative for information and a demonstration of his Total Intake System Cleaner.

Mighty AUTO PARTS

www.mightyautoparts.com

Finding repair information just got easier

With so much complexity in today's vehicles, auto repair technicians have much more to think about than just keeping the engine running. Everything in the car is more complex — even changing a headlamp is not the simple operation it used to be. And pretty soon, emerging technologies like pedestrian detection, adaptive cruise control and electronic scanning radar will be standard features that aftermarket shops must be prepared to service and repair.

So much information, so little time

The exponential growth of complexity has brought not only an explosion of information needed to repair vehicles, but also a proliferation of sources to access that information. Juggling all of these sources can be a time-consuming challenge, often with no way to verify the data is correct. The issue for technicians is no longer about availability of data to fix cars, but how to find the correct data — and more importantly, how to find it *quickly*.

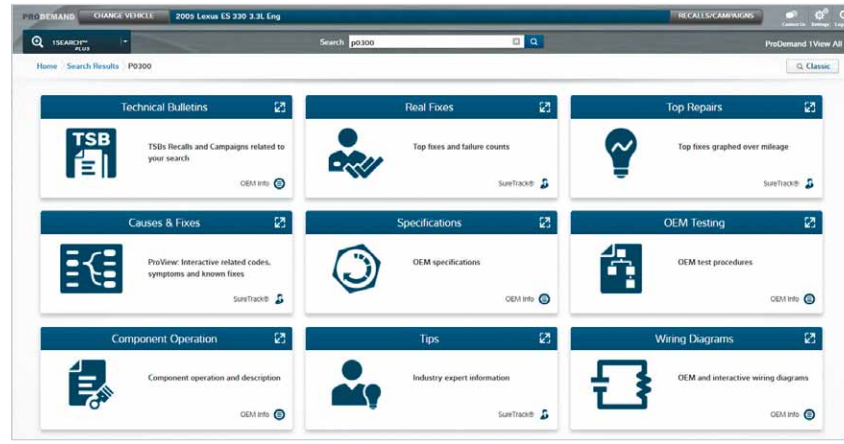
What has *not* changed is the need to keep cars moving through the bays. Customers still expect to have their car back the day they drop it off, or at latest by the next day. So the pressure is on auto repair shops to be as efficient as possible. One thing that can help is being able to access comprehensive, reliable repair information from a single source.

Single search, comprehensive results

ProDemand® from Mitchell 1 is designed to do just that, taking efficiency to the next level. In a single lookup, ProDemand delivers complete and verified OEM repair and maintenance information, diagnostic trouble code data, and powerful SureTrack industry-based knowledge from thousands of technicians.

But again, the challenge is to present all this information in a way that lets technicians find what they need quickly. That's where the new 1Search™ Plus feature in ProDemand can help. This advanced search engine returns targeted results in a graphical card layout organized into specific categories, so all relevant information is always just one click away.

With user-friendly access to all this data in ProDemand, there is no longer a need for multiple subscriptions and multiple forums to find information to diagnose and repair cars. There's no doubt that vehicles are more complex than ever and technology will continue to accelerate. But technology has also inspired a new generation of repair information tools that help simplify the repair process from diagnosis to completion. And



THE NEW 1SEARCH PLUS CARDS in ProDemand guide technicians to the information they need.

After a search, cards are returned according to a technician's natural diagnostic workflow. TSBs are returned first so techs know right away if there is common fix information from the OEM. SureTrack diagnostic information follows next, with industry-based content from professional technicians and aftermarket shops that sets the technician on the right path to an accurate diagnosis. Once the tech has properly diagnosed the problem, they can then use the OEM removal and replace, and after-repair calibration or reset procedures to finish the job.

because good repair information is an important key to overall efficiency, that is very good news for shops.

Mitchell1®
A Century of Innovation and Still Accelerating

800-896-3126
http://mitchell1.com

Sync for success

Tablet-based digital vehicle inspections were just the start of an automotive service-repair shop digital revolution.

Here's how NAPA AutoCare Centers, large and small, can benefit from new integrated DVI tools – SmartCheck and SmartFlow, provided by AutoVitals.

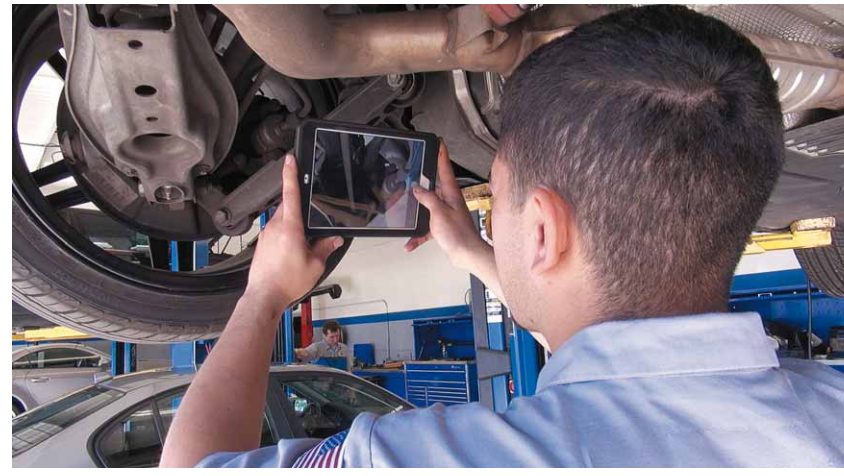
• **Increase repair order averages**; improve service quality; boost shop productivity and employee performance. Here are some recent examples of ARO increases at AutoCare Centers across the country. A shop in Vancouver, WA's ARO went from $161.00 to $376.00; another in Des Moines, IA, had their ARO go up from $501.75 to $726.87; and a shop in San Diego, CA saw their ARO climb from around $375.00 to around $475.00.

• **Educating shop customers** – *"Do I really need a brake job right now?"* – is time consuming. Tablet-based vehicle inspection reports reaffirm the need for a repair with photos of the customer's vehicle as well as test results, technician diagnostic notes and educational videos.

• **Faster Approvals**: Integration with your Shop Management System allows for a seamless connection from the technician to the customer's device. Unlike paper reports, tablet-generated inspection reports can be quickly sent to any electronic device. Creating work orders from the approved inspection makes it easier to keep the techs productive and the revenues coming in.

• Technicians are able to **complete thorough inspections on every vehicle with ease**, and have more power to increase their pay. Owners can easily track technician proficiency.

• **Integrates with NAPA TRACS and other major shop management systems** to sync the front counter with the back shop. Technicians and service advisors have virtually all the information they need right at their fingertips – from work orders to up-to-the-moment technician recommendations.



• **Increase Tech Productivity**: Interruptions break concentration and decrease tech productivity; walking back and forth between the front counter and the back shop wastes time. In a digital shop, techs can focus on vehicle repairs and billable hours, while service advisors focus on customers and dispatching work orders.

• **No more VIN scanning**. Technicians are alerted to repair order changes and can access work orders, service history, OEM recommendations, recalls and technical service bulletins – all on their tablets.

• **Devote more time to customers**: Service advisors are able to dispatch repair orders with just a click; they're also able to monitor work progress and tech availability, and they receive instant alerts from techs about unexpected events. This frees service advisors to spend more time focusing on building the relationship and trust with their customers.

• Technicians and service advisors can **instant message** each other with SmartChat.

• **Better reporting**: Labor inventory management, real time tech efficiency and productivity reports.

• **Customer retention management**, or CRM, **services built-in**: personalized thank you emails and push promos; plus service reminders, email blast, postcard and call campaigns.

• **Loyalty-point program**.

• **Nationwide training** and live webinars.

• **Exclusive Pricing** for NAPA AutoCare Center members.

Visit SmartCheck or SmartFlow on the web, or call now to enroll:
1-844-NAPA DVI (844-627-2384)
Interested to learn more about being a NAPA AutoCare Center?
Visit www.napaautocare.com/benefits today

Fleet brakes that work as hard as you do.

When it comes to keeping fleet vehicles on the road, time, money and even lives are at stake. That's why we created NAPA Fleet brakes from the ground up — designed to last longer and perform better on more than 90 percent of fleet vehicles.

More longevity. More performance.

As a rule, the longer a part lasts, the better. But longevity isn't the only marker of a good product. There's also performance to consider.

The truth is, NAPA Fleet brakes hit longevity and performance right in the sweet spot.

According to industry-standard SAE Safety Testing, NAPA Fleet brake pads and rotors last an average of two times longer than the competition. All thanks to special pad and rotor formulations that, when used together, stand up to the intense heat and friction service vehicles endure day in and day out. As a result, technicians experience more time between maintenance intervals and drivers benefit from more uptime — making project managers, accounts and business owners especially happy.

More safety qualifications than any other brand.

Imagine you're behind the wheel hauling a massive backhoe from a construction site, driving the morning rounds in a school bus or taking a police cruiser in pursuit from 80 mph to zero in a matter of seconds. You wouldn't want your vehicle equipped with just any normal brakes.

According to the tests, NAPA Fleet brakes are anything but normal.

After submitting NAPA Fleet brakes to rigorous research and development processes and safety tests, we've collected more safety qualifications than any other aftermarket brand. Our brakes even exceed the requirements of the Emergency Vehicle Operations Course — an industry benchmarking test where NAPA Fleet brakes passed with flying colors on performance and longevity, wear, and noise reduction.

Support you need to get the job done.

When it comes time to switch to NAPA Fleet brakes, we know you can't be left with a vehicle sitting on the lot waiting for parts. Time is money. That's why NAPA offers world-class training and technical support to all our fleet customers. And with more than 6,000 NAPA AUTO PARTS Stores and 16,000 NAPA AutoCare Centers nationwide, the parts and advice you need are never far away.

Don't settle for anything less.

When your business or organization depends on a well-maintained fleet, there's no better choice than the performance, longevity and service that come with NAPA Fleet brakes. Because while keeping a fleet of vehicles running longer and stronger is your job, it's our business.

NAPA AUTO PARTS

1-800-LET-NAPA | **NAPAOnline.com**

Save time & money with PicoScope

When fault codes aren't enough, our wide range of vehicle diagnostics equipment will help save you time and money. Our award-winning automotive scopes work with any car or truck, as well as, a broad range of other motorized vehicles from motorcycles to earth movers. They make it faster and more efficient to find the root cause of service issues with many different vehicle systems.

A PicoScope® (sometimes known as a labscope) turns your laptop or desktop PC into a powerful diagnostic tool. Think of it as the X-ray machine of diagnostics, letting you see the changing signals inside wires. You can purchase a PicoScope on its own, but most customers purchase one of our award winning Automotive Diagnostics Kits. These money-saving kits contain everything you need – just add a PC.

Pico has been designing, manufacturing and improving our oscilloscopes for over 20 years. Our objective is simple: to make the best automotive oscilloscope in the world.

The recently introduced two-channel PicoScope 4225 and four-channel PicoScope 4425 are our 5th generation of automotive PC oscilloscopes. They are 5x faster and have 8x more memory than the previous generation, ensuring they are powerful enough for the next generation of vehicles with new technologies such as CAN FD.

Other innovations include:

- New floating inputs for non-grounded measurements and voltage drop tests
- Higher voltage ranges (up to 200 V without attenuators)
- ConnectDetect® to ensure you have a good connection
- Advanced triggers to capture intermittent faults
- Hardware filters and frequency measurement
- USB 3.0 connected and powered.

When you purchase any diagnostic tool you not only spend money but you also spend time learning how best to use it. We protect that investment in two ways. First, we develop hardware and software that is easy to use for technicians new to oscilloscopes, but still packed with the power and features experienced users demand. Second, we do not compromise on quality or specifications, so expect the PicoScope you buy today to still be an essential part of your diagnostic toolbox 10 years from now.

PICO TECHNOLOGY
320 N Glenwood Blvd.
Tyler, Texas 75702
800-591-2796 (phone)
620-272-0981 (fax)
www.zauto.com

pico® Technology

Brake Issues

While many things have changed over the years on our vehicles, the basic brake system hasn't changed much. There's the same brake problems we've been repairing for years. Low pedals, noise, brake pulls and pedal pulsation are still on the top of the list of brake complaints.

Low brake pedal: Start with the isolation clamp test by clamping off the rubber brake hoses with the appropriate hose clamp, not locking pliers (Fig. 1). Once the hoses are pinched off, start the vehicle and press the brake pedal. If the pedal feels normal, everything upstream of the clamps is good. This includes the master cylinder, ABS unit and the brake hoses, if the hose was pinched close to the caliper. Now, take the clamps off one at a time until the pedal drops. If the

FIGURE 1

pedal drops when taking the right front clamp off, there's either air in that corner, wrong parts were installed or there's a leak. Keep eliminating parts until one thing is left. If the brake pedal is still low after putting the clamps on, the problem is upstream — the master cylinder or ABS unit. Take the lines off the master and install steel plugs. Start the vehicle and apply the brakes. If the pedal is hard, the master is probably good.

Noise: Noise is vibration so anything to prevent the brake pad from vibrating will help, including installing new hardware, using pads that have high quality shims and lubing all metal to metal contact points such as slides, bushings and backing plates. Using rotors that match OE in weight and vane configuration will help eliminate noise issues. Just because the rotor fits doesn't mean it has all the noise deadening attributes that were developed by the manufacture for that vehicle. This includes special metallurgies such as damped iron and developing vane configurations that are designed to suppress noise and cool.

Brake Pulls: Vehicles that pull to one side when braking don't always need brake servicing. Weak control arm bushings, worn steering components and suspension parts can cause pulling when braking. Before condemning the calipers, perform a dry park check. This is best done on a drive-on rack keeping the tires on the ground. Have an assistant rock the steering wheel back and forth slightly while looking for any movement in the steering and suspension parts. If everything looks good, diagnose the brake system. Inspect calipers for torn boots, bushing and slides working freely and for equal pressures at all corners. Rear brake issues can cause brake pulls so check all brakes, front and rear.

Pedal Pulsation: Pedal pulsation hardly ever happens during the first months of installation. The customer may complain about slight up and down movement in the brake pedal after 2-3,000 miles so the technician thinks

FIGURE 2

FIGURE 3

the rotor is warping and gets a new one. The problem is fixed, maybe for a while, but it may come back a second time. This isn't the rotor getting too hot, it's a thickness problem due to excessive rotor runout when it was installed. If the rotor contacts the brake pad every revolution, a thickness variation occurs. Aggressive semi-metallic pads cause the rotor to be thinner in one spot. Ceramic pads leave excessive material on the rotor in that one spot. This is called material transfer- a trait of ceramic pads. If the rotor has the correct lateral run-out, typically .002", the material will be applied evenly across the face of the rotor — not all in one spot (Fig. 2). To prevent pedal pulsation, clean the wheel hub thoroughly using proper tools and check runout with a dial indicator (Fig. 3).

Hub installation guide

SKF offers this technical tip that addresses installing the following hub units in the specified applications:

BR930772 Nissan Rogue (08-13) Nissan Sentra w/2.7L (07-12)	**BR930888** Nissan Juke (11-17) Nissan Leaf (11-12)	**BR930684** Nissan Sentra w/2.0L (07-12)	**BR930880** Subaru BRZ (13-17) Scion FR-S (13-16) Toyota 86 (2017)	**BR930872** Nissan Leaf (13-17) Nissan Sentra (13-17) Nissan NV200 (13-17)

Installation guidelines

Prior to removal of the old hub assembly, be sure the ABS wheel speed sensor is removed (fig. 1). Sometimes it is helpful to use rust penetrant in and around the ABS wheel speed sensor to aid in removal. WARNING: If the ABS wheel speed sensor is not removed, damage can occur to this sensor during removal of the old hub assembly or during installation of the new hub assembly. Damage can also occur to the metal protective cap on the new hub assembly if the ABS sensor is not removed.

The ABS wheel speed sensor head sits in-between the protective cover and the ABS encoder ring built into the seal on the back of the hub assembly (fig. 2).

Also, be sure that the old protective cap is not still stuck in the knuckle after removing the old hub assembly. At times, the protective cap becomes dislodged from the hub assembly during removal. WARNING: If the old protective cap is left in place, damage will occur to the ABS sensor and new hub assembly (fig. 3).

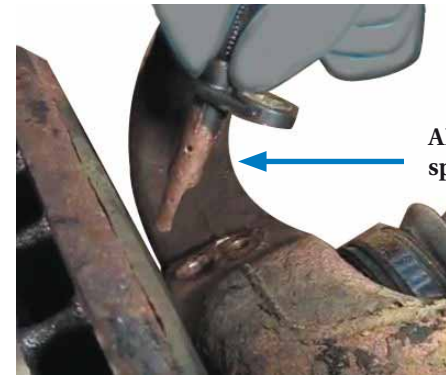


Fig. 1

Fig. 2

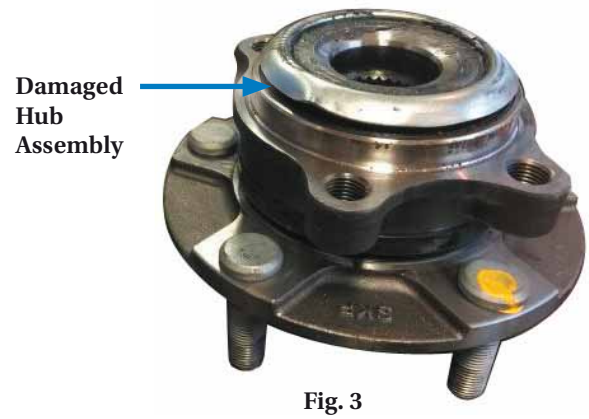


Fig. 3

SKF offers a web-based training and rewards program

SKF now offers the SKF Parts Xperience, a web-based training and rewards program designed to help automotive and truck technicians boost productivity and stay up-to-date on the latest vehicle technologies. Technicians can sign up for the program by visiting www.skfpartsxperience.com.

The SKF Parts Xperience program is designed to help technicians more easily engage with SKF products, learn more about installation and maintenance best practices, and manage reward points based on product purchases and installation. The new program makes it easy for users to tally points simply by scanning a box label barcode from their mobile device or by entering a part number online. Additionally, every time a user completes a training module, they'll be automatically rewarded with points. As users accrue reward points, they'll be able to redeem them for a wide array of merchandise.

Intelligent diagnostics strategies

The diagnostic strategies of old aren't 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, flow charts and diagrams. With too much information, the challenge is to find and follow the right clues to a solution.

The same computer and information technologies that add complexity to vehicles are enabling improved diagnostic strategies that simplify and reduce time spent in diagnosis and repair.

Regardless of the technology and system being diagnosed, air, fuel, spark, amperage, voltage and grounds are critical to making automobiles perform properly. ZEUS™ with Intelligent Diagnostics software has revolutionized the process and made it more efficient, bringing together the tests and information related to a diagnostic trouble code (DTC) to one place.

Intelligent Diagnostics can be used whenever a code is present and includes smart shortcuts to take technicians to information related to that code:

- Technical service bulletins (TSB) recalls
- 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 a step-by-step diagnostic process allows technicians to get through their diagnostic workload.

Step 1: Check for codes. Diagnostic trouble codes are the first and best source of clues to narrow the search. Once it's known if there's a code, go to step two and use the code or symptom to determine a likely cause. Identifying a code opens the possibilities of putting Intelligent Diagnostics to best use.

Step 2: Smart data filters unrelated PIDS so technicians only see what's relevant to the code. It also automatically sets PID triggers, which flag PID red or blue, out of limits or within limits

Step 3: Search factory technical service bulletins. Intelligent diagnostics narrows down TSBs to those for that code. TSBs are a time saver with OEM experience on failures after a vehicle has been on the road for a while. They're a great companion to fault codes and SureTrack. Most technicians use a good repair information system like ShopKey® Pro or ProDemand® for TSB access. Intelligent Diagnostics takes users to the TSB related to the DTC they're investigating.

Step 4: Check SureTrack for real world answers. SureTrack takes the clues: vehicles, code and symptom and shows the most common parts used to repair similar vehicle 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 5: Use functional tests or component tests to pinpoint and verify the problem. Using Intelligent Diagnostics, FastTrack Guided Tests display the information, relevant to the 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 workflow and the job at hand. Intelligent Diagnostics saves time and provides a confident solution on many repairs.

SNAP-ON DIAGNOSTICS
420 Barclay Blvd.
Lincolnshire, IL 60069
800-424-7226
http://diagnostics.snapon.com

UNIVERSAL IMPACT SOCKETS

GEAR-WRENCH® introduces its new X-CORE PINLESS™ Universal Impact Sockets. The pinless socket design offers exceptional strength, durability and value. The exclusive X-CORE PINLESS four-lug ball-and-socket design provides increased durability, speed and strength, allowing automotive technicians and industrial mechanics to quickly remove stubborn fasteners, even in the most cramped spaces.

WWW.GEARWRENCH.COM

OIL SPILL CLEANUP

Permatex® has a brand new product designed to absorb oil spills and clean soiled surfaces. The Fast Orange Grime Magnet® is an advanced, soap-infused sponge that quickly and effortlessly absorbs oil and other petroleum products from vehicle surfaces, garage floors, shop tools and hands and arms. The Fast Orange Grime Magnet can be used in the garage, shower or work place. It works with or without water.

WWW.PERMATEX.COM

TOYOTA REBATE

Earn a $15 rebate on all eligible Genuine Toyota Radiators and Condensers purchased June 1 – August 31 (88460-AZXXX and 16410-AZXXX part numbers only). To ensure your repair meets Toyota standards for fit, function and reliability, always use Genuine Toyota Radiators and Condensers — engineered and manufactured to meet Toyota's precise specifications. For rebate details go to the below website.

WWW.TOYOTAPARTSANDSERVICE.COM

2018 AAPEX SHOW

The Automotive Aftermarket Products Expo (AAPEX) represents the $740 billion global automotive aftermarket industry. In 2017, AAPEX featured more than 2,500 exhibitors, 47,700 targeted buyers, and 40 AAPEXedu sessions. AAPEX 2018 will be held October 30-November 1, 2018 at the Sands Expo in Las Vegas. Register today at the below link.

WWW.AAPEXSHOW.COM/REGISTER

TEMPERATURE CONTROL KITS

Stant Corporation has introduced a new line of temperature control kits. Specially developed to simplify cooling system service, 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

IMPACT WRENCH

Milwaukee Tool introduces the M18 FUEL™ 3/8" Mid-Torque Impact Wrench. Building off the widely popular 1/2" Mid-Torque Impact Wrenches, the new 3/8" version delivers up to 450ft-lbs of fastening torque and 600ft-lbs of nut-busting torque. The M18 FUEL™ 3/8" Mid-Torque Impact Wrench is designed with a three-mode DRIVE CONTROL™ feature, providing the user with the versatility to switch between Modes 1, 2 and 3 to match the power and speed to the application at hand.

WWW.MILWAUKEETOOL.COM

PAINTED ROTORS

Carquest Platinum Painted Rotors, an exclusive line of premium rotors offered by Advance Professional and Carquest, are designed to meet professional repair facilities' need for a high-performing rotor product that is visually appealing to today's drivers. Engineered with a rust-inhibiting barrier that provides more protection than non-painted rotors, Carquest Platinum Painted Rotors help decrease brake noise and increase the life of a vehicle's brake pads.

WWW.CARQUEST.COM

INDUCTION CLEANER

The ATS Chemical 3C Intelligent Induction Cleaner removes heavy carbon deposits from the gasoline based internal combustion engine. The 3C gasoline engine cleaning system is specifically designed for the ATS 3C carbon removing chemicals. The 3C microprocessor is programmed with a run profile that commands the 3C chemical to be delivered into the gasoline-based induction system where it can best reach all carbon sites within the engine.

WWW.ATSCHEMICALS.COM

MEMBRANE DRYER

According to Walmec North America, the WNA AMD-035 Membrane dryer has a 4-stage pre-filtration that is critical to the longevity and function of the membrane dryer. It has a flow rating of 35 SCFM and maximum working pressures of 150 PSI. The first and second stage filters remove moisture, liquids, dust, rust, scale and other contaminants to 5 microns. The 4-stage pre-filtration includes differential pressure gauges and comes complete with mounting brackets.

WWW.WALMECNA.COM

TIRE CHANGERS

The new John Bean® EHP series of tilt-back and swing arm tire changers provide users with advanced technology and safety features that make them must-have equipment for any shop looking for safety, speed and versatility. The John Bean T5745T and T1545T swing-arm and tilt-back tire changers feature the patented PROspeed™ technology which automatically minimizes risk of damage to tires.

CA.JOHNBEAN.COM/EN

SHOCKS AND STRUTS

Tenneco has announced the expansion of its Monroe® Shocks and Struts product line with the introduction of 27 new part numbers, including 21 new premium Monroe® Quick-Strut® strut assemblies, three new Monroe OESpectrum® shocks and struts and three new Gas-Magnum® light truck shocks.The latest expansion adds coverage for six domestic and 53 import applications, including popular late-model vehicles from Acura, Ford, Honda, Mazda and Suzuki.

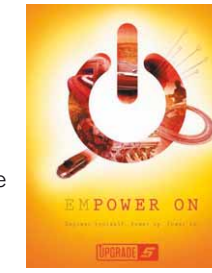
WWW.MONROE.COM

EXTENDABLE INDEXING PRY BAR

OTC has announced the new 7177 Extendable Indexing Pry Bar, available now in North America, for heavy-duty applications in the automotive, industry. The pry bar is designed for maintenance tasks, such as positioning/repositioning engines or equipment or aligning heavy steel plates or panels. Extending and indexing adjustments are made with separate oversized pins, allowing length and angle adjustments to be made quickly.

WWW.OTCTOOLS.COM

SOFTWARE UPGRADE



The Snap-on® diagnostic Software Upgrade 18.2 is more powerful than ever with new features. In addition to OEM-specific coverage for 100 vehicle systems and 49 manufacturers with more than 400,000 new and enhanced codes, data, tests and tips and 2017 model year coverage, Software Upgrade 18.2 provides brand new platform features so technicians can get the information they need right on the tool.

HTTP://DIAGNOSTICS.SNAPON.COM/18.2

IMPACT DRIVER KIT

The Matco Tools 16V Cordless Infinium ¼" Drive High Performance Impact Driver Kit, No. MCL1614H-PIDK, features an efficient brushless motor that provides 150 ft. lbs. of working torque and longer durability. The patented hammer mechanism reduces vibrations and the soft TPR grip increases comfort. Also, a trigger-activated dual LED light with time delay illuminates work in poorly lit areas. The kit includes two MC-L1620LB 2.0AH batteries, a charger and a carrying case.

WWW.MATCOTOOLS.COM

BATTERY BOLTS AND TAPS

Wirthco Engineering has simplified the process of adding accessories and components to your automotive electrical system with their line of Battery Doctor battery bolts and taps. The battery bolts allow for an easy and reliable direct connection to the battery. The studs accommodate one or several 3/8" ring terminals to be connected. Direct to battery circuits help reduce noise in stereos, communication and other electronic equipment.

WWW.WIRTHCO.COM

INTELLIGENT DIAGNOSTICS

With the introduction of Apollo D8™, Snap-on® is making Intelligent Diagnostics more accessible to more technicians, at all skill levels. Apollo D8 offers many attributes, including scan for vehicle fault codes/diagnostic trouble codes (DTC), SureTrack® common replaced parts and Real Fixes for the specific vehicle and DTC, OEM technical service bulletins (TSB) specifically related to the vehicle and DTC, and more.

HTTP://DIAGNOSTICS.SNAPON.COM

TIRE INSPECTION TOOL

Bartec announces the Tech200Pro, which is designed to work with your existing point-of-sale system, or Bartec's Service Center System, and as a result, making it easy, fast and accurate to inform customers of their tire's condition. The first tool to combine tread depth, TPMS and digital pressure measuring, the Tech200Pro captures the right safety information. The Tech200Pro is set up for a specific make, model and year by simply accepting the vehicle lookup from your point of sale.

WWW.BARTECUSA.COM

BRAKE PADS

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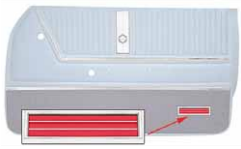
EXTRA-LONG HANDLE RATCHETS

GEAR-WRENCH® announces four new additions to its line of 120XP ultra-narrow swing arc ratchets. Three new extra-long handle ratchets, measuring 9", 18" and 24" long, and a two-piece set now join the growing line. 120XP ratchets feature 120 positions for every full rotation, allowing them to turn fasteners with a swing arc of as little as three degrees. 120XP Double-Stacked Pawl™ technology provides an ultra-narrow swing arc, allowing users to reach fasteners in severely limited access applications.

WWW.GEARWRENCH.COM

IMPALA DOOR PANEL REFLECTORS



Classic Industries announces new OER® reproduction of the original door panel reflector found on 1965 Impala SS and 1964-65 Oldsmobile Vista Cruiser models. Manufactured in zinc die-cast metal, then polished and chrome plated for a brilliant shine. The lens is injection-molded manufactured with reflective material in the correct red color. Features a pre-attached backing plate with mounting feet for easy installation. Sold individually, two required per vehicle.

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AD INDEX

AD INDEX

PRODUCTS

READING A WIRING DIAGRAM

READING A SCHEMATIC MEANS MORE THAN JUST IDENTIFYING WHERE THE WIRES GO

PETE MEIER // Technical Editor

In the dictionary under "reading" I found:

1. the action or skill of reading written or printed matter silently or aloud.

"suggestions for further reading"

synonyms: perusal, study, scan, scanning;

2. an interpretation.

"my reading of the situation"

synonyms: interpretation, construal, understanding, explanation, analysis

When you read a wiring diagram, which definition of "reading" are you using?

To be successful in diagnosing any electrical concern, techs must be comfortable in three areas: electrical fundamentals (volts, ohms and amps and how they all interact, as well as how a fundamental circuit operates), using electrical testing equipment (the basic functions of a Digital Multimeter is a start) and how to read a wiring diagram. This month, we're going to focus on the last.

Reading a wiring diagram has often been compared to reading a street map. You have to follow the roads from one component to the next to see how everything is connected. And that is true — to a point.

It is even more important to use the diagram to understand what is happening in those wires and components as well as when it's happening. For example, if the blue/white wire starts at a fuse and ends up at a relay, is that wire carrying power all the time or only when the key is turned on? Does that wire supply power to the control side of the relay or the component side? What causes the power to switch on or off — a manual switch request, or is it a control module-driven control?

Truly reading a wiring diagram will help you in your troubleshooting. Often, with this knowledge, you can isolate a very narrow section of the wiring in which to focus your actual testing. And that's what we'll focus on in this month's The Trainer.

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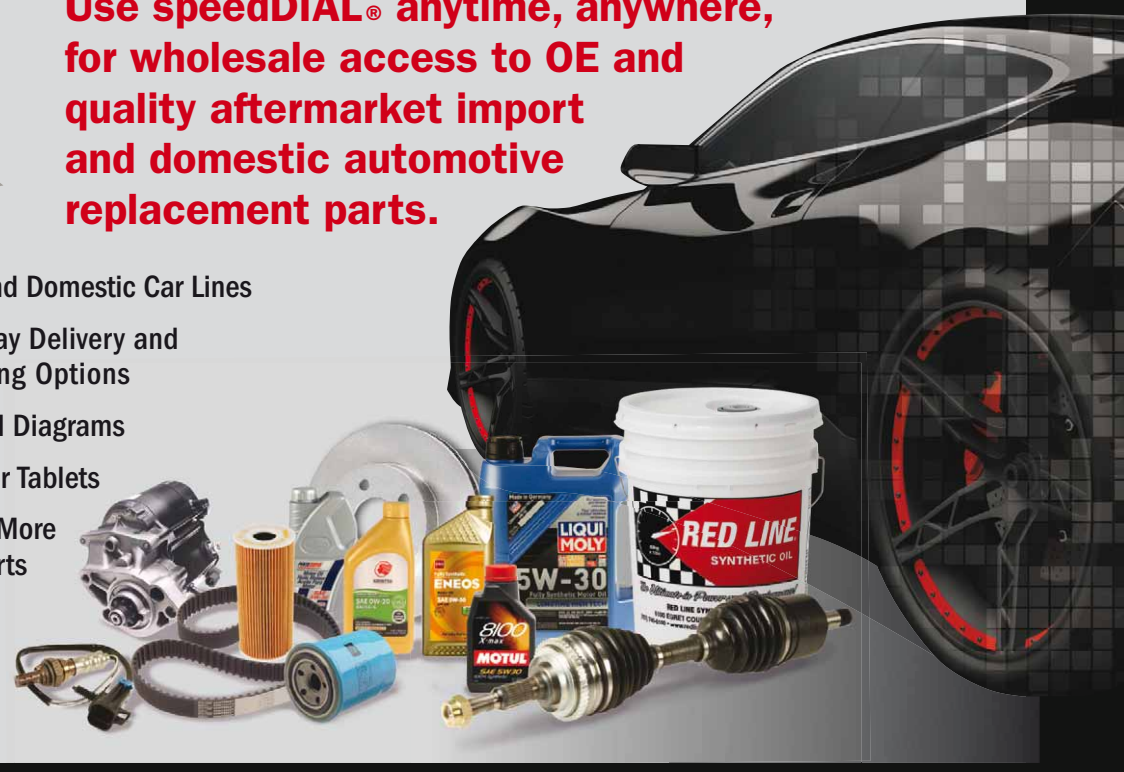

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