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48 ADVANCED DRIVER ASSIST SYSTEMS

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62 ELECTRICAL BATTLES WON

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80

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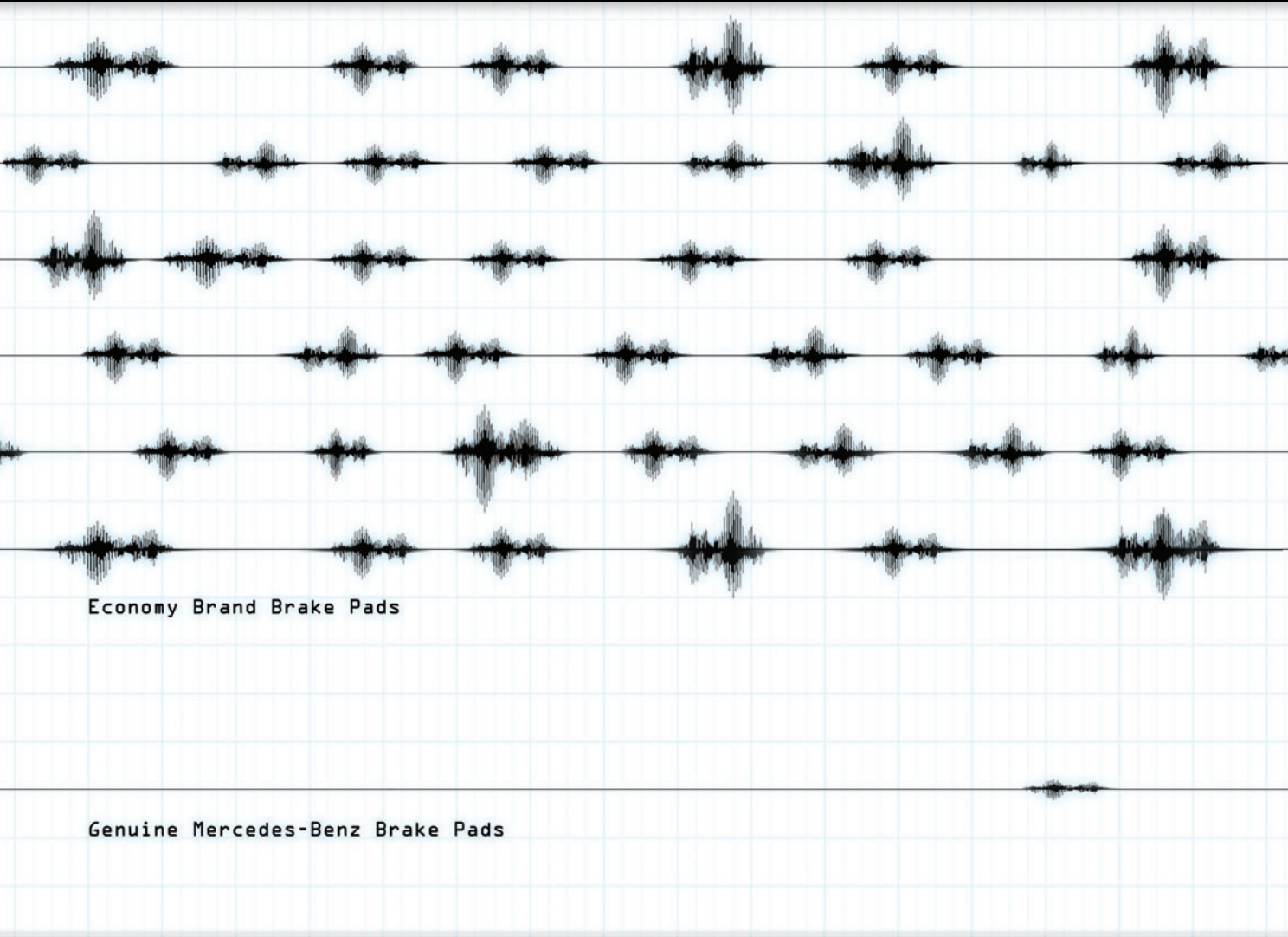
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APPRENTICESHIPS: YOUR EMPLOYABILITY AND ROI SOLUTION

Apprenticeships can be the answer for shops to make money while teaching a new technician how to repair and maintain vehicles — and how to do things the way they are done in your shop. Pete McNeil, owner, and Jake Sorensen, lead tech, with McNeil's AutoCare in Sandy, Utah, created their own apprentice program now certified by the U.S. Department of Labor. Their plan can be a blueprint for your shop. From outlining how it makes money for your shop practically right from the start to how it helps bring in quality employees, Pete and Jake discuss in the webinar why younger people are not interested in auto repair; the not-so-secret roadmap for success; the new NAPA AutoCare Apprentice Program; barriers techs and employers have to overcome; and your shop's potential success rate.

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PARTNERSHIP

EBAY MOTORS, CARADVISE GROW TIRE INSTALLATION PROGRAM

MOTOR AGE WIRE REPORTS //

➔ eBay announced a partnership with CarAdvise, a leading vehicle repair and maintenance technology platform, to expand the marketplace's Tire Installation Program (www.eBay.com/TireInstallation).

The new partnership with CarAdvise initially adds 3,500 tire shops to eBay's tire installer network that already includes top national chains like Firestone, Tires Plus, National Tire and Battery, and Tire Kingdom, among others.

Thousands of additional brand-

name shops within the CarAdvise network are slated to roll out over the coming months. eBay Motors' shoppers now have access to more than 10 times the amount of current tire listings that offer installation services at check out, with even more added throughout the year.

"As the nation's leading automotive repair and maintenance technology platform, we are thrilled to partner with eBay Motors allowing their customers to leverage our technology and extensive network to further

>> CONTINUES ON PAGE 6

BREAKING NEWS

ACQUISITION

EPICOR EXECUTIVE DETAILS "GREAT FIT" WITH MECHANICNET

➔ Last month, Epicor Software Corporation announced the acquisition of MechanicNet Group, Inc., a leading provider of customer relationship management and retention solutions for service repair businesses and their clients.

MechanicNet is a pioneer in the development of web-based CRM tools and related solutions designed to help vehicle service businesses increase sales and enhance customer satisfaction and loyalty. The company offers an array of solutions — service reminders, estimate follow-ups, online appointment setting, customer-facing service portals, shop-branded websites and comprehensive customer marketing campaigns — that have supported the growth of thousands of repair businesses throughout the U.S. and Canada. These solutions are compatible

>> CONTINUES ON PAGE 6

TRENDING

AUTO VALUE NAMES 13 TECH OF THE YEAR FINALISTS

Technicians were chosen because they stayed up to date on certifications, furthering their education and training and by maintaining superior automotive knowledge.

MOTORAGE.COM/13TECHS

NEXT DRIVE EXPO SET FOR CALIFORNIA

The upcoming three-day DRIVE Expo, set in September in Pomona, Calif., will offer management tools and a place to exchange ideas among other DRIVE clients.

MOTORAGE.COM/EXPO

AAPEX 2019 LINES UP TRAINING PARTNERS

Several industry groups will bring training expertise to the 2019 AAPEXedu, offering a mix of classroom, hands-on and underhood sessions to keep attendees ahead of the curve.

MOTORAGE.COM/EDU19

NORTHWOOD LAUNCHES MBA PROGRAM

Northwood University's Automotive Aftermarket Executive MBA program serves a wide-range of professionals that provide products and services for passenger and light to heavy-duty vehicles.

MOTORAGE.COM/MBA

ANTI-SAFETY INSPECTION BILL DIES

House Bill 451, opposed by multiple industry groups, and one that would have repealed a requirement that vehicles be inspected before being licensed has died in the Missouri legislature.

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streamline eBay's online tire buying process," said Greg Tepas, Founder & CEO, CarAdvise. "Through this partnership, we're able to connect with millions of eBay automotive shoppers, offering increased convenience and selection when it comes to servicing their vehicle."

"eBay Motors customers are able to shop our marketplace knowing they'll get an exceptional end-to-end automotive shopping experience," said Marie Niewiroski, Director of Parts and Accessories, eBay Motors.

"By expanding our Tire Installation Program with CarAdvise, we are providing a broad selection of tires from top brands, coupled with competitive pricing and local installation, to satisfy the needs of our eBay Motors customers."

How it works

Through the collaboration with CarAdvise, auto buyers shop top tire brands and conveniently add professional installation services with their purchase. At check-out, customers are prompted to choose a service provider in their local area and complete the transaction. Following payment on eBay, customers easily select a preferred date and time for their installation appointment and can even add additional services like a wheel alignment or oil change via the CarAdvise platform.

eBay's Tire Installation Program

eBay first introduced Tire Installation Services in the Summer of 2017 in Germany and the United States. With an initial 9,000 locations across the country, shoppers have the ability to bundle

new tire purchases with professional installation in their local area. The feature conveniently ships customers' tire purchases directly to nearby automotive repair shops for installation at no additional cost.

The expansion of the Tire Installation Program is another example of eBay's investment to improve the shopping experience through personalized shopping, convenience and value. In 2018, eBay announced partnerships with Handy, Porch and Installernet to launch eBay's installation services, in which shoppers have the ability to add a professional service for installation at checkout across home and electronic categories. eBay continues to make enhancements to the shopping experience and invest in opportunities to expand its selection, value and trusted, service offerings to meet the needs of shoppers. **TL**

>> CONTINUED FROM PAGE 4

with virtually every popular service management software platform, enabling users to integrate marketing and CRM activities into their daily business operations.

Scott Thompson, senior vice president, automotive and business services, Epicor Software Corporation, spoke with *Motor Age* about the acquisition, how MechanicNet fits into Epicor's existing portfolio and what is to come for the future of the companies.

What set MechanicNet apart to Epicor?

MechanicNet has been a pioneer in CRM and retention services for vehicle repair shops, and its platform was developed specifically to meet the needs of these front-line businesses. The solution works with most of the shop management systems and has a large base of users

who rely on its tools every day to help grow their businesses. And its purpose and capabilities are perfectly aligned with each of our other solutions for aftermarket businesses. This is a great fit.

Is there a plan to integrate current Epicor shop customers onto the MechanicNet platform?

Our existing portfolio of shop solutions includes the Epicor PartExpert eCatalog, which is embedded in many popular shop management systems; the Epicor Parts Network B2B eStore, which enables over 100,000 repair shops to look up and source parts through any of thousands of suppliers; and the Epicor Integrated Service Estimator solution, which helps service writers dramatically reduce the time needed to generate estimates and order the necessary parts and supplies for virtually any service occasion.

MechanicNet extends our portfolio to include outbound marketing, appointment setting and related CRM capabilities that help bring new and returning customers in the door. We are confident these capabilities will appeal to our existing customer base, and, similarly, that many MechanicNet customers will want to learn more about our other business growth solutions.

How do you feel the goals of MechanicNet and Epicor complement each other?

Ultimately, our industry depends on the continued health of front-line service businesses. MechanicNet and our other shop solutions are focused on helping these businesses attract and retain more customers, increase their operational efficiency and bay productivity, and access the latest and best information to complete each repair and provide a superior customer experience. **TL**

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TRAINING AND TEACHING TECHS

How to implement a new hire — and continue their education — in your shop

JOHN BURKHAUSER //

Contributing Editor

So, you landed a “green horn” — a new, inexperienced tech. Congratulations! With today’s employment environment, count yourself lucky. That’s great! But now, what are you going to do with him or her? Hopefully you have a plan in place for making this individual not only a great employee but a productive technician while not scaring them away by just putting them in a bay.

During the hiring process you should have gotten a good idea of the employee’s experience and knowledge. I’d recommend that you double check it for your own safety and liabilities. Many individuals will tell you what you want to hear so that they can get their foot in the door. Another reason to recheck the capabilities of your new employee is to put together a training program for them. With this knowledge you can start from the point that they can most benefit from. If the individual shows some good basic knowledge and skill, you do not necessarily have to spend time on these things; instead, you can move forward to what they need to know.

My recommendation is to have the new tech shadow you or one of your seasoned techs for maybe a week at first. What I mean by shadowing is that the new employee is only to watch and



pay attention to the tech they have been placed with. During this time the newbie is not permitted to do anything except watch and ask questions.

Some of you may question this method, especially since it will be costing you money, as the new tech isn’t bringing in any cash. You may wonder what they actually learn by shadowing.

During this time the newbie will learn how your shop flow works along with your other procedures that are in place to get the vehicles in and out efficiently. Watching how the leading tech goes about their day, the new tech will learn the best ways of doing things instead of having to muddle through and figure it out on their own, which may cost you money in vehicle

damage and inefficiency.

The other advantage of shadowing and only watching the lead tech is that you will see how well the individual follows directions and is motivated. Does the new person start ignoring the “just watch” rule? Do they hang close and ask questions? Do they look interested or are they mentally somewhere else?

If you find that they do not follow directions well or don’t look interested, you can address these items before you put them in a position where they could possibly cost you money or do real damage. Realize that for a young person, just watching can be a challenge and can indicate whether they will follow shop rules and best practices later.

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When the individual proves themselves through shadowing, put them to work doing oil changes. The lead tech should have them start pulling vehicles into the bay and putting them safely up on the lift while they watch and check each step. Set up a process such as:

1. Open the hood. Remove the oil cap and pull the dipstick partially out so it swings in the air to remind the tech that there is no oil in the vehicle when lowered.
2. Raise the vehicle partially up and check tire condition and pressure, adjusting it as necessary.
3. With the vehicle completely in the air, show where the oil drain goes when not in use, how to position it for minimum spillage and shifting it as the flow decreases.
4. Remove the old oil filter and not only look for but feel the filter base to be sure that the filter gasket has not been left behind.
5. Lubricate the new filter gasket and install by hand. Install and torque the oil pan plug. Clean up any oil that may have gotten on the engine or exhaust, etc. Move the oil drain to its spot. (Drain it if needed.)
6. Lower the vehicle, get the proper oil type and amount and pour into the engine. Replace cap and insert dipstick.
7. Start and run the engine, peeking underneath the vehicle to check for any leaks.
8. Shut off engine, reset the maintenance minder, check and clean up any spilled oil under the hood, pull the dipstick and verify proper oil level.
9. Close the hood check that it latched, apply reminder sticker and pull the vehicle out of the bay.

This may seem ridiculous, but it does serve a purpose. Again, you will see if the individual follows directions. Do they perform every step consistently? Are they focused? Are they put-

ting together a system that makes these steps flow smoothly?

From this point onward, when the newbie has completed all oil changes or other work they are assigned, the lead tech can start giving them other jobs to complete while monitoring their work.

Over time the employee will become more adept to performing many services and jobs and will be weaned away from the lead tech to work independently with little oversight. But don't think that the training ends here.

With technology constantly evolving in vehicles, training must continue to keep up with the changes. Any shop that does not believe this is risking life, limb and their business. No one can afford to learn by poking around in today's vehicles like you could 20 years ago.

Yes, training costs money and takes time, but you will find that with proper training, your efficiency will improve, and you will have less comebacks. You can also reduce your liability because you know better being less likely to make a fatal mistake.

"Where can I get this training?" might be the next question you have. The answer is most anywhere — all you must do is look! As it has become more evident how important training has become, more training is appearing. Parts companies and stores see the importance of training, so they see providing training as a way to get their products in front of you, hoping if they train you, you might buy their products.

An example of this is Garage Gurus. Garage Gurus has created a "Tech First" initiative sponsored by Federal-Mogul Motorparts. They have shops with classrooms scattered across the country. Go to their website and you will find that not only do they have actual classroom courses, they have a mobile unit that can provide training anywhere. Additionally, you will find that they also have on-demand train-

ing on their website.

The training that is provided by Garage Gurus covers many of the systems that you will see every day from brakes, steering, engine sealing and more. There is also a "quick tips" section where you can find tips that may help you with a vehicle. They allow technicians to share any tips that they might have to help others.

Look for local organizations that support shops like yours such as the Automotive Service Association (ASA). Many states have their own local ASA groups that sponsor training events across the country. Vision in Kansas City is one of the larger events. Hundreds of techs from across the Midwest travel to the event to take part in the many classes that are offered. The courses are many and varied, again covering the automotive systems that you see every day. Also, be aware that connecting with your local ASA also provides other advantages for your shop, so check them out.

Training needs to be a required part of the technician's job. It is too risky to learn as you work on a vehicle; mistakes can be fatal. Whether they are a newbie or experienced tech, everyone will benefit from training. Shop owners and managers need to stop looking at the costs and time required and understand that training needs to be a part of your shop's success plan. Fortunately, training is available — all you need to do is look for it and get it done. Make it happen. *ZZZ*



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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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Inspection organization		
Name: LaunchTechUSA Address: 1820 S Milliken Ave Ontario CA Contact Number: 0 5624831580 RN : 989700201020 Time and date of inspection: 10/09/2018 11:58:57 Inspection Location: 9 2489 Arroyo Dr, Corona, CA 92678, USA		
Inspection result		
There are 2 issues for Power system:		
1. On-Board Diagnostic (OBD) Systems Readiness Test: Incomplete		
2. Too Low ICP - Engine Cranking		
There are 2 issues for Safety and Security system:		
1. CAN Communication Bus Error - Reception Error		
2. FR Wheel Speed Sensor Input Circuit Fault		
There are 7 issues for Vehicle body system:		
1. Brake On/Off Switch Circuit Fault		
2. Transfer Case 2WD (Two Wheel Drive) Solenoid Circuit Open Or Short To Ground		
3. Ignition Run/Accessory Circuit Fault		
4. Transmission Transfer Case 4WD (Four Wheel Drive) Solenoid Circuit Fault		
5. Ignition Key In Circuit Error		
6. CAN Communication Bus Error - Reception Error		
7. Ignition Switch Circuit Open		
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1. TCM (Transmission Control Module)		
Inspections are normal for Safety and Security system		
1. PAM (Parking Aid Module)		
2. TBC (Trailer Brake Control Module)		
3. PCM (Restraint Control Module)		
4. VSM (Vehicle Security Module)		
Professional Report		
GEM (Generic Electronic Module)	Abnormal	1
ABS (Anti-Lock Braking System)	Abnormal	2
IC (Instrument Cluster)	Abnormal	2
PAM (Parking Aid Module)	Normal	1
PCM (Powertrain Control Module)	Abnormal	2
TBC (Trailer Brake Control Module)	Normal	1
TCM (Transmission Control Module)	Normal	1
RCM (Restraint Control Module)	Normal	1
VSM (Vehicle Security Module)	Normal	1

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The magic bullet for auto shop success

The shop owner — not the next big thing — drives the business direction

If you are looking for the ultimate magic bullet, then let's listen to an ATI coach and former shop owner, Rick Johnson: Over the many years of owning and running my shop, I was constantly being approached by salespeople with their special one-of-a-kind solution. Whether it be the latest brake lathe, Freon machine, or shop management software — what they were selling was truly amazing and would certainly produce wonderful results. I was always left wondering would it work for me . . . could it work for me?

One great example goes back to 1992, a time when I was still using handwritten tickets. A salesman came knocking on my door peddling his new shop management system. He demonstrated the system wonderfully, showing me how it would automate so many of my processes and make my life easier. What's more, I was so excited about his claim that my shop would soon be paperless! Wow, did that sound good! After years of handwriting tickets, copying and filing duplicates and triplicates of nearly everything, this was going to be

a game changer! The reality is that after I bought and installed this wonderful new system (the latest "shiny penny"), I was now generating more paper than ever before! I began to wonder, was it me? Did I do something wrong?

SHOP OWNERS TRY THESE SHINY PENNIES AND THEN GET DISCOURAGED WHEN THEY DON'T GET THE RESULTS PROMISED. AT THE END OF THE DAY, WHETHER THESE WIDGETS SUCCEED OR FAIL COMES DOWN TO YOU AS THE OWNER.



Three years later, here comes another salesperson selling a competing shop management system with more bells and whistles than the system I had. Thankfully, I didn't buy it, but I did realize something about myself. Truthfully, I was looking for shiny pennies and magic bullets that would take my shop

to the next level — and I must admit, I tried most of them. Some worked, while others failed miserably. For the ones that failed, I wondered what went wrong, or what I didn't understand.

It's common to want the next big thing

I know I'm not alone in my line of thinking. As a coach today, I work with lots of different shop owners. I'm often asked what I know or think about this widget or that marketing tool, or vendor. They often want to try some exciting, new kid on the block that's preaching radically different ideals that go against proven business practices. Shop owners try these shiny pennies and then get discouraged when they don't get the results promised. It's also frustrating when they know of shop owners that are using the same widget, service or advice and getting "killer" results. As we talk about these things and dig into why, I have the same answer I've learned many years ago at my own shop.

Before I give you the answer, I'm going to share a story that I was told many years before I ever bought my shop, and yet it still applies today.

The story goes something like this: a big shoe company sent two salesmen to a remote developing country. They gave each salesman 10 cases of shoes to sell. The first salesman sent a telegram that said he was sending the shoes back because no one there wears shoes. The second salesman sent a telegram that requested 10 more cases of shoes because no one has shoes — it's a wide-open market! Think about it: same market,

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same products, same opportunities and yet totally different results. Do you know why? The difference is in the salesmen and their perspective and approach.

Your sure-fire strategy for magic bullet success

By now you're probably thinking, there's no magic bullet for my shop's success, but I'm happy to tell you that's not true. The magic bullet is actually you. At the end of the day, whether these widgets, advice or services succeed or fail, comes down to you as the shop owner. Can it really be that simple and yet that hard at the same time? You're darn right it can! Your success with these endeavors will depend on how hard you're willing to work.

At minimum, before implementing anything new that will cause a major change in your shop, you must be ready to answer these five questions:

1. Does it align with my shop strategy?
2. How will it impact my current processes and procedures?
3. Will I get buy-in from my staff and will they be engaged?
4. How will I train my staff?
5. How will I measure success?

Until you can answer these questions, I would ask you to wait on making your new shiny penny purchase, or it will soon dull to be like all the others. Instead, challenge yourself to determine why you're not getting the results that you want rather than look for the next



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 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 former shop owner and ATI Coach Rick Johnson.

chubby@autotraining.net

new thing. Ask yourself if you are doing all that you can with what you currently have. Because no other shop in America has you, and you are the difference maker! Remember, it's a wide-open market, now go out and sell!

Get started today!

A great place to start would be with the

"Exceptional Customer Service Checklist." How consistent are you? How about your staff? Before you spend time and energy on new products, advice, services and marketing tips, let's see how good you are at delivering "Exceptional Customer Service" with this great checklist. Simply go to www.ationlinetraining.com/2019-07 for a limited time.

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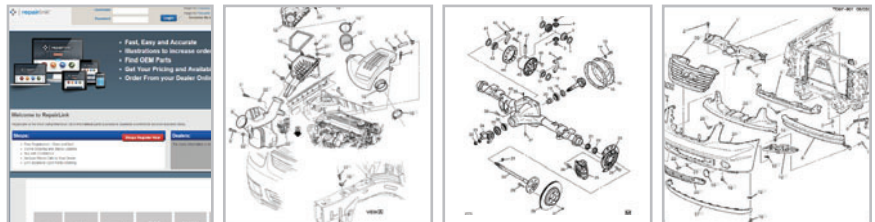


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FROM THE GROUND UP

Now more than ever, it's time to take a chance on entry-level employees, help them find a career path and encourage them to stay in the industry.

BRYCE HOLT // Contributing Editor

If you've been around the automotive industry for any length of time, you probably are fully aware of a couple of things. First, the technician shortage is very real. According to the U.S. Bureau of Labor Statistics, this country needs about 76,000 auto service technicians each year between 2016 and 2026. These new technicians would replace those retiring or leaving the industry and fill new openings.

Let's be clear — the shortage does not just affect the automotive industry. Nearly all technical industries currently face a shortage. However, the automotive industry faces a particularly challenging situation because aviation, marine, wind energy, oil and gas, con-

struction and other industries are actively recruiting from the automotive trades. Pair that with rapid technology advancements that increase the need for technicians, and the supply-demand outlook is pretty grim.

Second, this problem will likely take decades to solve because there is not just one answer to the problem. That is why it is so important to take the time to find the entry-level techs you need today, grow them into the techs you need tomorrow and provide quality mentoring so they stay in the industry for years to come.

Taking a chance

When the outlook to fill a vacancy seems impossible, what is a shop to

do? Sit back and watch it happen? Turn customers away? Pay your employees overtime because you can't complete the jobs during regular work hours?

Perhaps a better solution is to think practically about how to fill that technician pipeline. It could be that the answer is right down the road at your local tech school or post-secondary automotive program.

But wait — can you afford to hire entry-level? Won't they make a lot of mistakes because of their lack of experience? And will they stay in the industry? Are they worth your consideration?

Though these may be valid questions, there are many reasons to take a chance on entry-level, semi-skilled technicians:

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- **Their enthusiasm.** Career-tech students may have tinkered with cars or motorcycles at home, and they have experience from their school shop environment, but this may be their first exposure to a real workplace. With that first job comes the excitement of learning all they can as they work their way to the more difficult skilled tasks.

- **Their love of technology.** Technology has changed cars in countless ways over the past couple of decades, and more changes are coming down the pike. Students coming out of career tech have grown up with these new technologies and are eager to share their knowledge. They have been exposed to all kinds of computers, tablets, smart devices and other technology, so they may adapt better to rapid technological changes. The old ways have been changing for some time now, and your business needs employees with fresh attitudes who are willing to take the leap with technology.

- **Their willingness to learn.** Often a new employee, no matter what the age or experience, wants to start with the most complex task instead of learning the basics and getting to know the specific shop environment. Entry-level employees are no different. It may take some coaxing to convince them to slow down and take their time, but it will be worth the effort. An eager willingness to learn may set an entry-level employee apart from those who've been in the industry for years and would rather not take the time to learn new technologies or ways of doing things. Good employees always relish an opportunity to learn, no matter what their age or experience.

- **Your commitment to grow your own.** You've heard this phrase before, but have you really thought about the advantages of developing an employee over a period of years? This doesn't mean you neglect your long-term employees, but it does mean that you make a steadfast commitment to an

employee who is willing to grow within your business. An entry-level person can be trained and molded to the traits and habits of your business, and this makes them a potentially valuable team player.

- **It might be all you can find.** Apart from poaching from your competitors, what are your other options when looking to hire? As mentioned earlier, many career-tech students with automotive experience are being drawn away by other industries. Many of these industries involve similar skill sets, and they are actively attempting to out-recruit the automotive industry, either with more compelling opportunities, better benefit programs and/or more pay at the outset. Don't let your unwillingness to hire entry-level employees make it more difficult for your business in the long run.

In your own neighborhood

So let's say you are willing to hire entry-level or semi-skilled technicians. Where do you find them? This may be easier than you realize, and they might just be in your own neighborhood.

Here are some ways to foster relationships with those who have access to the entry-level technicians you need:

- **Visit your local career-tech schools.** Do you know the career-tech schools and post-secondary programs in your area? See if you can visit the program, observe the students and visualize the needs. You may be a graduate of a local program; use this opportunity to stop by the school to share your own success story. Making a site visit may help you come up with ideas of how you can form a partnership or at least plant the seed that your business is willing to hire young people. Putting a face with a business name can help students see themselves in the industry. Let them know you can be a resource as they further their education and envision their career path.

- **Join your local school's advisory board.** There may be an oppor-

tunity to join the advisory board at your local career tech or college. The board often has more input than an instructor regarding funding, as it is often composed of a mix of people with a range of experience. Often, joining a board is not a huge commitment, but the rewards are many. You may have the opportunity to offer guidance on the needs of the industry, how the curriculum fits with those needs, and how industry and schools can partner together.

- **Get to know the automotive instructors.** Instructors are busy in the classroom, but they need guidance from industry about what skills need to be emphasized and how they can be supported. Connect with instructors as you travel to trade shows, conferences and other learning opportunities. Let them know you are interested in helping their students find career paths, not just jobs, in automotive. Tell them you need skilled technicians, and find out who their best students are.

- **Get to know the higher-level administrators at career-tech schools.** The president of the college might not be a "car guy" or aware of how much the automotive industry has changed over the years and what the program needs might be. Open the lines of communication regarding today's changing automotive marketplace. Leadership needs to hear from industry what is needed to support the program. Sometimes it's about starting a dialogue.

- **School career counselors are a great source.** They have direct contact with students and are involved in helping them make career choices. Tell them what you are looking for so they can guide students in your direction. Let them know about the math and technology components to the automotive industry today — start changing the perception at the career counselor level.

- **Donate something to a program.** Many career-tech programs or

classes lack funding for the basics of working on today's cars. Your shop may not have a large budget to work with, but any donation will help you forge a partnership with your local school. Put your business name on it and let them see you have a vested interest in the program.

- **Have an open house at your shop.** Open your shop for a half-day or a few hours, letting students walk around the shop, ask questions and observe your technicians working. Introduce them to all aspects of the business, from the front desk to the parts department to the work areas. Let them see the possibilities of all of the jobs they may encounter in the industry. Expose students to the real world in an easy, free and effective way. Introduce your employees, and have them explain what they do on a daily basis. Be sure to let your employees know you will be having guests and to be friendly and welcoming. Let students observe the best techs in your business.

Invite the best students back for a "job shadowing" day and see how serious they are about getting a mentorship or a job. This is an opportunity for a one-on-one connection that you might not get elsewhere. Help them to a good start in a career they want!

- **Use S/P2 Careers as a recruiting tool.** S/P2 Careers is the automotive industry's largest career database, with more than 50,000 resumes of today's career-tech students who are ready to take their career to the next level. These students have created a resume through their career-tech school and are looking for part-time, full-time and internship or mentoring opportunities.


BRYCE HOLT is COO of S/P2. Each year, S/P2 provides online training to more than 175,000 workers and students nationwide on industry-specific safety and pollution prevention, ethics, soft skills, and human resources topics, as well as an online workplace mentoring program for the automotive industry.

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A balanced combination

The best long-lasting combination of employees in your shop are a mix of experienced and entry level. Ideally, the ones with years of experience will be willing to mentor the young, and the ones with just a little bit of experience will be willing to learn and pass on what they know, too.

Take a chance on a young person,

and you might be surprised at the successes you will achieve. The perception of this industry isn't going to get any better unless businesses are out there participating with our young people. Keep in mind that there are a lot of other industries out there who would love to have these entry-level techs — get them while you can! 

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A disconnect in the business can destroy success

Your team needs a common purpose, agenda and commitment to thrive

All shop owners have — at one point in time over the last quarter — most likely felt the frustration of the business being seemingly stuck in inertia, rather than moving forward. It has been a tough first quarter in general for nearly everyone across the country. Many shop owners have expressed frustration with the shortage of personnel within the industry and the current staff “not getting it,” which in turn has created a negative atmosphere and a dark cloud throughout the shop.

The phrase “not getting it” really isn’t the true problem. The proper phrase should be that they have a disconnect with the business and specifically their position within the business. When that happens, the bottom line disappears.

Consider the definition of the word “disconnect” — people sharing a common space, but not sharing a common purpose, a common agenda or a common commitment. The result is consistent conflict that keeps them working against each other in meeting goals.

Many people who have attended our classes have always heard that it is important to “inspect what you expect.” Time must be set aside to ensure that all of your staff members are performing their tasks with a common purpose, a common agenda and a common commitment to the success of the shop because they understand the importance of it to the team, the business and are very

proud of the function they have.

Management’s No. 1 function in business really is to build relationships, and one of the most important relationships is with the staff. Take the time to ask each staff member to explain in detail their function within the business and how it fits within the entire business set of goals as it affects the team and desired business outcome as a whole. Listen very carefully to them. If they can’t explain it completely, then there is a disconnect

MANAGEMENT’S NO. 1 FUNCTION IN BUSINESS IS TO BUILD RELATIONSHIPS, AND ONE OF THE MOST IMPORTANT RELATIONSHIPS IS WITH THE STAFF. LISTEN CAREFULLY TO THEM.

and that entire picture now must be redrawn again by you for them. Walk them through their role and how it plays into the business as a whole. Once you have redrawn the picture, have them repeat the understanding in their own words.

This disconnect, if not handled properly, will continue to grow stress within the building, possibly causing a key person to leave the business. This could lead to the bottom line continuing to erode. That is a sink hole, meaning you have an emotional let-down that steals your energy, focus, determination and desire. The

result is you feeling uncertain about what to do to try to fix your business or where to even start.

Every one of us in business has been through this at some given time. The important point is to recognize it and deal with it calmly and logically. The sun will still come up in the morning, so be positive, take the emotion out of it and reconnect the team to each other, the business and their careers.

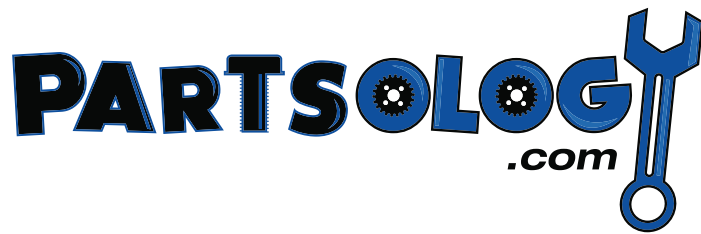
To continue moving forward and connecting with the team, ensure you review daily the businesses performance along with the team’s performance. Always connect the two in a positive way. By that, I mean that constructive criticism only works when the team trusts what you are saying, knowing that they will benefit also for listening to you and performing your suggestions. A connected team that believes in the direction of the company and how it is going to achieve their objectives becomes a very productive team, which in turn drives self-confidence throughout the shop and net income to the business. Now those are results worth striving for. *ZZZ*



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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TRADING OUT TIRES

Buying quality used tires starts with a reputable supplier

PAUL ARELLANO // Contributing Editor

When it comes to acquiring used tires for resale, quality is key. A lot of consumers are looking for used rather than new for the obvious reason of saving money. This has created a growing market for used tires. Whether you're a collision shop looking to fix damaged tires while keeping an estimate more affordable or a service repair shop looking to replace worn tires, your shop could make a lot of money on used tire sales, but to get started, you need to find a supplier.

The key to consistent quality is the right supplier

There are a variety of options available, from huge importers to local suppliers. There are also some scrap tire recyclers that salvage the usable tires they collect. Regardless of what supplier you choose, you want to make sure you pick a reputable one. Here are some signs of a good used tire supplier.

They inspect their tires thoroughly

When it comes to inspecting used tires, a quick visual examination isn't good enough. Any reputable used tire supplier will

have a dedicated inspection team that is up-to-date on the latest standards. This type of knowledge takes training. Each tire should be examined in a detailed inspection process.

When vetting suppliers, ask them about their inspection process. Also clarify who does the inspections and what kind of training they have. If the supplier can't give you confident, specific answers to your questions, don't buy from them.

They have a variety of sizes and treads available

Experienced suppliers will carry a wide variety of sizes and treads. When considering vendors, be transparent with them about your exact needs. You may even be able to negotiate price. Tell them what sizes and treads you'll need, and the quantities of each type.

They offer competitive pricing

Understand that suppliers need to make a profit, too. That being said, you should see what kind of pricing a vendor's competitors are offering. This will give you a good idea of whether you're getting a fair price. Also take into account any mini-

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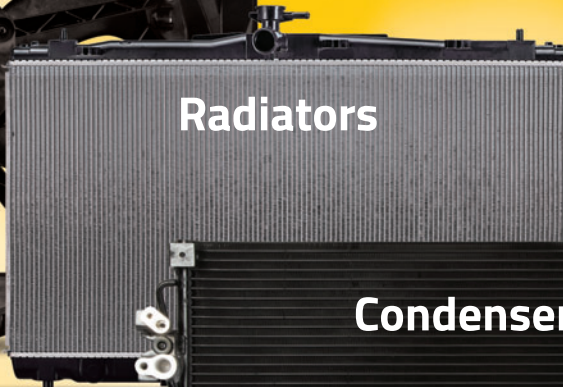
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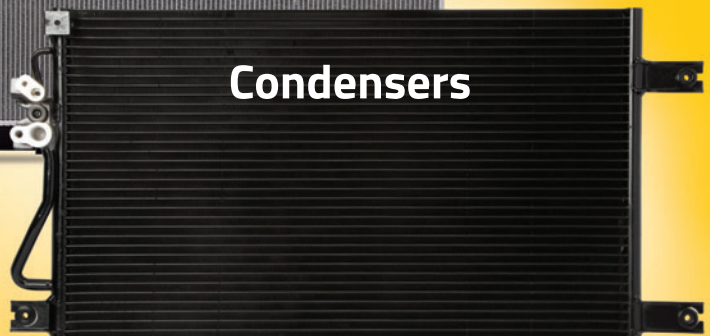
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mum order requirements and order processing times.

They receive positive online reviews

Search for suppliers online and see if you can find them listed on established review sites like the Better Business Bureau or Yellow Pages. Don't just look at the number of stars a supplier gets; read through the reviews. If none of them contain any comments, then the reviews may not be legitimate. It can also be informative to read the negative reviews, but you should take them with a grain of salt, as reviewers can sometimes get emotional and may exaggerate when this happens. If several different people are saying similar things, this is a good indication that the reviews have truth to them.

Thoroughly research potential suppliers

Once you've narrowed down your search to just a few vendors, talk to previous customers. Be sure to find customers who were satisfied and customers who were unsatisfied so that you get a complete picture of how each supplier manages their business.

There is an abundance of online databases, such as Alibaba.com, that exist to connect you to wholesale tire suppliers. However, these databases may not always be a great source to find credible vendors. While there are probably reputable companies listed on such sites, it's best to establish a relationship with a supplier in your own country. Used tire safety laws can vary, and you want someone who has been operating in your country and is familiar with the laws. It's also easier to vet your supplier if you're close enough for an in-person meeting.

The importance of quality used tires

You know tire safety is important and you want to sell your customers quality

used tires. Besides ensuring your customers are happy, there's another vitally important consideration you need to take into account. You could find yourself facing a lawsuit if you were to sell a faulty or compromised used tire.

Many states are now passing laws banning the sale of unsafe used tires. What constitutes "unsafe" varies by state.

For example, a proposed bill in Texas defines an unsafe used tire as a "passenger or light truck tire that has tread less than one-sixteenth inch deep; has chunking, bumps, knots or bulges evidencing cord, ply or tread separation from the casing or other adjacent material; has exposed tire cords or belting material as a result of damage to the tire; has a repair to the tire in the tread shoulder, sidewall, bead area, or belt edge area; has a puncture that has not been sealed or patched on the inside with a cured rubber stem or plug that extends through to the outside surface; does not clearly show the United States Department of Transportation tire identification number located on the sidewall of the tire; is subject to a manufacturer's safety recall; has a puncture larger than one-quarter inch; or does not otherwise meet department safety standards under Section 547.101."

Most of these bills aim to apply common-sense standards that tire dealers should already be following, but it's important to be aware of any upcoming legislation and know the standards for tire safety in your state.

The thought of litigation can be frightening for any shop. One large settlement could potentially put you out of business, and then there's the issue of negative press. How can shops protect themselves from lawsuits?

Inspect your used tires before selling

The best defense you have is to inspect each tire before you sell it. Besides visually inspecting it for defects and improv-

er repairs, you should use an air test to look for leaks, examine tread depth, and judge the overall wear. It's also a good idea to put the tires on yourself, rather than just selling them loose to the consumer. This way, you can ensure that they're properly installed.

Inform the customer of the risks

Inform your customers about potential risks with used tires. Make sure they are aware of manufacturer guidelines for use. While there is no way to be completely certain a used tire won't pose a safety hazard, if you do your due diligence and keep written records of the types of inspections performed on your used tires and what information is relayed to the customer, you should be protected in the case of a lawsuit.

Arkansas trial lawyer Tab Turner puts it succinctly: "All dealers in used products have to do is recognize that they are legally responsible if they distribute defective products; be honest and truthful to consumers, fully inform consumers of the known risks associated with the used product, inspect the product to ensure that it does not contain a defect and make sure that all information provided by the manufacturer regarding usage are followed and relayed to the consumer."

The used tire industry is growing. Now could be the perfect time for your shop to get into selling used tires. It's vitally important that you choose a reputable supplier, inspect your tires before selling them, and inform each customer of the risks associated with used tires. It may be a bit of extra work for your shop, but the peace of mind will be worth it as well as the additional revenue. *ZZ*



PAUL ARELLANO is the sales and marketing

manager at Lakin Tire, a scrap tire recycler and used tire supplier. Lakin is committed to providing safer, smarter recycling solutions and high-quality used tires.

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Bill includes vehicle safety, technology language

Legislation includes new automated Safety Center of Excellence

The U.S. House of Representatives is set to consider the Fiscal Year 2020 Transportation Appropriations legislation on the House floor soon. The bill provides \$86.6 billion for investments in infrastructure and other U.S. Department of Transportation administrative and project expenditures. Important for independent automotive repairers are House Appropriations Committee initiatives that were also included in the legislation.

House and Senate Appropriations Committees are trying to get their bills approved prior to the end of the fiscal year, Sept. 30, 2019. The Transportation bill will be bundled with four other appropriations packages. This “minibus” is an effort to avoid the gridlock in the appropriations process in recent congressional sessions.

Some of the key initiatives included, relative to automotive repairers, are the creation of a new Center for Excellence at the U.S. Department of Transportation (DOT) that focuses on Highly Automated Systems Safety, a provision directing the National Highway Traffic Safety Administration to provide more regulatory oversight of the development of autonomous vehicles and instructions for NHTSA to re-focus its efforts on new structural materials for vehicle manufacturing.

Highly Automated Systems Safety Center of Excellence (COE) — Advanced technologies are rapidly transforming the national transportation system, and are already critical components in airplanes, trains and motor vehicles. In recent years, multiple fatal accidents have underscored the importance of validating the safety of new technologies. As automated technologies become more widespread, the Committee believes the safety of the traveling public jointly depends on technology developers, owners and operators, and appropriate Federal regulations and effective oversight. To ensure automated technologies are safe and work as intended, the Department needs a workforce that can review and analyze complex transportation-based systems. The Highly Automated Systems Safety



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COE would serve as a dedicated workforce at the Department with the necessary skills and expertise to audit, inspect and certify the safety of highly automated systems across all modes of transportation.

Autonomous vehicles — Autonomous vehicles (AVs) have the potential to transform transportation networks by reducing the number of lives lost on our roads and by improving mobility options. Research into the safety and operations of these new technologies is a key part of NHTSA's mission. To that end, the Committee provides not less than \$18.5 million for NHTSA to continue research on AVs, automated driving systems, advanced driver assistance systems (ADAS) and vehicle electronics and cybersecurity. The Committee anticipates that NHTSA will include analysis of both vehicles without drivers and without passengers in its analysis. The Committee supports performance-based minimum standards for AVs and directs NHTSA to collaborate with the Office of the Secretary to ensure that AVs are safe for occupants, other drivers, pedestrians and cyclists.

Crashworthiness research —The Committee recognizes the importance that lightweight plastics and polymer composites play to improve automotive safety, meet consumer demand for innovative vehicles, increase fuel efficiency and support new U.S. highly skilled manufacturing jobs. NHTSA is encouraged to focus on updating the countermeasures in its frontal, side, rollover, front seatbacks and lower interior impacts for children and small adults as well as pedestrian crashworthiness projects, with an emphasis on vehicle lightweighting in both traditional and autonomous vehicle structural designs.

To view more of Congress' efforts in the automotive space, please go to ASA's legislative website, www.TakingtheHill.com. *ZZ*

ROBERT REDDING is the Automotive Service Association's Washington, D.C. representative. He has served as a member of several federal and state advisory committees involved in the automotive industry. rredding@reddingfirm.com



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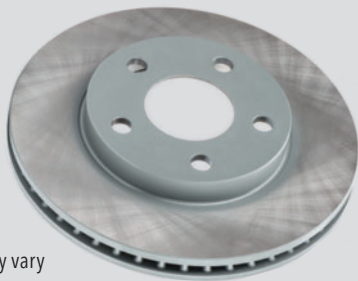


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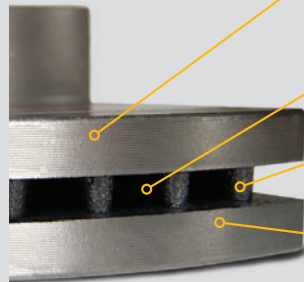
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KEEP CUSTOMERS COMING BACK

How to identify, target and drive your best customers continually back into the shop

TIM ROSS // Contributing Editor

Don't know one shop owner who doesn't want to increase sales. Yet, many fail to dedicate time to the one thing that is guaranteed to drive sales — customer retention. Cultivating loyalty among your customer base is a surefire way to ensure a steady flow of business. Unfortunately, shop owners often put all their energy into luring new customers, mistakenly assuming that existing customers will automatically return to their shop when the need arises.

Placing more focus on improving customer retention will not only increase sales but will also drive up your average repair order, since customers who are familiar with your shop and trust you are more likely to spend more money than those there for the first time. It also costs more to acquire a new customer than to keep an existing one. How much more? According to the Harvard Business Review, customer acquisition costs businesses anywhere from five to 25 times more than customer retention.

So, how can you keep your customers happy and coming back? The first step is to make sure you're delivering an exceptional experience every time they visit your shop.



Offer excellence

You may not realize it, but customer retention begins the minute someone searches for your shop online. If you offer a well thought-out, easy-to-navigate website, you'll not only stand a better chance of attracting them initially, but into the future. Your physical shop should match your online presence. The branding, color scheme and offers should be the same as what a potential customer encountered online. First impressions are key. What does a customer find when they approach your shop? Is the parking lot well-lit and secure? Is your shop clean and inviting? Is your

staff welcoming? Do they greet customers promptly? All of these characteristics factor into whether a customer will make a second visit.

Providing outstanding customer service will also differentiate your shop from competitors and make it easy to retain customers. As I've discussed before, the best way to stand out is to become a "yes" company. Being a yes company means going above and beyond to accommodate customers even when it's inconvenient. For example, instead of turning down a last-minute oil change when your technicians are busy with a major repair job, find a way to fit it in and you'll

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Roxie speaks loudly as she calls out each module being scanned.

Roxie Utilizes an integral plug and play cellular toggling technology that seeks out the strongest signal from two providers. Roxie doesn't require any Wi-Fi, Bluetooth pairing or Smartphone Connection. Roxie is the perfect solution for Collision/MSO shops requiring a Pre/Post scan report without the need of a trained scan tool technician or reoccurring remote diagnostics service.

Report No.: A0000014193

Full vehicle systems AI inspection report
This report is created by
LAUNCH ROXIE

Vehicle Information

VIN: 1FTWW01P0E001636
Vehicle manufacturer/model: FordF-350
Year of manufacture: 2009
Mileage: 230371 KM

Inspection organization

Name: LaunchTechUSA
Address: 1820 S Milliken Ave Ontario CA
Contact Number: 5624831580
SW: 98970001023
Time and date of inspection: 10/09/2018 11:58:57
Inspection Location: 92499 Arsenio Dr, Covina, CA 92979, USA

Inspection result

There are 2 issues for Power system:

1. On-board Diagnostic (OBD) Systems Readiness Test Incomplete
2. Too Low ICP - Engine Cranking

There are 2 issues for Safety and Security system:

1. CAN Communication Bus Error - Reception Error
2. FR Wheel Speed Sensor Input Circuit Fault

There are 7 issues for Vehicle body system:

1. Brake On/Off Switch Circuit Fault
2. Transfer Case 2WD (Two Wheel Drive) Solenoid Circuit Open Or Short To Ground
3. Ignition Run/Accessory Circuit Fault
4. Transmission Transfer Case 4WD (Four Wheel Drive) Solenoid Circuit Fault
5. Ignition Key In Circuit Error
6. CAN Communication Bus Error - Reception Error
7. Ignition Switch Circuit Open

Inspections are normal for Power system

1. TCM (Transmission Control Module)

Inspections are normal for Safety and Security system

1. PAM (Parking Aid Module)
2. TBC (Trailer Brake Control Module)
3. RCM (Restraint Control Module)
4. VSM (Vehicle Security Module)

Professional Report

Module	Status
GEM (Generic Electronic Module)	Abnormal
ABS (Anti-Lock Braking System)	Abnormal
IC (Instrument Cluster)	Abnormal
PAM (Parking Aid Module)	Normal
PCM (Powertrain Control Module)	Abnormal
TBC (Trailer Brake Control Module)	Normal
TCM (Transmission Control Module)	Normal
RCM (Restraint Control Module)	Normal
VSM (Vehicle Security Module)	Normal

**- PRE & POST REPORT -
WILL AUTOMATICALLY SEND UP TO 5 EMAIL ADDRESSES**

earn a reputation for convenience and flexibility. Open your shop on Saturdays to provide more options for customers who have difficulty stopping in during the week. When a customer brings their vehicle to your shop, make a point of keeping them informed on repairs/services even if it creates extra work for technicians or front desk staff. Going the extra mile — while often challenging — will make your shop memorable.

Make marketing a priority

Let's say you have the customer service part of the puzzle mastered. You've established such a strong reputation that your previous customers are guaranteed to return, right? Well, not exactly. Don't forget that your competitors are constantly marketing to your customers and if their messages hit at the right time, that shop might be the one your customer calls for their next maintenance or service concern. To keep pace, you can't take anything for granted — you have to market, too.

A great option for reaching your existing customers is direct mail. With direct mail, you can target customers closest to your shop by income, car make and a variety of other variables. An easy way to connect with existing customers is to simply incorporate your current customer database in the mailings you might be sending as part of your customer acquisition efforts. In fact, I always recommend that shop owners never remove existing customers from their direct mail campaigns. At a minimum, this approach ensures that your existing customers are receiving your messages on a monthly or quarterly basis, and you're able to blunt the impact of competitors.

For customers who have spent significant sums in the past — say \$300 or more — I suggest a more aggressive strategy. Instead of just including this group with your larger mailings, target

them with a gift card worth \$25 off any service. This provides a stronger incentive to return. You can also personalize your postcards to these customers with information about their vehicle, citing specific services or maintenance that might be coming due. By offering discounts on the specific services an existing customer needs, you give them a stronger reason to use your shop rather than a competitor offering a more generic promotion.

Foster connections

Newsletters are also a good tool for cultivating loyalty — particularly among those customers who are focused on more than just price. For independent shop owners, taking the time to develop a printed newsletter helps distinguish them from corporate chains, whose marketing materials often lack that personal touch. In terms of content, the newsletter should give customers the chance to learn a little more about the shop and their local community. Highlighting the owner, employees, community activities, recipes and even sharing a few jokes will make this piece feel less promotional and more compelling to readers.

Digital options

Of course, it's impossible to discuss marketing strategies for customer retention without touching on the opportunities now available through digital media. While email has always been a great way to easily remind existing customers about upcoming service and current promotions, that's just the tip of the iceberg in terms of digital options. Geotargeting has opened a whole new world of possibilities for marketers. The practice allows advertisers to deliver digital content to potential customers based on their location. For example, a shop owner could send a targeted ad to a person searching for Toyota repair within a certain mile radius of their shop. When it

comes to customer retention, geotargeting can be especially powerful because you can deliver ads based on buying patterns and past behaviors. Geotargeting can also work in concert with direct mail. You can set up what's known as a "geofence" around the homes you've mailed to and then deliver digital ads to those residents both before and after sending a mailing, helping to reinforce the messages on your postcards.

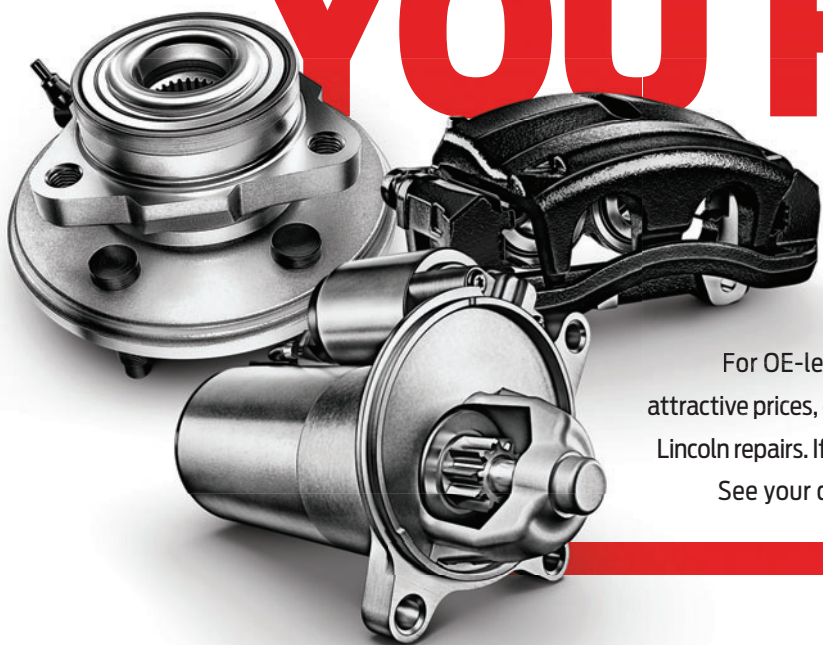
One last thing worth noting is the importance of tracking data. It's difficult to market to existing customers unless you have information on who they are, how frequently they visit your shop and how much they spend when they do. With that data in hand, you'll be able to better develop advertising and promotions to drive those customers back into your shop. It also makes sense to track customer count and revenue, average repair order, offer redemptions and call counts per day, week and month. Analyzing that information will give you a better idea of how to evaluate the success of any marketing campaign and will make it easy for you to figure out what to adjust if things aren't working.

The bottom line is you've got to deliver high-quality service and value to give customers a reason to stay loyal and you have to employ consistent marketing to remind them why it's worth visiting your shop time and time again. Focusing on customer retention pays big dividends, with the global consulting firm Bain & Co., estimating that increasing customer retention rates by just 5 percent will boost profits by 25 to 95 percent. Remember, the best customers are the ones who already know and trust you. **ZZ**



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

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Sound philosophy

Owners believe shop name embodies the essence of auto repair

ROBERT BRAVENDER // Contributing Editor

➔ This column doesn't cover motorsports per se, but it often lurks in the backstory of many repair shops, as one frequently leads to the other. It's a little more obvious in the case of Performance by Fisher, where owners Kevin and Kathy Fisher spend their summers racing in Top Dragster. However, Kevin maintains that the name of their business embodies the essence of auto repair.

"There's performance in every vehicle out there," nods Fisher, looking out at the city of Lima, Ohio. "If your vehicle is having a problem, essentially it's a performance issue. Our job is getting a vehicle to where it's running right, performing properly. To me performance is a wide range of things, not just high performance."

Fisher probably started developing this concept back when he started working on cars at age seven. "My dad used to give me the tools and say, 'get underneath that car and take the starter off.' He didn't even have to jack up the car; I could slide right under there."

By the time he was 14, Fisher was pulling motors and doing engine rebuilds. "The first rebuild I ever did was my uncle's '63 split-window Corvette, which was a fuelie. Of course I got to have the car for the weekend; how many 14-year-old kids do you know that get to drive around in a pretty blue '63 Vette?"

Fisher would continue driving fast cars throughout high school, but would refine his technical abilities after joining the U.S. Air Force in 1974 as a weapons specialist. "We worked on everything from nuclear warhead missiles to bombs," he recounts. Once Fisher got out of the Air Force, he started working at various dealerships as a flat-rate mechanic.

"I never went to school for this stuff," he explains. "It was the school of hard knocks." After knocking around for a few years, he discovered he had new knack: exhaust work.

"I got to be an excellent welder," Fisher notes. "Back then we'd use a coat hanger and a gas torch to weld, because MIG welders were high dollar, and hardly anyone had one. Then in 1980 I learned how to use a pipe bender and got good at fabricating systems and running dual exhaust."

Custom exhaust became a foundation of Fisher's business when he went independent in 1992. "We also do auto and truck repair — everything from a one-ton on down; foreign and domestic," he explains. "But we're known for our fabrication of



PERFORMANCE BY FISHER INC.
Lima, Ohio // performancebyfisher.com

Kevin & Kathy Fisher
Owners

4
No. of employees

1
No. of shops

3,500
Total square footage of shop

27
Years in business

4
No. of bays

exhaust systems. I sell all the top line mufflers: Borla, Magna-flow, Flowpro out of Canada."

Historically, exhaust performance wasn't a top priority for automakers. "Back in the day, most cars came with single systems since all the manufacturers wanted out of them was to be quiet," says Fisher. "They weren't really concerned with exhaust flow, performance, horsepower and fuel mileage."

Automakers have since caught up a bit on higher-end models, but most systems are still pretty basic. Replacing these restrictive pipes with better flowing dual exhaust creates more horsepower, and true to Fisher's philosophy, they also help overall performance.

"A lot of people think horsepower drinks fuel," he wryly notes. "Actually, it's the other way around because with better flowing exhaust you'll gain fuel mileage. Plus, people like the sound of a balanced exhaust system."

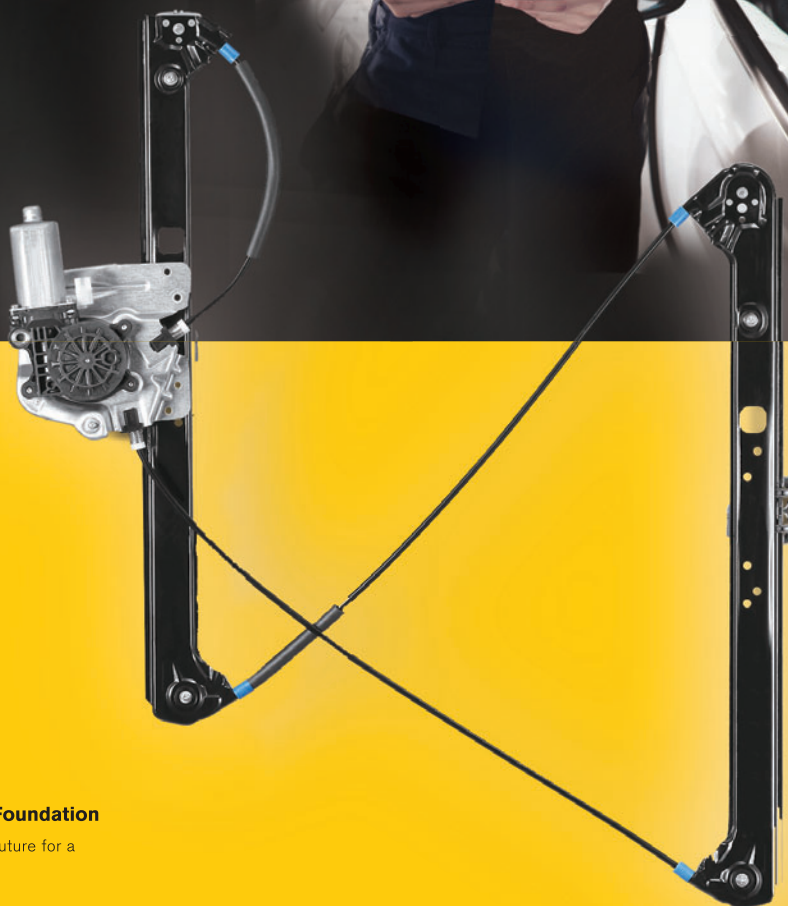
One place people can hear this sound is on Fisher's own truck. "I use it as a selling tool," he smiles. "If someone likes the

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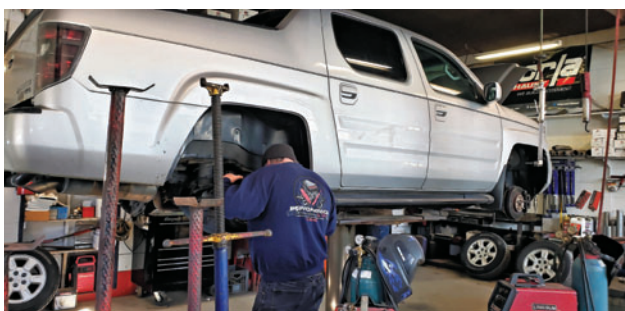


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sound of it, I'll have them come in, give them a free inspection, show them what we can do and what it's going to take to get their truck sounding and running better. We also do a lot of fabrication on stock systems."

One reason for this is climate: living in the snowbelt produces a lot of rust, but Fisher believes the switch from rock salt to pre-wet brine seems to have aggravated the problem. "It just eats brake and fuel lines, exhaust systems, any metal valve stems. It used to be we'd replace brake lines on a vehicle after it was 10-12 years old; now we're doing them on 6-year-old vehicles.*"

"We can get (our clients) a better price than an OEM system," Fisher points out. "And this is kind of a depressed area, so money's hard to come by; that keeps us busy. Plus, I like to think our systems actually improve on the engineering that the car makers were doing."

Fisher has also fabricated exhaust systems for local manufacturers like limo and hearse builder Accubuilt and Titan Bus. "(The latter is) on a cash-and-

carry basis, so that's something to fall back on," he reports. "We have jigs and whatnot that we built, so we can kick these things out for them."

For manpower, Fisher has a hometown advantage — the University of Northwestern Ohio (UNOH), a premier tech school located in Lima. "There are a lot of people who go there, and they need work. I have a lot of respect for the kids who do that, and we're teaching them the right way to do things with real-life, hands-on experience."

And Fisher has assembled a staff that can handle the shop during those days when he and Kathy are on the road drag racing. "When I'm not here, the assistant manager's in charge," he says. "If there's an issue, they can get ahold of me right away and we'll get it resolved. You've got to have common sense; that's a requirement to work here."

For diagnostics, he has a Snap-On scanning station, "a real nice Modus," says Fisher. "Once we 'diag' what the problem is, we take the customers out and do what I like to call 'take them to

school.' We explain to them what they need, why they need it, the cost to them and how much labor it's going to take.

"And if they live within 5-6 miles of us, we'll give them a ride," he adds. "If we need to come pick the car up, we'll offer that too. It's all about trying to take care of customers as if they're family. Because I always try to give them that seven letter word that's hard to find anymore...service." *TL*

**Besides the anecdotal evidence, a three-year study by Volkswagen supports this view. (<https://www.getsurrey.co.uk/news/local-news/corrosion-concern-over-gritting-technique-4826238>)*



ROBERT BRAVENDER

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

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JOHN BURKHAUSER //

Contributing Editor

Is the morning chaotic at your shop? Customers all showing up at the same time wanting to get in and out as fast as possible, forcing you to rush through every interaction? When you call or text customers, do they get back to you quickly? Are they declining work because they are not prepared for it financially or mentally? Do your customers return to your shop for the services their vehicles need?

More than likely your shop experiences the above and other scenarios every day, which are affecting your service process, ultimately slowing it down or even stopping it all together.

Have you tried to “train” your customers? To get them to work with all the processes you have in place that make your shop run smoothly and efficiently? If not, it is time.

Customers can become a part of your service process, making it work better. Because we never really explain to the customer what our expectations from them are when they are at our shop, they don't know how they affect the work flow and getting their vehicle back sooner than later.

Will all your customers accept your ideas and training? No. And that is OK. If we can train most of our clientele, we will be in a better position to deal with these customers building on our service success.

Training is basically setting the customer's expectations. We let them know what we expect from them, and they know what to expect from us. If all these

expectations are met, both the customer and business win.

Customer training begins with the appointment phone call. The customer will expect that the shop will gather the important information such as name, phone number, vehicle type, year and what needs to be done. The advisor gathers this information, entering it in the SMS calendar and then goes over any recommendations that may need to be done during the visit. Doing this will mentally and financially prepare the customer for the visit.

Once the service day is agreed on, the advisor will tell the customer what time they are to drop off their vehicle and go over the details of the appointment. The time given is for the customer to meet with the advisor, not when the vehicle is going into the shop. When setting the appointment, the advisor sets aside about 15 minutes for each customer.

Training the customer that they are to come in at a specific time should involve telling the customer that a 15-minute block of time is being locked so that the advisor can focus only on that customer's wants and concerns.

You will still need a plan to deal with your walk-ins. Ways to handle this are to limit the amount of scheduled appointments you have during the rush time. Build extra time into the appointments, giving you a window of time for writing up the walk-ins.


Another way to train your customers is on how they communicate with you during the repair visit. Limit phone usage and switch to texting. This will

open your phone lines for more important things such as setting appointments and selling work.

Take time with each customer to introduce how your shop will use text. Send them your shop's “Vcard” with your contact information and have the customer put it into their contacts. Every time you text the customer, your shop name will come up and they will know the text is about their vehicle. Reinforce the need to respond to these texts quickly so their vehicle gets completed as soon as possible.

Train your customers to expect an “exit conversation” either in person or on the phone. During this talk, the advisor should go over the results of the current visit and then go over the recommendations and services that may be due during the next visit.

Finish this conversation by setting the customer's next appointment before they leave based on their actual driving habits and service intervals.

Putting these ideas in place will take some time and resolve at first, but they will reward your efforts over the lifetime of your customers. Every visit will pay you back for the time invested up front. 



JOHN BURKHAUSER

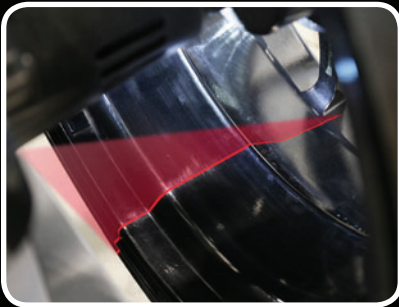
is an auto repair specialist with more than 30 years of experience. As the Director of Education at BOLT ON

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. jburkhauser@boltontechnology.com

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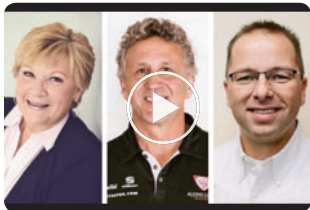
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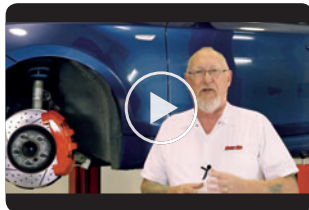
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WATCH + LEARN



Parents discuss succession plans for their daughters

MOTORAGE.COM/Daughter



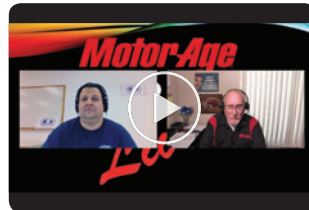
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ISUZU NPR-HD BLOWS 80-AMP FUSE

VEHICLE: 2002 Isuzu NPR-HD, L4-4.8L DSL Turbo (4HE1)

MILEAGE: 226,005

DETAILS: The technician found that the 80-amp FL-1 fuse was blown. He installed a new fuse, which blew immediately, even with the key in the Off position.

Based on the wiring diagram, the Tech-Assist consultant suggested unplugging the alternator because it was one of the main components connected to the GL-1 fuse circuit. Other circuits had their own smaller fuses, which should have failed if there was a problem in their circuits.

CONFIRMED REPAIR: The technician unplugged the alternator and the fuse was OK. The alternator was replaced and the vehicle was fixed.

This tech tip and others come from ALLDATA Tech-Assist, a diagnostics hotline of ASE-certified Master Technicians.

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TOYOTA'S RADAR
used for adaptive cruise is mounted directly behind the Toyota logo in the center of the grill.

PRACTICAL TIPS FOR ADVANCED DRIVER ASSIST SYSTEMS

DAVE HOBBS // Contributing Editor

Are you “radar ready?” Don’t want to mess with the new complicated radars and smart cameras on today’s cars and trucks? If you answered “no” to either question, are you planning on doing any 4-wheel alignments on newer vehicles? How about radiator replacements? You might want to check for the presence of ADAS (Advanced Driver-Assistance System) prior to your next repair procedure. Both scenarios have the potential to create the need for an ADAS calibration. A long-range radar sensor offset of just 0.040” (visualize a

spark plug gap) can make a difference of 40 feet (left or right) down the road for your customer’s adaptive cruise control. For the sake of argument, let’s say you do get a radar sensor off calibration enough to adversely affect the system. This scenario could leave the potential for three different outcomes:

1. PREFERRED OUTCOME — The onboard diagnostics within the adaptive cruise control sees the radar targeting information as erroneous, sets a descriptive DTC and promptly disables the system until repaired/calibrated.

2. UNDESIRABLE OUTCOME — By itself, the vehicle slams on its brakes to avoid a perceived head-on collision when

the inaccurately calibrated radar sensor for the adaptive cruise control misinterprets an oncoming vehicle safely in its own lane as a vehicle directly in front of it.

3. TRAGIC OUTCOME — Your customer’s vehicle plows into the car in front of it while your customer is not paying attention or placing too much trust in his/her radar cruise as the inaccurately calibrated radar sensor “stares” off into an open field instead of at the vehicle directly in front of it.

Outcome No. 1 will take some education and equipment to correct, but it sounds pretty good compared to Nos. 2 and 3 where property damage, injuries or even deaths may result.

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The business side of ADAS

If you think you'll dodge the bullet on this new technology (i.e. your shop doesn't do hybrids, diesels, etc.) you might want to rethink that. As we move at lightening speeds to integrate this technology into the average car or truck (ADAS is not just for luxury cars anymore), it is likely to become the next airbag or ABS system — meaning most every vehicle will have it. The popular prediction from tech-savvy industry leaders is that privately-owned vehicles will be replaced by completely autonomous ride-share vehicles that pick you up and take you where you want to go. In some vehicular-congested urban locales, this seems practical at lower speeds in controlled environments if infrastructure is improved. The full autonomous ride-share approach to transportation will also be a huge help to those who aren't close to mass transit and are unable to drive a vehicle on their own for a variety of reasons, including cost, health, age and disabilities. However, in rural areas with higher speeds, careless drivers (just do a Google search on "ADAS Abuses" to see what I mean) where many conventional freedom-loving Americans live, the autonomous ride-share micro buggy seems quite a way off. Regardless of the timing and details of ADAS evolution, there are plenty of ADAS-equipped vehicles



YOUR CUSTOMER'S VEHICLE MAY SAY "RADAR READY" but are you radar ready? Today's ADAS-equipped vehicles have tons of new technology for techs to learn to diagnose, repair and educate customers on!

Components	Jobs Requiring Calibration	Special Tools (e.g. Calibration Targets) Required?	Scan Tool Needed?
Adaptive Cruise Control System			
Adaptive Headlight System			
Automated Parking System			
Blind Spot/Rear Cross Traffic Systems			
Lane Assist System			
Lane Departure Alert System			
blind spot monitoring indicator	-	-	-
blind spot monitoring system	-	-	-
blind spot sensor	calibrate blind spot sensor	-	-
	replace blind spot sensor	-	-
cruise control systems	-	-	-
exterior light control modules	-	-	-
exterior lighting	-	-	-
forward looking radar module	replace cruise control sensor	-	Y
	perform wheel alignment	-	Y
headlight	-	-	-
lane departure switch	-	-	-
lane departure warning actuator	-	-	-
lane recognition systems	-	-	-
multifunction switch	-	-	-
outside view camera	calibrate outside view camera	-	-
	perform wheel alignment	-	Y
	replace outside view camera	Y	Y

DO YOU HAVE TO CALIBRATE with targets or a scan tool? Both or neither? Mitchell 1 has added a brand-new quick link choice once you select a new vehicle to research. Simply click "ADAS" from the main menu to get the screen shown above for this 2017 Cadillac CT6.

roaming the roads right now in need of service. In order to gain a level of understanding enough to diagnose and repair ADAS, let's peel back two of the layers of technologies (Radar and Camera) that go into these complicated vehicles. A third technology layer (LiDAR) constantly scans with lasers (at a frequency not visible to the human eye) instead of a camera in order to view the vehicle's surroundings. LiDAR is relatively new to ADAS, so it's unlikely you'll encounter LiDAR-equipped models in your service bay anytime soon.

Technology layer 1 – Radar

The days of radar being expensive, heavy and noisy (from internal moving parts) are long gone. Today's radar sensors are solid state with no moving parts, are the size your hand, weigh just a few ounces and can cost less than \$100 to manufacture. Some



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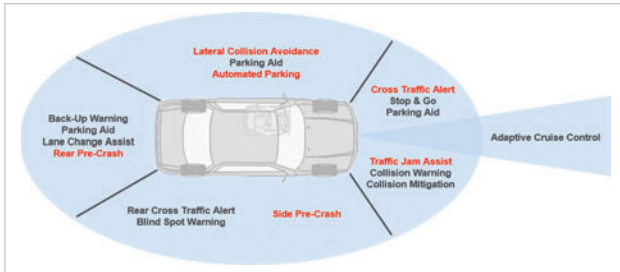


PHOTO: DELPHI

MULTIPLE ADAS SYSTEMS MEANS multiple radar beams scanning for targets ranging from a child on a tricycle when you're backing up to a motorcycle in your blind spot when you change lanes.



EVERY RADAR SENSOR I'VE ENCOUNTERED produced a heat signature. Some brands run hotter than others. The sensors on this Chevy located behind the rear bumper cover were running about 5 degrees F warmer than the surrounding areas of the bumper. While this doesn't tell you how well the sensor is working, it will certainly pinpoint a sensor that is dead from a lack of power, ground or completely inoperative. **Health/Safety Note:** If the radar is warm, it's emitting radar signals. I'm not aware of any official studies on health issues for techs leaning up against a bumper or grill for prolonged periods. However, there have been reports of male infertility issues that were blamed on radar sensors. Pulling the fuse for the ADAS systems prior to long periods of fender-side leaning (with the ignition on) might be something you would consider doing just to be on the safe side if you're planning a family!

of today's vehicles may have several radar sensors mounted all around them forming a "360 field of view," creating a "cocoon" of awareness and safety around them. Radar sensors now scan electronically using multiple beams to send a radio signal at a reflective object in order to get the same signal bounced back. The delay in time it takes to get the signal bounced back equates to a distance. The rest is a lot of complex trigonometry embedded in advanced software. Radar sensors operate at extremely high frequency, which gives them the name "millimeter radar." The higher the frequency, the shorter the wave length.

- 25 GHz Ultra-Wide Band Radars
- 24 GHz Narrow Band Radars
- 76-81 GHz Multi Mode Radars

Technology layer 2 – Smart cameras

Cameras have been used for BUA (Back Up Aid) for many years prior to ADAS. BUA cameras are divided between the more conventional BUA cameras that use composite video signals operating like an analog audio signal and the newer digital variety that transmit video signals via a CAN bus message. All the ADAS forward-facing cameras I've encountered are of the digital CAN bus variety. These "smart" cameras send CAN bus signals with message packets representing video images. The digitized images are then analyzed by a video processor module in order to determine exactly what to do with the information. That information is used in systems such as lane departure warn-



NEED A NEW RADAR? Purchase a tail light assembly and Ford includes one for free! This F-150 houses the rear RADAR sensors for BLIS (Blindspot Information System) and Cross Traffic Alert in the tail light assembly. The front sensors are behind the front bumper fascia.

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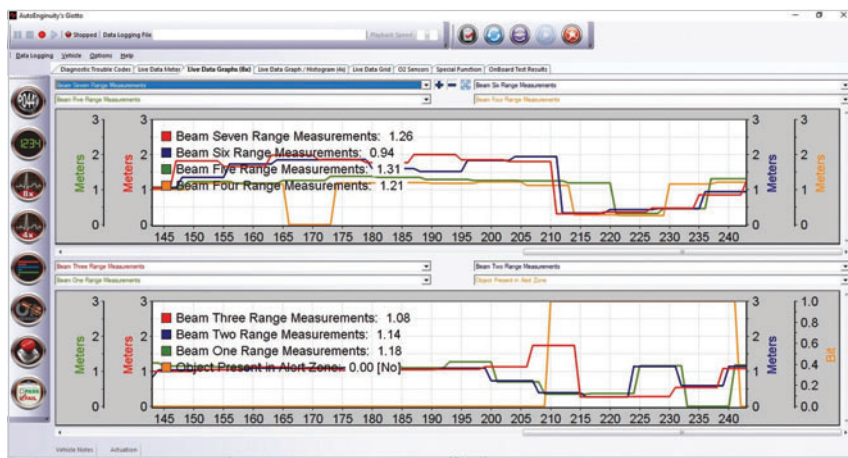


ON MANY OF THE SIDE (medium and near range) radars using the lower frequencies (24 & 25 GHz), a radar detector can be used to see if the sensor is at least functional.

ing, lane keep assist, lane centering/autonomous steering, pedestrian detection and forward collision alert/avoidance.

Radar and camera service concerns & calibrations

Both radar and smart cameras (in most cases) require some sort of initialization when installed, as most modules do these days. This presents a challenge for some aftermarket scan tools trying to do all things for all vehicles. Radars and cameras also may need set up via a static calibration. Typically, cameras will require a certain target board with a specific size and pattern on it. Radars typically use a triangular-shaped metal dish to bounce their signals off while calibrating. Both camera and radar calibrating targets require EXACT placement for accurate sensor static calibration. The position, distance and height of the target cannot be off even a little. This requires a lot of space in the shop, attention to detail and patience. After the static aiming/calibration, there is usually a follow up required with a dynamic calibration, which also requires the right scan tool to initiate the procedure. Dynamic calibrations set into motion by the scan tool require driving on a “target-rich” road. “Target rich” means the sensors see lots of things for the learning/calibrating process. Fence posts, road signs, guard rails, etc. all speed up the process of dynamic calibrations.



MOST SCAN TOOL PIDS SIMPLY GIVE THE POWER FEED STATUS, DTCs status, disable history and maybe the software calibration p/n. This late-model Ford's BLIS (Blind Spot) left rear short range radar sensor's multiple beams came up as data PID choices on the author's Auto Enginuity scan tool. The PIDs were being graphed while on a road test. The same PIDs are NOT available on Ford's factory IDS tool. While knowing the distances each beam is targeting an object won't likely be a diagnostic question in a factory trouble tree, the fact that they are changing as you drive past objects at least gives a very quick indication that the sensor is indeed powered and functioning.

- Radars do NOT like certain aftermarket grills, certain bumper stickers, bumper covers/bras and in some cases certain types of custom paint that may obstruct the ability of the radar signal to be received once it bounces back after hitting the target.

- On some vehicles, the bracket for the long-range radar can become easily bent, which can drastically throw off the radar's calibration.
- Front camera may also need a static calibration if its aim becomes offset after collision/body repairs or other repair procedures:
 1. Service procedure in proximity of the camera (rear view mirror replacement)
 2. Vehicle center angle or trim height changes after a wheel alignment, suspension modification, or alternate size tire & wheel installation.

- Smart cameras need a clean windshield free of excessive dirt, bugs, snow and ice. Excessive amounts of blockages may result in symptoms ranging from subtle reduced performance to a DTC

File	Function	Setup	TIS	User	Help
System Select	Stored Data	Front Recognition Camera Live			
2018 Camry A25A-FKS	Blockage Status	Parameter	Value	Unit	
009352 mile	Blockage History		OFF		
4T1B11H42J089324	Low Temperature Status		OFF		
	Low Temperature History		OFF		
	High Temperature Status1		OFF		
	High Temperature History1		OFF		
	High Temperature Status2		OFF		
	High Temperature History2		OFF		
	Backlight Status		OFF		
	Vehicle Information (2WD/4WD)		2WD		
	Vehicle Information (Com/HV)		Com		
	Heater Connection		ON		
	Heater Control Status		Permit		
	Heater Control Status (Cycle A)		Prohibit		
	Heater Control Status (Cycle B)		Prohibit		

THE SCAN TOOL PIDS AVAILABLE on the Toyota factory Techstream for this 2018 Camry's front recognition camera make it clear that heat is a big factor for these windshield-mounted cameras. Excessive heat can cause a system inhibit followed by a recorded history event to tip you off in your diagnostics.

with DIC messages alerting the driver that the system is currently unavailable.

- Smart cameras also need a distortion-free windshield. Some aftermarket replacement glass can be problematic.
- Smart cameras typically have a 12-volt electric heater element in them to keep the portion of the windshield directly in front of them free of ice, snow or fog.
- Smart cameras can overheat from too much sun load or a malfunctioning internal heater element. Some cameras even contain fans in them to prevent

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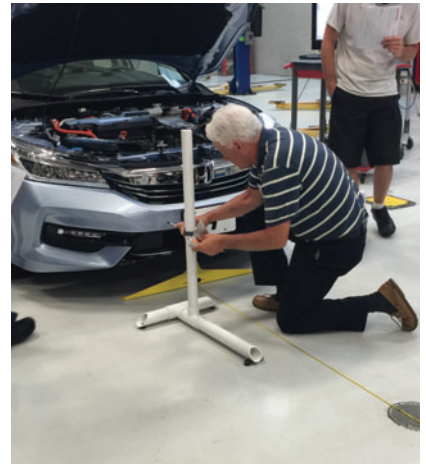
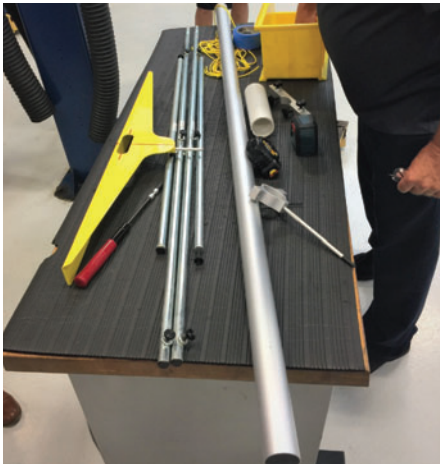
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THE GREATEST CHALLENGE BY FAR WITH ADAS IS the need for dynamic calibrations on both radar sensors and cameras in the shop. The proper scan tool is not the only tool you'll need. For the initial static calibration, you'll need the proper kit consisting of pipes, brackets, squares, plumb bobs, levels/lasers, a tape measure and string. If that wasn't enough, you'll also need a flat and level shop floor with well over 21 feet in front of the vehicle of unobstructed space to set the various targets. Triangular-shaped metal dishes are used for reflecting radar and printed patterns are used for aiming the vehicle's camera. Shop is small so just do static calibrations outside? Most OEMs direct you to use tape or markings on the shop floor as you basically perform a large-scale geometry equation to find the exact center of the vehicle at an exact distance from it.

EXCERPT FROM BMW SERVICE INFORMATION TSB SI B66 21 16

Applicable to 2015 BMW 228i Convertible (F23) L4-2.0L Turbo (N20);

There are two categories of system limitations – those that can be eliminated and those that are beyond control. The following table details possible limitations and what, if anything, can be done to eliminate or explain them.

Limitation	Recommendation	Notes
Obstructed camera view	Remove obstruction	Clean windshield, replace wipers
Calibration incomplete	Complete calibration	Calibration is a lengthy process. Some features may not be functional during calibration. No faults stored during calibration period. Calibration needed after windshield replacement
Calibration failed	Diagnose with ISTA	Fault code 0x800AC4 - Camera calibration unsuccessful stored in KAFAS memory >3 times
Weather conditions	Inform customer	Possible situations: strong rain, snowfall, ice, fog, blinding sun (strong back light), tunnel entries/exits transitions into light/dark)
Non-typical surrounding vehicle	Inform customer	Possible situations: Rear of vehicle poorly illuminated Extinguished taillights, Custom rear body shape, Carried load (log truck), Open Trailers, Open Tailgates
Surrounding vehicle/ pedestrian	Inform customer	Possible situations; Sudden movement in traffic Too close to/on highway

warn the driver they are not holding their lane (the smart camera determines this) with an audible sound and/or vibration in the seat or steering wheel. Lane keep assist will integrate with the electric power steering in the attempt to maintain the lane. Failure to use directional signals has resulted in more than a few customer complaints of steering symptoms. "I think I've got a worn-out tie rod" or "it feels like a tire pulling" may be what the customer suggests, but if the vehicle has LKA we need to diplomatically ask "do you occasionally change lanes without using your turn signal?" As with any new technology, sometimes the only thing that needs fixed is the customer's knowledge level. Hopefully we've increased your ADAS knowledge level and you're on your way to being radar ready! **TLZ**

overheating. One Cadillac dealer tech told me he had to put a heavy glove on to handle the camera when removing it from its mount after it's been on even for just a few minutes.

Customer education

In the above chart from the BMW TSB the phrase "Inform customer" was repeated. If you read the entire TSB, there

are numerous photos and tips to pass along to customers. One important point to remember when interviewing customers with complaints for anything steering related is to find out if the vehicle has an ADAS system that involves lane departure warning, lane keep assist or semi-autonomous steering (at any level). Is your customer complaining about a phantom vibration? Lane departure warning may



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experienced hybrid instructor. Dave has been featured as an instructor in more than 15 automotive training videos.

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ADVANCED DRIVER ASSIST SYSTEMS

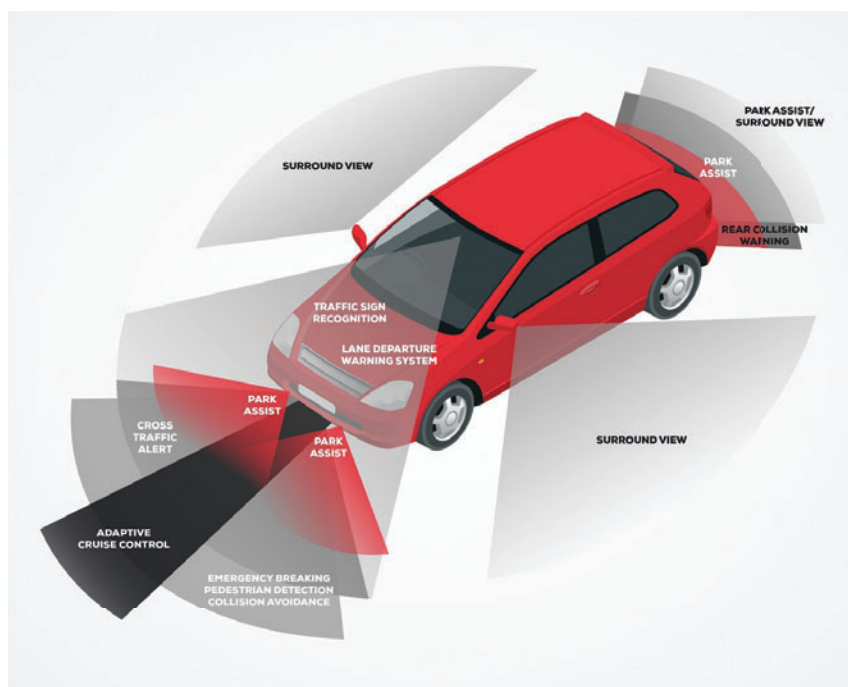
IS DRIVER ASSIST REALLY NEW?

TRACY MARTIN // Contributing Editor

ADAS, or advanced driver-assistance systems, is front and center in today's automotive technology and is the precursor to fully autonomous driving vehicles. Featured in futuristic automotive advertising, ADAS is touted as cutting-edge technology. However, the concept has been around longer than most people realize.

One of the oldest driver-assistance systems is automatic braking systems (ABS) that was developed for 1920s-era aircraft. Having an airplane skidding uncontrollably after touching down on a runway was to be avoided, and ABS braking systems help prevent accidents during landing of heavy airplanes and eventually jet aircraft. It wasn't until the 1970s that — when Robert Bosch patents, in joint development with Mercedes-Benz — ABS was widely used on automobiles. Chrysler and the Bendix Corporation developed an ABS system called "Sure Brake" for the 1971 Chrysler Imperial. Ford had "Sure-Track" on Lincoln Continentals and General Motors marketed "Trackmaster," a rear-wheel-only system on Cadillac and the Oldsmobile Toronado. Nissan had an early electronic ABS system developed by Denso fitted to their Nissan President sedan in the 1970s. BMW even applied ABS technology to the K100 motorcycle in the 1980s.

Another driver-assistance tech-



THIS ILLUSTRATION SHOWS THE EXTENT OF SENSORS used on a generic ADAS system. Even a windshield replacement affects the camera alignment for multiple systems.

nology was the load-sensing proportioning valve used in the mid-1960s. Proportioning valves were installed on pickup trucks to minimize vehicle spin (swapping ends) during hard braking on wet roads. The load-sensing valve was located in the hydraulic system for the rear brakes. A metal rod attached to the pickup bed and the valve provided a rough indication of how much weight the truck is carrying during braking. It functions to control the brake fluid pressure from the master cylinder in response to vehicle load and prevents

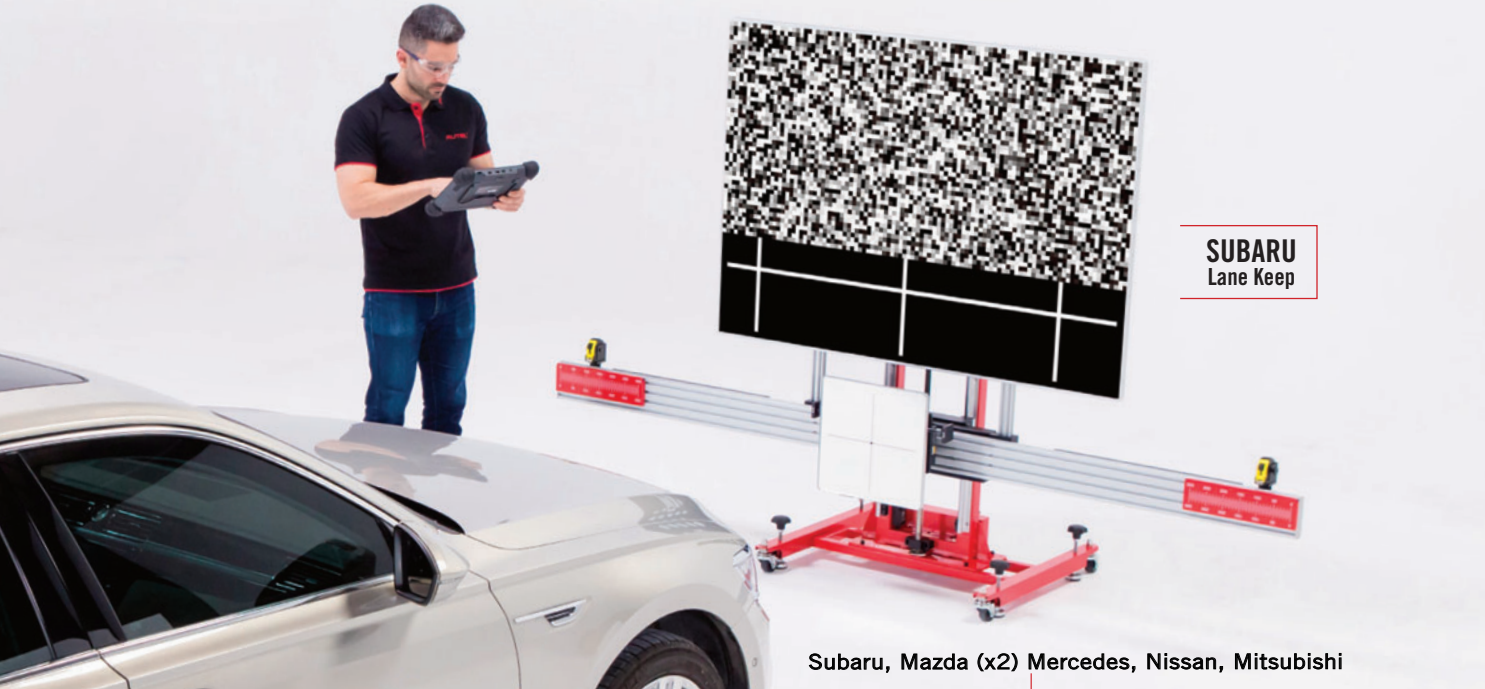
early locking of the rear wheels.

Since the 1950s, speed warning systems have helped drivers to ease off the gas pedal to reduce speed. The 1962 Buick Wildcat's speedometer had a speed indicator that could be set by the driver. When that speed was exceeded, a buzzer sounded as a warning to slow down. Other driver-assistance innovations include automotive cruise control that was new in 1947, but is common on vehicles today, and the neutral safety switch (or inhibitor switch) for both automatic and manual transmissions

ADAS CALIBRATION **AUTEL**

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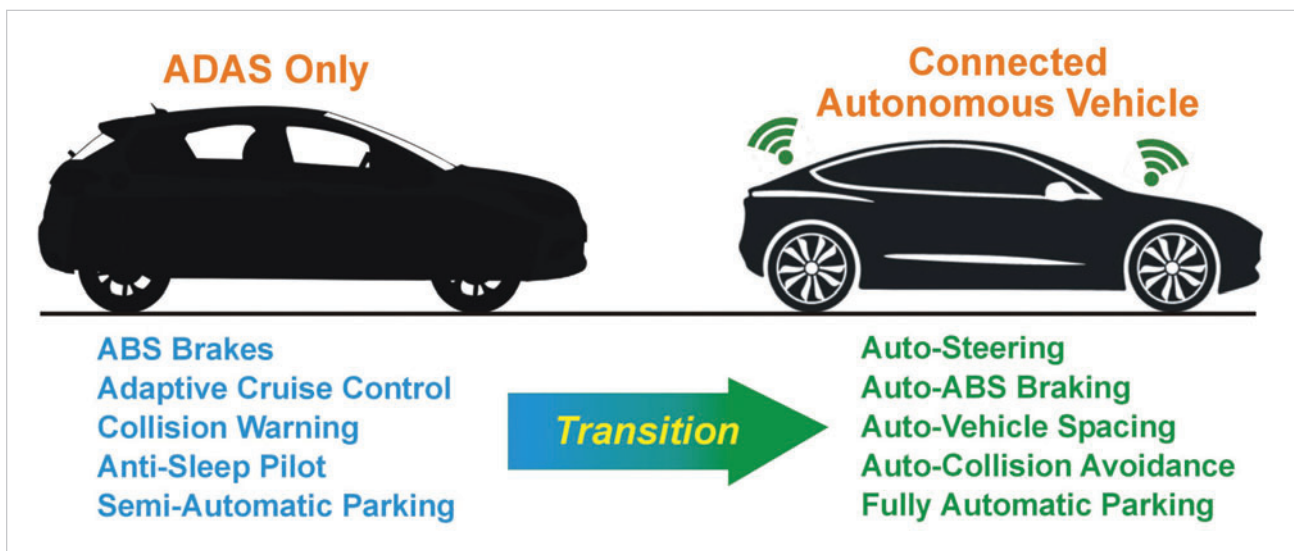


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THE ADAS CARS OF TODAY will eventually make the transition to fully autonomous vehicles. With autonomous cars digitally connected to each other, the roadway and driving hazards, ADAS systems will operate in the background with little or no driver interaction.

— a form of driver-assistance that prevents drivers from starting the engine with the transmission in gear. Even some vintage radios had an automatic volume control that would increase volume with vehicle speed, allowing the driver to pay attention to driving. All of these systems, while not labeled as true ADAS technology, provided early forms of driver-assistance functionality.

Current ADAS systems

Not everyone in the automotive industry uses the term “automatic assist” precisely resulting in accidents caused by a misinformed driving public. This has happened with Tesla and other luxury cars when salespeople tout the benefits of their brand’s offerings and over-state ADAS capabilities. For example, a salesperson might say to a customer, “Just press this button and the car almost drives itself.” After purchasing the car, the new owner gets on the interstate, engages the ADAS system and starts playing a game on their phone. This lack of understanding of ADAS limitations has resulted in accidents with some fatalities.

Because OEMs, software companies and the aftermarket are all develop-

ing autonomous cars and the components that supports them, a common language is necessary to describe the technology to avoid confusion. In 2016 the National Highway Traffic Safety Administration (NHTSA) adopted descriptions of automated driving functionality, developed by the Society of Automotive Engineers (SAE) International, of five levels of ADAS technology. It’s based on “Who Does What, When.”

Level 0 — The human driver does everything.

Level 1 — Automated system(s) on the vehicle can sometimes assist the human driver to conduct some parts of driving tasks.

Level 2 — Automated system(s) on the vehicle can actually conduct some parts of the driving task, while the human continues to monitor the driving environment and performs the rest of the driving tasks.

Level 3 — Automated system(s) can both conduct some parts of the driving task and monitor the driving environment in some instances, but the human driver must be ready to take back control when the automated system requests.

Level 4 — Automated system(s) can conduct the driving task and monitor the driving environment, and the human need not take back control, but the automated system can operate only in certain environments and under certain conditions.

Level 5 — The automated system can perform all driving tasks, under all conditions.

The use of ADAS that help drivers with steering, braking, monitoring and warning tasks is expected to increase over the next 10 years. In part, this usage will be driven by consumer and government interest in safety applications that protect drivers and reduce accidents. For example, the United States and European Union are mandating that all vehicles be equipped with autonomous emergency braking systems and forward-collision warning systems by 2022. The increased usage of ADAS will have a significant impact on the auto repair industry as well. Even a simple job like replacing a windshield is complicated by the presence of ADAS sensors that need to be calibrated. Businesses like The Windscreen Company (www.thewindscreen.co.uk), located in the

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NONE OF THIS EARLY ADAS TECHNOLOGY required a computer to operate. Everything was analogue using mechanical switches and actuators. While these vintage driver-assist aids were low tech, they did provide benefits to drivers.

United Kingdom, are having to educate consumers regarding increased costs for windshield replacement. Consumer surveys show that the car-buying public is increasingly becoming more interested in ADAS applications that offer driver comfort and convenience, like blind spot monitoring and parking assist. The following are some highlights of ADAS in current use.

Adaptive cruise control (ACC), also known as dynamic cruise control, is considered a Level 1 ADAS technology. ACC systems can use radar, LIDAR [like those made by Ainstein (www.ainstein.ai)] laser or camera-based sensors to assist drivers in maintaining spacing between vehicles. Sensor input from ACC systems can use the vehicle's engine management system to control braking and acceleration at speed. Radar systems can be long- or short-range, and some vehicles use both. The black-box sensor on a laser-based system must be exposed to the area that it is tracking and because the laser reflects off other cars it does not work well (or at all) in heavy rain or snow. Some camera-based systems use two forward-facing cameras placed on either side of the rear-view mirror, providing binocular vision to the system's computer. Through digital processing, the ACC system can calculate distance of vehicles ahead.

On some vehicles, collision avoidance is another feature of ACC systems and uses the same sensors to warn drivers of a potential fender bender, or worse. In addition to sensors, GPS information can be used to alert the system of fixed objects like stop signs, intersections, exit and entrance freeway ramps and other hazardous driving areas. Future ACC systems will have an impact on increasing the capacity of roads by maintaining optimal separation distances between vehicles and provide a safer driving environment.

Wake up! Anti-sleep pilot, driver condition monitor, fatigue detection or tiredness detection warning are some of the names of systems that warn a driver that they are not paying attention to the road ahead — time to get some coffee or pull over and take a nap. Studies have shown that 20 percent or higher of road accidents are driver fatigue-related. Driver drowsiness detection and lane departure warning systems are similar, if not identical. They can use road lane monitoring via a camera, steering pattern monitoring or driver eye and face monitoring to determine when to sound a warning. Future systems could use body sensors to measure things like heart rate, brain and muscle activity and skin conductance as a measure of how awake a driver really is.

From the inception of the automobile, the ability of a driver to “park” the car has been a challenge. The parallel parking test for licensing is one of the most difficult skills that drivers have to demonstrate — so difficult that 16 states have dropped the requirement. The lack of parking skills has led to a vicarious form of entertainment — watching drivers trying to parallel park. No matter how many times they back-and-fill, and/or bump other cars, they can't seem to get any closer to the curb. Automatic parking is an ADAS system that bridges the gap between driver assist and fully automatic driving in that the system takes over steering during parking maneuvers.

In general, Automatic Parking Systems (APS) use ultrasonic sensors located at the four corners of a vehicle to determine its position relative to other parked cars. In operation, APS is turned on and the car is driven past the desired parking spot to determine if there is enough room to park. During parking the system instructs the driver to put the car in reverse or drive and apply the brakes until the car is parked. Perpendicular parking is a similar process. After driving past an empty parking space and measuring it, the vehicle self-steers, backing into the space while the driver controls the gas and brake pedals. With driver angst over parking,

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Andreas Wittler Owner Hans Wittler's Automotive

“The ATS 3C machine is revolutionary. It has immensely decreased the repair time on vehicles that need carbon removal. We have used the 3C system a lot and it produces great results. The problem with purchasing a vehicle equipped with GDI has been solved by the invention of the 3C system. We highly recommend this system.”

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it's no surprise that automakers want to offer customers a way to circumvent their lack of parking skills.

Future ADAS systems will be a real factor in differentiating automotive brands from one another. OEMs and their suppliers know that they will also be a significant revenue source for selling consumers various levels of trim and add-on packages. As costs for ADAS technology comes down, it will be found on less expensive cars and become common place.

ADAS and autonomous cars

As evidenced by current ADAS systems, driver-assistance technology of the future is only going to become a larger part of consumers' automotive experience. The use of ultrasonic, radar and optical sensors will provide a more complete picture of a vehicle's surroundings and shift more driving responsibility away from human drivers and towards computers with the goal of a safer and more relaxed driving experience. An important part of the transition to fully automatic driving is connecting vehicles to one another and their environment. The combination of sensor technology and connected vehicles will play an increasingly important role in the transition from ADAS systems to fully autonomous vehicles.

While ADAS systems are effective for line-of-sight driving situations, they can't offer the situational awareness of



PHOTO: AINSTEIN

THE AINSTEIN AUTOMOTIVE SAFETY RADAR, Kanza-77 enables ADAS features like forward collision warning, automatic emergency braking, pedestrian and cyclist collision warning and adaptive cruise control.

AFTERMARKET ADAS ADAPTION HEADING TOWARD INCREASED CATEGORY GROWTH

As OEM-installed and retrofitted Advanced Driver Assistance Systems (ADAS) continue to gain popularity, the aftermarket is well-positioned to provide much-needed education and training for installers, repairers and motorists along with benefitting by selling the numerous ad-on products that are becoming available within the category.

"ADAS is among the fastest-growing automotive segments today, and it presents a significant opportunity for aftermarket retrofitting and new vehicle upgrades," says Chris Kersting, president of the Specialty Equipment Market Association.

In 2017 the segment was valued at just under \$1 billion, and it is expected to grow to more than \$1.5 billion by 2021, according to a SEMA-commissioned study conducted by Ducker Worldwide and the Center for Automotive Research (CAR).

Establishing just what this category actually entails needs clarification, as industry groups are calling on the market to precisely define universal nomenclature along with detailing the product lines, properties and capabilities of the equipment.

Continue reading at MotorAge.com/ADASgrowth.

vehicles that are connected to one another and the environment. Vehicles that are connected to each other can use their respective sensors to create a network of awareness that will extend far beyond the range of a single vehicle using ADAS alone. Connected vehicles will receive alerts of dangerous situations, providing drivers and autonomous vehicles more time to react. For example, an oncoming car in the wrong lane in a blind curve, vehicles swerving to avoid a road obstruction, and a driver about to run a red light as they are nearing an intersection could all be detected by connected cars that would transmit this information to other vehicles.

Connected vehicle technology will ultimately be less expensive to install per vehicle than ADAS systems and perform many, if not all, of the same functions. Connected cars will receive data from surrounding vehicles and infrastructure; display driver alerts;

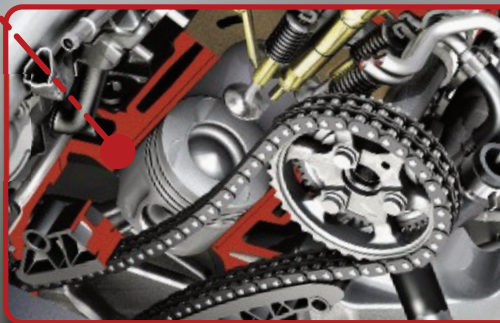
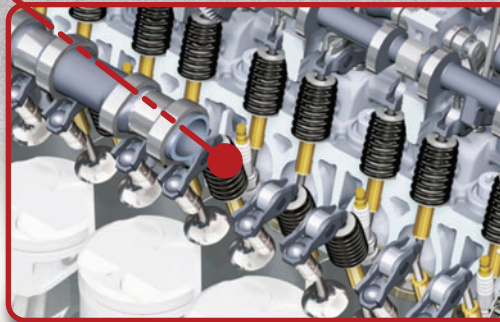
and interact with onboard braking, steering and engine management systems. OEMs and high-tech players like Google and Microsoft are spending huge sums of money on research and development to create self-driving cars, but they can't get there without ADAS systems that will bridge the gap between current driver-assistance features and fully autonomous cars. Within 10 to 20 years, drivers will be able to get into their car and say "Take me home" and read a book or take a nap during the drive, but this will only happen in part because of ADAS systems that are used in today's vehicles. **TM**



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



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MAKING SENSE OF TOYOTA'S "SAFETY SENSE"

TOYOTA SAFETY SENSE is Toyota's advanced driving assist system.

HERE'S AN OVERVIEW OF TSS — FOUND ON EVERY NEW MODEL TOYOTA VEHICLE — AND INFORMATION ON ITS DIAGNOSIS AND REPAIR

DAVE MACHOLZ // Contributing Editor

The push toward autonomous vehicles is driving vehicle manufacturers to create and implement integrated technology packages that are aimed at assisting the driver. These safety packages are commonly referred to as Advanced Driver-Assistance Systems or ADAS. Toyota Safety Sense (TSS) and Lexus Safety System (LSS) are the proprietary names Toyota is using for their ADAS systems. While these systems are currently designed to support the driver, the foreshadowing towards autonomy is evident. The challenge for today's repair and collision facilities in diagnosing, repairing and calibrating these vehicles will include the need for proper training, service information, scan tools and related tooling.

The complication to this technology on Toyota and Lexus vehicles comes down to the differences in system buttonology and display technology found on each varying vehicle. It has been rumored that Toyota and Lexus are on their fifth generation of this technology, adding to the complexity of diagnosis

and repair. For example, Toyota Safety Sense has gone under the name TSS-C, TSS-P and the Current TSS 2.0. These formal TSS classifications come after years of utilization of millimeter wave radar systems found on Lexus vehicles and Toyota nameplates such as Sequoia and Prius.

The push toward autonomy

While most manufacturers are forging toward a driverless future, most are still sure to tell their customers that this is an assist feature and not a replacement for the vehicle's driver. The Society of Automotive Engineers recently published a chart that outlines the six classifications from fully driver-operated vehicles to fully autonomous vehicles. Level "0" representing the former, while level "5," the latter. Most manufacturers, including Toyota, find themselves in the level 1-2 range with still quite a few complications and hurdles to overcome before moving up in level.

A look at the current Toyota Safety System reveals the current level of technology as well as some of the obstacles to full autonomy.

Pre-collision system with pedestrian detection

The pre-collision system with pedestrian detection utilizes a forward-facing, windshield-mounted camera as well as a millimeter wave radar sensor typically mounted in the Toyota or Lexus emblem in the vehicle's grille. This technology is designed to detect hazards and/or pedestrians between speeds of 7-110 mph for the pre-collision and 7-55 mph for pedestrian detection and will alert the driver to hazards both audibly and visually with a series of beeps and a flashing warning to brake. If the driver brakes in response to this warning, the system will often provide additional brake force to bring the vehicle to a stop more quickly. If the driver does not brake at all, the system may apply the brakes for the driver automatically.

While the idea of this system is very well intended, Toyota specifically points out that there are multiple scenarios in which this technology is unreliable. Specifically, the system relies on straight roadways, and clear visibility. If visibility is poor, such as in bad weather, the system may be unreliable. Additionally, the sudden appearance of a vehicle or other object, uneven roadways or sharp curves, something on the sensor, strong sunlight or the ability to see motorcycles or bicycles all provide complications to system reliability.

Toyota is sure to issue the disclaimer that drivers are responsible for operating their own vehicles.

Lane departure alert

Tired or distracted driving that causes a driver to swerve out of their lane is mitigated through the use of lane departure alert. LDA typically activates when the system observes the driver veering out of a visibly marked lane. This system utilizes a forward-facing camera to detect the lines on the road. Above a speed of 32 mph with the system enabled and on a reasonably straight road, the system will provide an audible and visual warning to the driver. Some vehicles are also equipped with steering assist that will provide slight adjustments in an attempt to keep the vehicle in the lane. Many of these functions are adjustable and, in some cases, can be turned off entirely.

This system, as well as its pre-collision relative, is highly dependent on the windshield-mounted camera. It works best on straight roads and when lane markers are clearly visible.

Toyota warns to not overly rely on this technology, as it will not work in every situation. Poor visibility of the camera in bad weather or due to bugs, dirt, ice, frequent or sharp curves,



TOYOTA'S TSS 2.0 FEATURES upgrades such as pedestrian detection.

PHOTO: TOYOTA MEDIA

oncoming headlights, bright sunlight and poorly marked lanes will all affect operation.

Automatic high beams

The automatic high beam system utilizes the forward-facing camera to automatically switch between high and low beam

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operation to maximize visibility for the driver while limiting the interference of high-beam lighting on other drivers. This system utilizes the camera to detect light levels and can sense oncoming headlights and tail lights from vehicles.

Dynamic radar cruise control

TSS vehicles come with dynamic radar cruise control. This system operates like traditional cruise control but adds a feature of distance control from the vehicle in front of you by adjusting speed to maintain distance. This system has an overall operating range from 25-110 mph. A speed above 28 mph is required to initiate. There is also full speed range on some models that will allow the vehicle to come to a complete stop if the vehicle in front of it stops. This system is operated through the use of the millimeter wave radar sensor located in the emblem.

Road sign assist

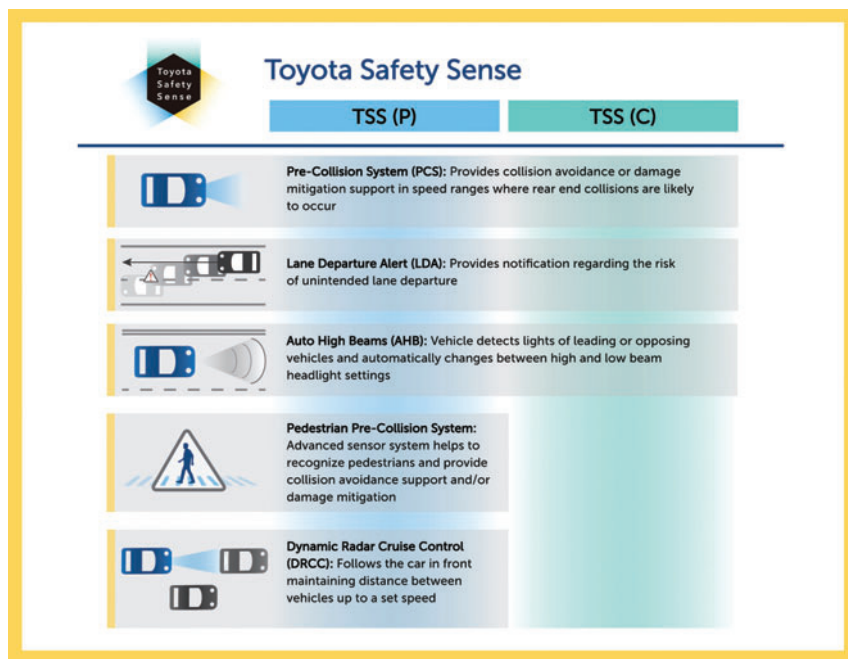
Road sign assist is a new feature for TSS 2.0 and is designed to read certain traffic signs and display them on the vehicle multi-function display. The signs it is capable of recognizing and displaying include speed limit, stop, yield and do not enter signs.

Lane Tracing Assist

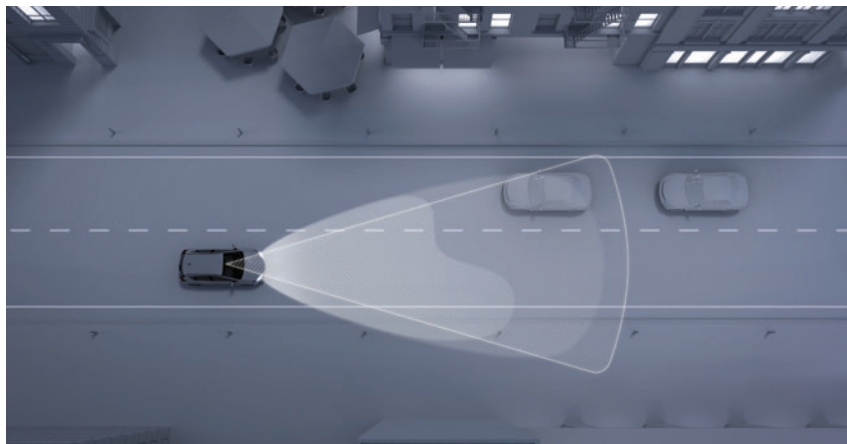
New with the 2019 corolla hatchback, lane trace assist combines LDA and DRCC technologies to enhance the vehicles ability to remain centered in a lane and at a safe distance. This system requires the driver to be an active participant and requires the driver's hands to be on the steering wheel. Failure to do so will result in a visual warning.

Blind Spot monitoring

While not a formal part of the Toyota Safety Sense suite of technologies, Blind Spot monitoring is another technology that alerts the driver to vehicles not visible in mirrors. Not all vehicles



TOYOTA'S TSS-C AND TSS-P were the predecessors to TSS 2.0



AUTOMATIC HIGH BEAMS add a layer of safety through improved visibility.



PRE-COLLISION SYSTEMS detect closing targets, provide warning and ultimately brake.

are equipped with this technology, but a button with “BSM” to the left of the steering wheel is the way of determining if this system is present.

In summary, the TSS suite of safety systems provides a wealth of technologies to support the driver. However, the technology has a way to go. For instance, how will an autonomous vehicle handle the complexity of America’s roadways with complex geography and various nuances in state-to-state infrastructure? New Jersey’s right-hand turn to make a left comes to mind. On an even more basic level, how will weather and mother nature be compensated for?

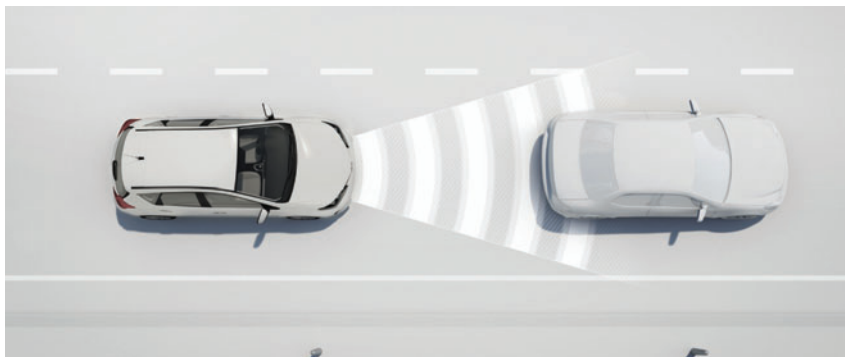
Service Information

Factory service information is critical in the diagnosis, service and repair of Toyota/Lexus ADAS systems. Many of the vehicles that independent shops will encounter will still be under warranty, adding an extra layer of consideration before proceeding with service procedures of any kind. As with any technology, ADAS is constantly evolving, and there are now several generations of ADAS-related equipment found across the Toyota and Lexus product line. As mentioned previously, there are multiple generations and various nuances even within the same model year. With these considerations, accessing Toyota Service Information will be critical.

Toyota makes their service information readily available to the independent repair market via a paid subscription at www.techinfo.toyota.com. Twenty dollars for a two-day subscription will provide you with the full suite of Toyota and Lexus service information, wiring diagrams, service bulletins and supporting materials such as technical training guides and Quick Training Guides. Monthly and yearly subscriptions are also available. These resources provide a wealth of information for the independent repair facility and will ensure that any work related to ADAS will be done by the book.

Before proceeding with any service related to ADAS, be sure to consult Technical Service Bulletins, as there are many related to the ADAS system that will be relevant to basic ADAS procedures such as calibration. For example, there are several Lexus models that have TSBs related to the angle of the shop floor and how to compensate for this phenomenon when calibrating the system.

Toyota and Lexus Quick Training Guides also provide valuable insight into the calibration of Toyota and Lexus ADAS systems. Think of these Quick Training Guides as a “Greatest Hits” document that includes snippets of infor-



RADAR CRUISE UTILIZES millimeter wave radar located in the front emblem.

PHOTO: TOYOTA MEDIA

mation from the repair manual, New Car Features Guide, Electronic Wiring Diagrams and more. As such, they are a massive time saver and a “go-to” guide for technicians.

When is service required?

The service of the TSS system typically relates to scenarios in which either the camera, millimeter wave radar, sonar or alignment may have been altered due to collision, replacement of parts or regular service. When in doubt, consult the service information.

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Required tools

At a recent instructor training event for the national Toyota T-TEN program, many of us were surprised to see a plumb bob and laser level among the “special tools” required when performing calibration functions of the TSS system. The plumb bob is utilized to find the center line by locating the center of the emblem in the front and rear of the vehicle and marking center on the floor at the location of the plumb bob. Then the center line of the vehicle can be projected with the laser level to the specified distance in the service information. While low-tech, it works well.

In addition to these easy-to-find tools, calibrations will require an appropriate scan tool and targets for both the camera and millimeter wave radar. The targets can be printed through the

service information and some related TSBs, meaning the only piece that will have to be truly sourced is the diamond-shaped reflector for the millimeter wave radar calibration.

There are quite a few companies out there that are beginning to design ADAS calibration systems to work with multiple manufacturer vehicles. Currently in production are systems by Autel, Bosch and Hunter Engineering, while many others are rumored to be working on their own solutions.

Other considerations

Performing TSS calibration may sound like a new line of income for your business, but proceed with caution. Most Toyota dealerships in the metropolitan New York region are charging 2.5-3 hours labor for this service. The

Reflector Setup

The radar sensor adjustment procedure requires the following SSTs:



INCLUDED IN QUICK TRAINING GUIDES are the service tools required.

complication is that some dealers are unable to perform these functions. Why, you might ask? Because some of the service functions require a flat, level surface with a significant distance of up to 20 feet in front of the vehicle. Add to this the need for good lighting and limited objects in the background during the aiming process, and you have eliminated every small dark service facility in the country.

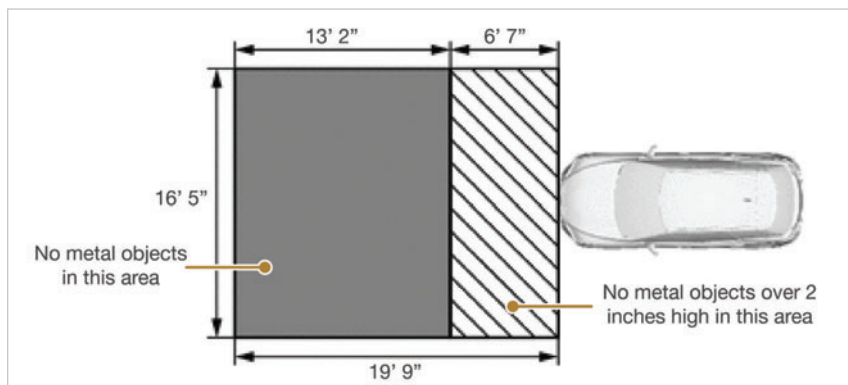
Toyota Safety Sense 2.0 captures the present-day safety features found on Toyota vehicles in 2019. As the saying goes, the only constant is change. You can expect that by this time next year there will be more to write about. In the meantime, consult service information and educate and prepare yourself for the present and future. *TL*



DAVE MACHOLZ is an instructor for the Toyota T-TEN, Honda PACT and general automotive programs at Suffolk County Community College in

Selden, N.Y. He is an ASE CMAT and L1 technician and holds a New York State teaching certification in vehicle repair.

liautotraining@gmail.com



QUICK TRAINING GUIDES FOUND in TIS provide critical service information such as space requirements for calibration.



2016-2017 RX 350 and RX 450h Millimeter Wave Radar Sensor Service

Quick Training Guide – QL616A

This Quick Training Guide demonstrates key procedures for adjusting the millimeter wave radar sensor. Because this guide does not describe every step in the entire procedure, be sure to follow Repair Manual instructions when performing radar sensor adjustment.

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Click the ENTER button to view the Quick Training Guide.

QUICK TRAINING GUIDES provide a wealth of information on TSS system functions.

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ELECTRICAL BATTLES WON

YOU WILL NEVER FORGET THE TOUGH DIAGNOSTIC DILEMMAS, WHETHER WON OR LOST. LET ME SHARE A FEW OF MY MOST MEMORABLE EXPERIENCES WITH YOU.

JAIME LAZARUS // Contributing Editor

When I mention “electrical” problems, I’m not referring to electronics. That’s a different topic altogether in my book! To me, electrical is typically anything that’s not involving a computer. To clarify more, electrical may include the wires and terminals leading up to a module, but not necessarily the module itself. We’ll have opportunities to share war stories involving faulty electronics at some point in the future.

At almost every automotive training class I attend — and at the ones I

present — at almost every trade show and at just about every technician gathering, it is inevitable someone will share (with anyone who will listen) a diagnostic dilemma in which they are currently involved or had recently encountered. It is in our nature to share them I think, but not so much to beat our chests (in most cases), but instead to possibly learn how we can better diagnose such a problem in the future. In almost every case, you’ll hear how much longer the solution took to find than the story-teller thinks it should have, had they encountered something similar previously.

I’ve not seen everything there is to see, and I pity the poor soul who thinks they have when it comes to automotive electrical problems. I attend as many training events as I can in part to hear other people’s war stories. My feeling is, if it happened to that person, it will likely happen to me as well and when it does, I’ll have an advantage — that I learned how it was solved without suffering the pain and agony that the other person went through! I am a member of many automotive technician websites for the same reasons. There’s no logical reason for me to work harder than I have to. Is there one for you?



BURNED CONTACTS ON RESIDENTIAL HVAC UNIT - Once disassembled, it's obvious the electrical contacts could not conduct well, much like a starter solenoid's contact disk that is worn.

In my classes I try to emphasize the importance of understanding the concepts, the strategies and the principles of operation rather than to focus on how any one manufacturer has applied those to their products. What I mean is, for example, it's great to know how a GM TPS (Throttle Position Sensor) works, and it's important to know how to properly test it. It's as important to know where each one may be located on the various applications ONLY if the majority of vehicles on which you work are manufactured by GM.

However, most of us do not work on only one brand of vehicle. If you know the principles of operation for a GM TPS, for example, then no matter which manufacturer employs a similar device, you should still be able to apply the concepts learned about the GM TPS to the one you are working on today. There are rare exceptions, but a majority of TPSs, a majority of starters, a majority of fuel injectors, etc. all share the same concepts. Master those concepts and apply them to whatever you're fixing today to be considered a great diagnostician!

Applying electrical principles

I recently had an opportunity to put my own instruction to the test on a non-automotive application. Some good friends, a married couple, had called a residential heating and air specialist because their home HVAC (Heating, Ventilating and Air Conditioning) unit would blow air properly but not always at the correct temperature. The HVAC technician spent less than half an hour after arriving to inspect the unit before presenting my friends with the recommendation to replace the whole thing. He claimed it was very old and inefficient and said he's not familiar with that brand, then said he wasn't trained on them anyway. It didn't cost anything for his service call nor for his writing an estimate for replacing the

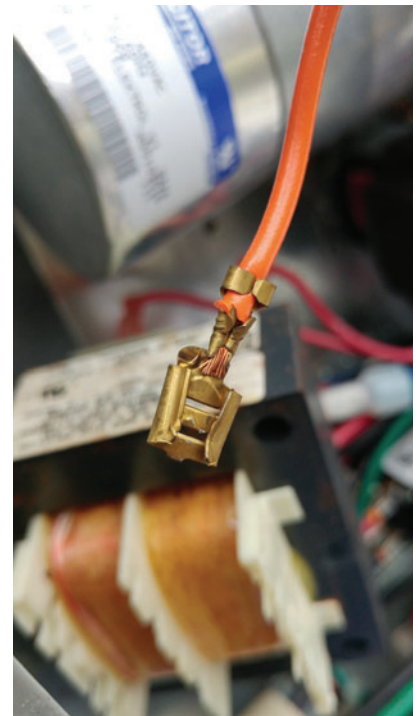
unit (thankfully!). I suppose we consider 1999 cars as "very old," which is the same year this HVAC unit was produced. I'll give the tech that much.

When my friends told me of their dilemma and what the tech had said, I just shook my head in shame, knowing a lot of automotive technicians say similar things to owners of vehicles on which they were not trained. The HVAC technician could have applied the same concepts he knew to this (well-known) brand, but apparently didn't have confidence in his skills to attempt such a thing. It seems more of us at least attempt to apply the principles of operation on vehicles we may not be familiar with. The HVAC technician never even tried.

Being the brave soul that I am, I told my friends I'd look at it and see what I can do. I started by researching the complaint for the brand and model on a few DIY home repair and HVAC websites. I wanted to see if there was something that went wrong commonly with units that were similar to my friends'. This is no different than one of the first steps I'd perform when researching an automotive problem on a brand with which I was unfamiliar. Do you use websites like iATN, Identifix, Diagnostic Network, etc.? I find these extremely valuable, especially under the same circumstances.

I didn't have any good luck. There weren't enough identical complaints/fixes for me to condemn any particular component based on a common problem. There were no silver bullets for me here. I had to consider doing what a good HVAC technician might do — diagnose it!

My research led me to the manufacturer's website where published were the complete wiring diagram, the Owner's Manual, a Quick Start Guide and, get this, an installation manual complete with a troubleshooting guide!



DAMAGED ELECTRICAL TERMINAL ON RESIDENTIAL HVAC UNIT -

Optional capabilities are often enabled on a residential HVAC system simply by attaching a wire to the correct circuit board. This damaged wire terminal required replacing, but once attached correctly, the option worked perfectly.

How about that? This very old unit has built-in troubleshooting complete with blink-out codes!

You younger folks might not appreciate my excitement, but having been present when cars were finally equipped with self-diagnostics, it completely changed the much-lengthier diagnostic processes we had to perform prior to that improvement! Imagine what we went through when working on computer systems that were not equipped with a way to direct you to a system, let alone a component that may be faulty?

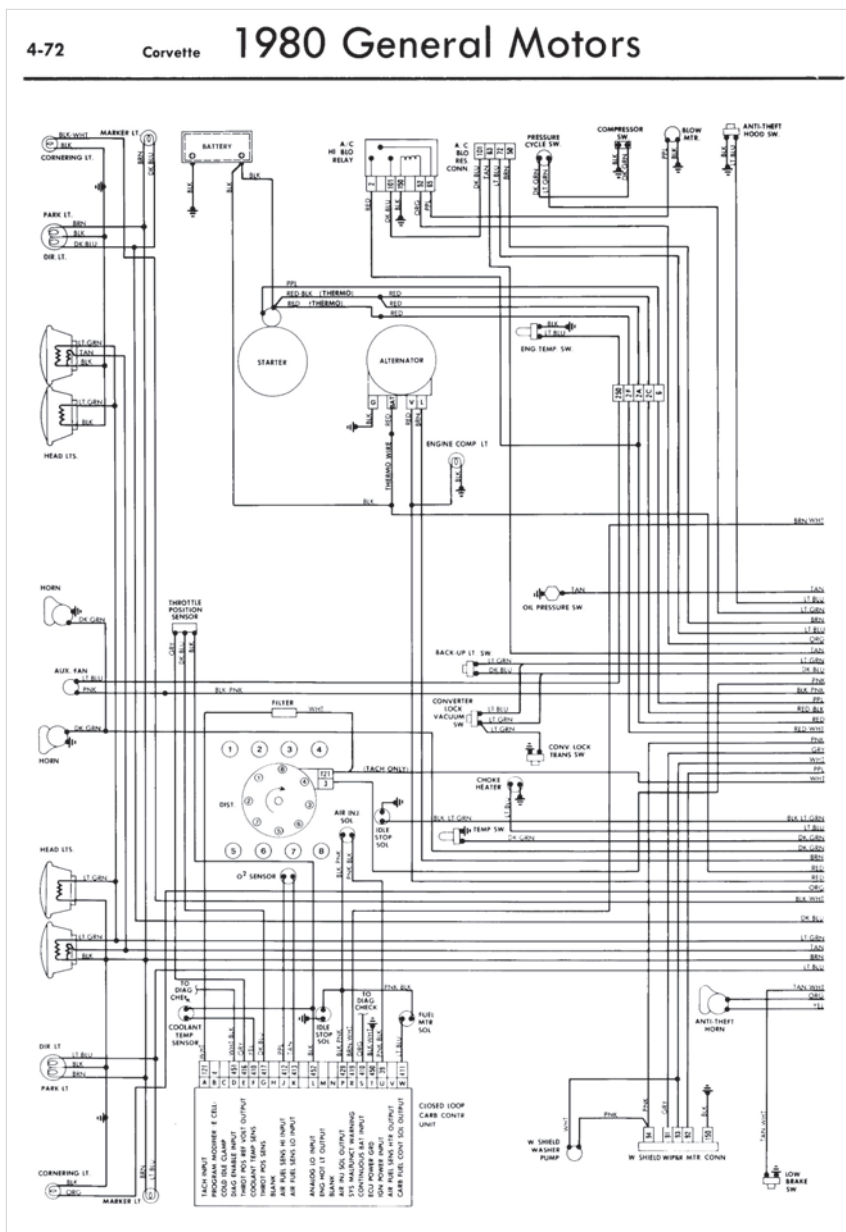
As typically happens when working on cars with an intermittent fault, when I arrived to look at the HVAC unit, it was working as designed. Also as expected, this very old unit had no ability to store codes, just like the very old

cars that erased codes when the key got turned off. This is where my diagnostic instincts came into play.

I looked at the wiring diagram to understand the circuits — excluding the air distribution section (remember, the home owners said it continued blowing, just not always at the desired temperature). In the diagram was a compressor “Contactor” which looked similar to the way a car’s starter solenoid would be wired. Knowing how an intermittent “No Crank” complaint was sometimes attributed to the starter solenoid, I headed in that direction.

With BOTH circuit breakers tripped, I removed a service panel. Once the unit’s cover was off I performed a visual inspection and saw almost every serviceable component well within reach — unlike what we encounter on cars — and in plain view was the Contactor and just about everything else. It was obvious there had been a lot of arcing of the contactor plate, which required no disassembly for me to measure voltage drop across the circuit when operated. I carefully attached the best meter I have to the terminals on each side of the Contactor, then I operated the compressor repeatedly while observing the meter’s readings (from a distance — I don’t like 220 Volt systems). Not once in the 10 times I turned it on, did I see the same voltage on each side of the contactor. Just like when a starter solenoid fails, the contacts had worn out!

The original equipment (OE) manufacturer had stopped making that part several years ago and listed it in their catalogs as obsolete. I found two aftermarket Contactors that were the same size, same shape, had the same number of terminals but had a higher amperage rating than the OE part. I bought them both for less than \$50, including shipping. After verifying identical circuitry to the HVAC unit, I installed the better-looking (higher quality) Contactor and



1980 GENERAL MOTORS CORVETTE WIRING - It was rare to see isolated circuits when you wanted to look at a wiring diagram for a vehicle in 1980. This diagram is four pages — for the whole vehicle!

ran the same voltage drop test again. This time the test results were identical, every time. I was confident their unit would work as designed for many more years to come. I like to verify that my test results differ from previous readings after a component replacement. Do you?

To date there have been no more complaints of intermittent operation. As a side note, this HVAC unit had an

optional feature that could have been enabled had the wire terminal not been damaged that allows the feature. I replaced the terminal, connected it appropriately and have some very happy (and comfortable) friends again! I'm not a HVAC technician but I was able to accurately apply the concepts I learned in the automotive repair trade to successfully repair a residential HVAC unit.

PHOTO: MITCHELL

Principles of induction

I was a dealership diagnostic technician who was presented with a particularly challenging diagnostic dilemma in one memorable diagnostic battle that occurred early in my career. One of the first redesigned Chevrolet Corvette models to be delivered to the public (at that time) had been purchased by the dealership's owner's son. The car returned with an A/C blows warm air complaint in less than a week after initial delivery.

The compressor fuse had opened the circuit it protected, but whatever had caused it to do so was not evident. A new fuse was installed, and the car returned to its owner. Within a week the same thing happened with the same test results and the same repair. You know what happened again — yes, the car returned. I was instructed to locate the cause and to repair it before taking on ANY other job. When you work in a flat rate environment, you do not like hearing instructions like that, ever! Knowing it was the owner's son's car also made this job extremely important.

In the early 1980s we didn't have all the fancy diagnostic tools that are available today. What I had to work with were made by Radio Shack, Sears & Roebuck and a few miscellaneous items bought from tool truck vendors. Does that give you any idea what kind of challenge this intermittent fault presented?

In short, at the 10-hour (into it) mark, my service manager enlisted the assistance from techs at other dealerships. I knew how to reproduce the blown fuse, but we couldn't determine what was causing it. The blower had to be in M2 speed, the third fastest selection, for about 15 minutes, but visual inspection of the circuits involved did not reveal any shorts. We isolated wiring, jumped circuits, replaced several components, etc., etc. with no positive effects.

At the 20-hour mark, (over the

FIND THE TIME AND MAKE THE SACRIFICE TO ATTEND TRAINING

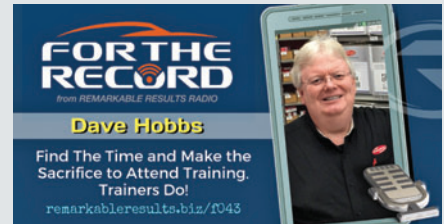
In this latest Remarkable Results podcast with Carm Capriotto, he speaks with Dave Hobbs, who urges people to find the time and make the sacrifice to attend training — trainers do!

Dave Hobbs' automotive service experience spans 40-plus years in the industry, starting out as a technician and then as a service manager working in his family's repair shop (Hobbs Auto Electric) in Kokomo, Indiana. After leaving Hobbs Auto Electric, Dave began working as a hotline advisor and field engineer at GM's Delco Electronics. Those roles eventually led to becoming an electronics systems instructor for thousands of Delco Electronics / Delphi engineers throughout North American and Asia.

Dave Hobbs is currently the lead technical trainer and course developer for Delphi Product and Service Solutions. In addition, he serves part-time as a contributor to *Motor Age* and as a field correspondent for MACS Worldwide (Mobile AC Society).

phone) assistance was requested from the GM engineers. We followed their directions to no avail. At the 30-hour mark, two instructors were flown in from a GM training center several hundreds of miles away. They flew back by the end of the week dumbfounded. After that, two engineers were flown in from either Bowling Green, Ky., or Detroit, Mich. (or both, I don't remember).

Meanwhile, not having received a



Key talking points in this podcast include:

- Hands-on training is the best method. When you do it yourself you learn better than any other training.
- Techs need to find the time and make the sacrifice to attend training.
- There is a huge sacrifice by every training supplier to design and present great training.
- Use community colleges for these events vs. a hotel or restaurant.
- Let the college's instructors attend for free. Include their students.
- Stop considering the convenient place to get training and find the best place so you can do more hands-on.

To listen to this episode, go to MotorAge.com/TimeToTrain.

decent paycheck since this job started, I was getting poorer by the week. These two gentlemen came on the scene like gangbusters, were full of ideas (none of which hadn't been tried yet) but after the fourth full day, were as flabbergasted as all the rest who had touched this car. They went to lunch with the service manager and for a change, I left the premises, too. I went to a nearby park, sat under a tree and processed ev-

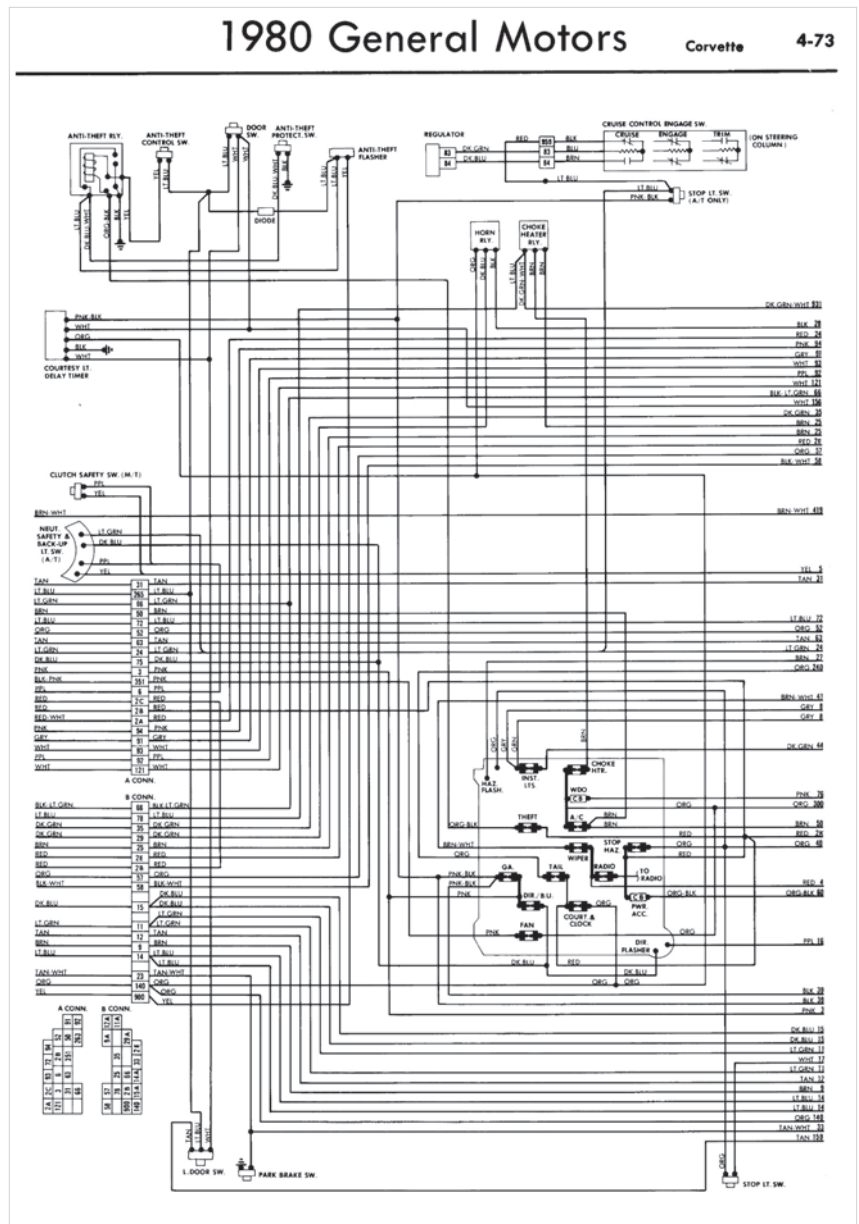
everything that had been done over the past several weeks. I got away from the car — and figured out what was causing the problem.

Upon arriving back from lunch the engineers were not sure in which direction we would proceed. I told them to go to their respective homes and that I had it figured out. Of course, everyone was excited and wanted to know what was causing that fuse to blow. I refused to say unless I was guaranteed to receive payment for every hour I had invested (by then, 48 hours!). At first the service manager balked, said something about not being able to promise that. I replied there were several thousands of these cars built the same way that will dumb-found a lot of people — and if THAT wasn't worth the money I should have earned then I was walking! The engineers convinced the service manager to change his mind.

You're wondering too, aren't you? Here we go...In M2 speed, the blower resistor is using all of its resistors, glowing cherry red. A lot of amperage is flowing through that circuit. At that blower speed, with all the windows closed, after about 15 minutes the low-pressure side of the air conditioning system drops and the (axial) air conditioning compressor cycles off. When it cycles back on, the total amperage requirements of the alternator exceeded the voltage regulator's abilities to work properly.

This vehicle was equipped with an Amp gauge which was wired IN SERIES with the alternator output. Between where the heavy (10 Gauge?) wiring passed through the "Firewall" (Bulkhead) connector to and from the Amp gauge, was located the air conditioning compressor clutch circuit wire. It was basically sandwiched between both of the Amp gauge's wires.

During the momentary alternator overload condition, amperage was in-



1980 GENERAL MOTORS CORVETTE WIRING 2 - "Page two" - Mostly interior wiring, including the Alternator and the AC circuits mentioned in the article.

duced into the A/C compressor clutch circuit — which subsequently caused the fuse to blow (open the circuit). Relocating the smaller wire in a different position of the bulkhead connector solved the problem.

I repeated the blown fuse, and proved the repair, multiple times for the benefit of the engineers before they left. Like I mentioned earlier, I want to test the repair repeatedly in order to

confirm the problem is fixed. I got paid for every hour I invested in that car and never forgot about induction again. I'll bet those two engineers didn't either! *TLZ*



JAIME LAZARUS has regularly presented technical seminars since 1985. He recently taught instructors at the North American Council of Automotive Teachers conference and the NASCAR Technical Institute.

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PHOTO: MITCHELL

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YOU HAVE TO WALK BEFORE YOU CAN RUN

THE TECHNICAL CHALLENGES YOU FACE WON'T BE SCARY IF YOU HAVE A SOLID FOUNDATION UNDER YOUR FEET

PETE MEIER // Technical Editor

How did you learn how to work on cars? Did you, as I did, learn at the side of an older mechanic? Are you self-taught? Or did you attend a post-secondary program in automotive technology?

Regardless of the course that brought you to where you are today, how confident are you in your foundational skills? Are they based on myth or reality? Are they out of date or up to date?

I used to think I was pretty well informed until I started writing as the occasional contributor to this magazine. I'll never forget an article I wrote many years ago, focused on diagnosing fuel systems, that contained some erroneous information that brought the wrath of the readers down upon my head! Until that point in my fledgling writing career, I based nearly every article I wrote on my personal experience and training. I discovered that what I'd been taught was not always correct. I also discovered that there would always be a few *Motor Age* faithful that would be sure to point my mistakes out to me!

And ever since then, I've made every effort to ensure that what I wrote, and what was submitted by our contributors, was as true and accurate as I could make it.

So back to my question: How confident are you in your foundational skills and knowledge?

Let's find out

I'm not trying to put anyone on the spot or make anyone feel bad about their current technical capabilities. Far from it. I am trying to help those who may be operating on the dark side to see the light. I can't begin to tell you how much I've learned in the last decade as the magazine's technical editor, including how much I've discovered I had learned incorrectly, as well as what I didn't know at all! From understanding the latest ADAS technologies to the nuances of servicing wheel bearings, I've found there is always something new to learn. And it makes me a better tech in the process.



USING A SCOPE TO DIAGNOSE electrical concerns requires a solid foundation in electrical troubleshooting. How strong is your base?

So let's try a little experiment. The following is a short quiz to test some of your foundational knowledge. Willing to try it out?

1. Technician A is troubleshooting a blower motor that runs slow on all speeds (**Figure 1**). He backprobes the BLK TAN wire at the blower motor with his voltmeter, selects HIGH speed with the fan selector switch, selects HEAT with the mode switch and turns the ignition key to the RUN position. He reads 4.7 volts. Technician A says the reading most likely indicates a failed blower motor. Technician B says the reading most likely points to a bad ground at G202.

- A. Technician A
- B. Technician B
- C. Both technicians
- D. Neither technician

2. Technician A says you can detect a failed front wheel hub bearing by grabbing the tire at the 3 o'clock and 9 o'clock positions, then shaking the wheel assembly back and forth while feeling for play. Technician B says that the use of a dial gauge to measure the end play of the bearing with the wheel removed is the preferred method of testing. Who is correct?

- A. Technician A
- B. Technician B
- C. Both technicians
- D. Neither technician

3. Technician A is diagnosing a cooling fan motor that won't operate. He uses a scan tool to command the fan on while backprobing the still-connected two-wire connector with his voltmeter. He reads 12.6 volts on both sides of the connector. Technician A says the most likely problem is a faulty fan motor. Technician B says the most likely problem is an open ground circuit. Who is correct?

- A. Technician A
- B. Technician B
- C. Both technicians
- D. Neither technician

4. Technician A says that a small amount of "anti-seize" compound is necessary when installing spark plugs into an engine with an aluminum cylinder head. Technician B says that spark plugs should be tightened with a torque wrench. Who is correct?

- A. Technician A
- B. Technician B
- C. Both technicians
- D. Neither technician

5. Technician A and Technician B are discussing fuel trims and their value in drivability diagnostics. Technician A says that total fuel trims on a vehicle equipped with an MAF sensor that are positive on one bank and negative on the other could indicate a failed catalytic converter. Technician B says that total fuel trims that are positive at idle on the same vehicle, but normal at cruise speed, could indicate the presence of a vacuum leak in the intake. Who is correct?

- A. Technician A
 - B. Technician B
 - C. Both technicians
 - D. Neither technician
- So, how did you do?

The answers

The answer to the first question is B. The first tip is the blower motor speed being tested. On HIGH, the ground path is not routed through the blower motor resistor, taking any issues there out of the equation. If Technician A were correct, though, the blower motor should still cause the applied voltage to drop to next to nothing on the ground side of the connector. Since voltage is present, that tells Technician B there is an additional, and unwanted, source of resistance on the ground path back to the battery. He may be jumping the gun on G202, though. Corrosion at splice S228 is certainly a possibility, as are issues with the connections at the heater control head.

I wanted to lead off with an electrical question because this is where I find most technicians struggling — including myself. The idea of reading voltage

when your meter leads are attached to two ground connections [the pin on the blower motor connector with one-meter lead and, of course, the other meter lead to (preferably) battery ground] continues to blow the minds of many. Yet, the concept of voltage drop is considered to be as foundational as they come. How are you going to build advanced electrical troubleshooting techniques or understand how to repair the electronic systems on today's — and tomorrow's — vehicles if you aren't comfortable with the basics?

On to question No. 2.

B is also the correct answer here. Grabbing the front wheel and giving it a shake is something I still do almost automatically, but it will only reveal a bearing failure that should have been addressed long before it got that bad. Wheel bearings, both hub and tapered-style, with excessive end play can lead



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to brake pulsation issues and other concerns. The only way to check either accurately is through the use of a dial gauge. Do you use one to check the bearings when performing a brake overhaul?

How about question No. 3?

Once more, the answer is B. This is also related to voltage drop testing. If the measurements on both sides of the load are reading battery voltage, then you should know right away that there is an open on the ground side of the circuit. No current is flowing so there can be no voltage drop. A similar scenario is reading battery voltage on the positive side of the connector and a perfect 0.0 volts on the ground side. In this case, the open is between the two-meter leads and could, in this case, be a fault in the connector or the fan motor itself.

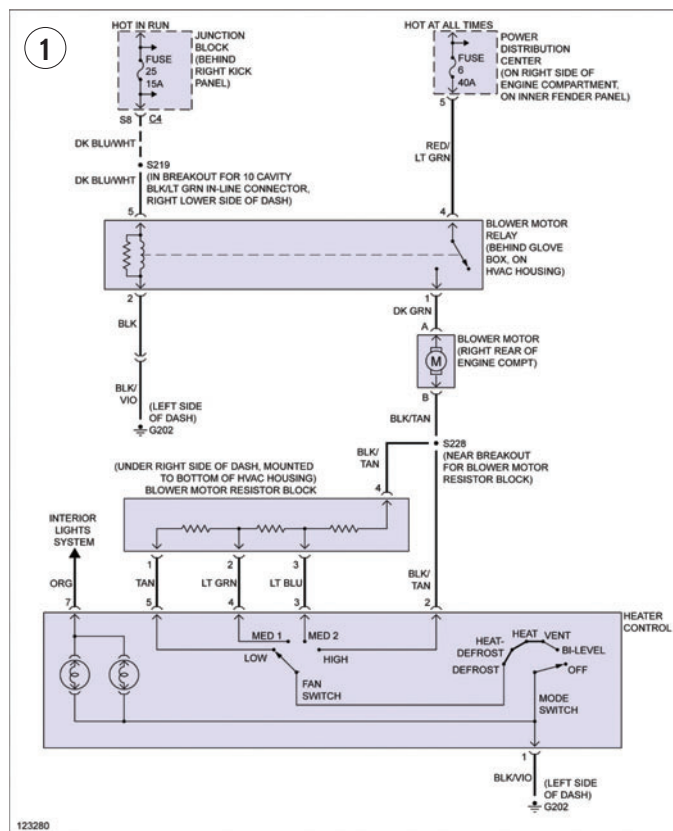
Question No. 4 is next. The correct answer for this one is also B. See, I'm trying to make the test as easy as I can on you!

All joking aside, this is related to a topic I did some time ago. And the responses I got from techs who were in favor of anti-seize and those who weren't ran about 50/50. According to the people who make the plugs, though, there are a few good reasons to avoid using anything on the threads. For one, most of us still tend to use too much of the stuff, and that can interfere with the electrical ground path for the plug. Additionally, the use of anything on the threads can also impact the ability of the plug to dissipate heat. Last but not least, the use of anti-seize (or any kind of compound) on the threads of any component or fastener (that doesn't specify its use) impacts your ability to torque it down accurately. So, the best practice is to make sure the threads are clear and clean and leave the anti-seize on the work cart.

As for Technician B? Yes, every plug manufacturer recommends torquing plugs to specification. This protects the plug from damage during installation (common faults include cracking the insulating ceramic and separating the plug body from the metal shell), aids in proper heat transfer and keeps it from loosening up in the head over time.

Last, question No. 5. Did you answer B to this one? If so, you would be — incorrect! I had to throw some kind of curve ball in there.

Both technicians are correct. Fuel trims are a valuable diagnostic aid if you know what impacts them and how to decipher what they're telling you. But many techs I've met don't understand what fuel trims are to begin with. They don't understand how or why the ECM makes changes to them, or what factors impact those decisions. If you aren't comfortable with how the ECM manages fuel delivery, how will you be able to comprehend what's happening when fuel trims go awry?



USING A SCOPE TO DIAGNOSE electrical concerns requires a solid foundation in electrical troubleshooting. How strong is your base?

Shore up your foundation

Let's be real with one another. We don't know what we don't know, or what we've learned incorrectly, until a situation arises and brings the weakness to light. Back in the old days, we could afford to make mistakes, because the vehicles of the day more easily tolerated them.

The same is not true today. So, no matter how long you've been turning a wrench, no matter what school you've attended, attend frequent training and continue to feed your mind and build your skills. Question everything an instructor tells you, be sure you understand the "why" when presented with new material, and never give up on moving forward. The technologies waiting for us ahead demand it. **TM**



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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Get on the road to the future of the aftermarket Industry

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AAPEXedu brings you a carefully curated offering of cutting-edge education. Newly revamped for 2019, AAPEX's education program includes in-depth sessions designed to easily fit into your schedule on topics of specific interest to service professionals in the aftermarket industry.

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It's time to make your move. Get on the road to AAPEX, November 5-7, 2019, at the Sands Expo in Las Vegas. Register today at www.aapexshow.com.

AAPEX is a trade-only event and is not open to the general public.

AAPEX represents the more than \$1 trillion industry and is co-owned by the Auto Care Association and the Automotive Aftermarket Suppliers Association (AASA), the light vehicle aftermarket division of the Motor & Equipment Manufacturers Association (MEMA). For more information, visit www.aapexshow.com or e-mail info@aapexshow.com. On social media, follow AAPEX at #AAPEX19.

Autel diagnostic automotive intelligence

Autel is a manufacturer of advanced diagnostic scan tools and ADAS calibration tool packages for the automotive aftermarket.

ADAS calibration package

The Autel MaxiSYS ADAS Calibration Tool Package provides advanced components and accurate repair procedures for camera, radar, lidar and night vision driver-assisted systems. The ADAS Tool Package comes equipped with an easily adjustable calibration frame and interchangeable targets, ideal for collision repair, wheel alignment, glass replacement and specialty repair shops. The advanced collision-repair ready software package provides detailed graphic instructions and precise measurements for setup and calibration procedures. The included single button Pre-SCAN / Post-SCAN feature performs an AutoSCAN test for all modules in all vehicle systems to help create an efficient repair plan from the start. Detailed report files, including shop information and photos taken during inspection, are then generated for insurance carrier submission. This scan feature also includes ADAS identification to pinpoint modules requiring calibration procedures on the Pre-SCAN report. Additionally, the MaxiSYS software offers the OE-level coverage, bi-directional diagnostics, and service reset features that technicians depend on during their normal repairs, providing greater return on investment.

New expansion package: LDWTARGET2

The Autel MaxiSYS ADAS System now has an expanded LDW vehicle coverage upgrade. The new LDWTARGET2 Package contains Lane Departure Warning (LDW) calibration targets for Nissan, Mazda, Mercedes-Benz, Mitsubishi and Subaru. The targets in this package are compatible with the Autel MaxiSYS ADAS tablet and other MaxiSYS MS908 tablets with the ADAS software upgrade. The target board holder is required to use these targets and is available via purchase of either the LDWPACKAGE or ADASCOMPLETE Package. A software update on ADAS-capable MaxiSYS tablets is re-



quired to utilize this expanded vehicle coverage. A 1-year Warranty is included with package purchase.

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Parts Plus Car Care Center loyalty program

Rewards programs are indisputably a staple these days. Most retailers have them, and consumers have come to expect them. Maybe you have even considered one in the past? While the independent auto repair and parts industries have been more cautious adopters in the past, perhaps it's time to take another look.

The issue is that most retailers and service facilities view rewards programs as an expense, rather than a revenue generator. While it's true that there will be an expense with any well-run loyalty initiative, your ROI should greatly outweigh the costs of maintaining your program.

So, let's look at the bigger picture. Ask yourself: What am I currently doing to truly engage my customers? Customer engagement is an essential component in building closer, more profitable relationships. Having a well-defined, relevant, multi-channel customer engagement strategy is key to optimizing your customers' ongoing experience and developing long-term retention while maximizing the lifetime value of your customers.

Loyalty programs are more than just rewards. Parts Plus Car Care Centers offer their customers a good quality loyalty program, such as LoyaltyTrac[®] by Performance Loyalty Group,

Inc. It provides all the tools to maintain an ongoing, opt-in engagement program between your business and your customers. Utilizing this loyalty membership platform as the conduit to your customer, you can extend your reach across web, email, social media, mobile and offline channels, all with one very important common theme: **YOUR LOCAL BRAND!**

Your loyalty program will provide you with a much more efficient, relevant and cost-effective method to reach and interact with those customers who ultimately drive your business revenue by capturing their attention through targeted, relevant and timely program communications. The result is a more responsive customer base, a deeper customer relationship, greater recognition for your local brand, and of course, increased revenue for your shop or parts business.

While rewards do have a role in any loyalty program, they are not the main component. The rewards elements should help drive the purchase and retention behaviors that you want most. When properly designed, rewards will increase your customer's visitation rate and annual spend. Unfortunately, in the automotive business, customers regularly seek a discount on their purchase. How often do your employ-

ees give your best customers a 10 or 15 percent discount? Have you ever thought about replacing those cash discounts with an internal form of currency, either as points or shop dollars? By leveraging LoyaltyTrac[®] to issue your own form of shop currency, you are practically guaranteeing that your customer will return and spend it on another purchase with you, all while garnering a higher gross on the sale of your products and services.

As you can see, there are numerous benefits to a loyalty and retention program — from improved customer engagement, to better brand recognition, to higher profits. Loyalty programs have come a long way in helping you grow your business and profits. You may want to take a more serious look if profitability is important to your business.

Parts Plus Car Care Centers receive exclusive discounts through LoyaltyTrac[®]. To learn more, visit www.partspluscarcarecenter.com or www.getloyaltytrac.com/adn.

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Now available — Chrysler Communication Course from FMP Training

Most new Chrysler platforms have started using a different style Data Bus communication system. With this new communication system, the control for most sub-systems will be different than what has been seen over the past years. These changes will be introduced as the new platforms are implemented. The Compact Wide Platform was the first of this completely new Buss system and was introduced in the 2013 Dart, Jeep Cherokee and then the Pacifica. Be aware the Ram trucks had a mid-year change in 2013, so there two different schematics and diagnostics for that vehicle.

One of the biggest changes will be the elimination of the Diagnostic Can C Buss and the despised TIPM. The TIPM has now been replaced by a BCM. The BCM is part of the interior power distribution center (PDC). The BCM is a Flash Programmed Computer and

must be replaced as a unit with the PDC.

The BCM is not the only change. Chrysler revamped its wiring harnesses and schematics to help cut down diagnostic time regarding U codes but also for Parasitic Draw problems. Diagnostics can now be performed at the DLC rather than the TIPM.

Be aware of the growing usage of the LIN Buss. Chrysler is now using the LIN Buss extensively in its vehicles. Be careful in identifying the sub-systems as there may be two different wiring diagrams along with flowcharts for a sub-system.

Star Connectors have been updated to provide even quicker diagnostics. This new feature helps in isolating the problems with modules or wiring.

The FMP Training Webinar, offered on August 20 and 21, will show you detailed diagnostic tips and shortcuts for a



quick but complete repair. Learn how to diagnose the Busses by schematic, not flowcharts.

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Accessory and suspension modifications present diagnostic challenges

By **LARRY HAMMER** // Technical Services, Mighty Distributing System

Accessory components and suspension modifications that enhance the cosmetics or performance of a vehicle are readily available for most vehicle makes and models. When modifications are made to steering, suspension, or tire and wheel assemblies, they can have an effect on the handling characteristics of the vehicle, illuminate fault lamps and display failure messages. These additions must be considered in the diagnostic process and how they may affect the performance and life of other system components. Failure to do so and not communicating with the customer may come back to haunt you in the form of a customer returning, convinced the repairs should be made at the shop's expense. In some cases the customer will have to make a choice between removing the accessory, returning the suspension to the factory spec, or accepting a symptom as a normal characteristic.

Suspension modifications

Premature failure of some suspension components may result from cosmetic enhancements such as taller and wider tires, off-set wheels and suspension kits to level, increase, or decrease the vehicle's ride height. These modifications may result in upper ball joint wear-out in 30K miles or less. Taller and wider tires are more aggressive, resulting in a load on the driveline, in addition to causing noise and vibration at highway speeds. Suspension modifications affect u-joint

angles, stressing the components, resulting in premature wear and vibration. Drop spindles or other lowering devices can promote the same alignment issues with the u-joints, promoting vibration and premature failure.

Accessories

Running boards, bicycle or ski racks, brush guard grilles, emergency lighting, etc. can affect the airflow around the vehicle, promoting annoying noises. Steps or running boards mounted rigid to the frame or cab without insulation can transfer noises and create vibrations in the passenger compartment. Pinpointing the source of these noises may require removal of some of these accessories for diagnostic purposes.

Steering pull or wander

Low aspect ratio tires can create some challenges for the technician trying to resolve a customer complaint of steering pull or wander. This is considered a normal characteristic for these type tires, as they have a tendency to follow grooves or inconsistencies in the road surface. Increasing the tire pressure above the vehicle manufacturer's recommended specification may stiffen the sidewall and further aggravate the symptom. While wheel alignment is often thought to be a contributing factor, it will not correct this condition.

Steering pull or wander

Vehicle owners may complain of a flashing Traction Control Light that may occur



under hard acceleration at higher speeds. In addition, ABS lamp illumination may occur, or they may have a handling or brake related complaint. These symptoms may occur following the installation of a new set of tires or custom wheels. GM states that these symptoms may be the result of tires that do not meet the same tread wear, traction or temperature ratings. Their recommendation is to ensure that the original equipment type tires have been installed, which will be documented via the VIN number. It is imperative that the same type be installed, such as summer or all season, the original size, and with the same or higher load and speed rating. The information can be accessed on the GM website or their Tire Hotline.

For additional diagnostic challenges, refer to Mighty Tech Tip #194 "Vehicle Modifications" on our website.



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NAPA Premium Brakes are designed to be as good or better than the OE. As a result, NAPA ensures they have proper fit and performance, are 100 percent chamfered to eliminate initial engagement noise and come with a hardware kit to complete the "perfect brake job." So it's no wonder that NAPA Premium

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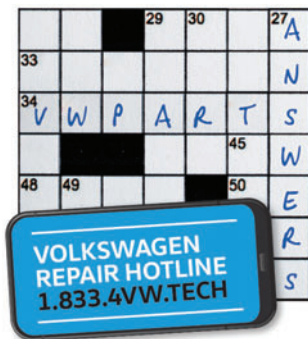
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THE EVOLUTION OF THE THERMOSTAT

REGULATING ENGINE TEMPERATURE IS A KEY FACTOR IN REDUCING EMISSIONS AND MAXIMIZING PERFORMANCE

PETE MEIER // Technical Editor

Research performed in the 1920s revealed that a major cause of cylinder wear on these earliest engines was the condensation of fuel when it came into contact with cool cylinder walls. This resulted in the wash down of the lubricating oil film on the walls, leaving the piston rings defenseless. The first thermostats were the answer to that dilemma, allowing the engine to reach operating temperature much faster and minimizing the effect.

These early t-stats used an organic fluid that had a boiling point just a bit lower than the desired engine operating temperature and utilized a bellows-style design. Due to the fact that they were prone to failure, they were mounted in easily accessible locations, typically under the water outlet on the top of the cylinder head. A decade later, automotive cooling systems took a lesson learned from their aviation counterparts and became pressurized. Unfortunately, the bellows-style thermostat didn't play well with pressurized systems, often being shut inadvertently by the system's internal pressure and that resulted in unwanted overheating.


The solution came in the introduction of the design still in common use today. Rather than use a fluid, a custom-



ized wax is used to control thermostat operation. As the wax is heated, it expands, and because it's a solid, its overall mass changes very little, making it better suited for use in a pressurized system.

Today, though, the demands on the thermostat have exceeded the old wax pellet thermostat's ability to cope. For peak efficiency, the optimum engine temperature varies outside of the range the conventional thermostat is capable

of responding to. Enter the electronically controlled, or MAP, thermostat. This thermostat uses a conventional design with one added feature — an electronic heating element embedded in the wax and controlled by the ECM.

Exploring the evolution of the thermostat and how to diagnose both conventional and MAP-style designs is the topic of this month's edition of "The Trainer." I hope you enjoy it! 

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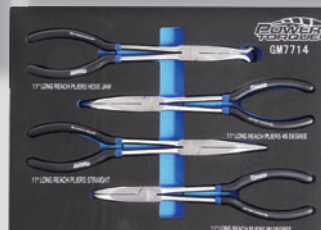
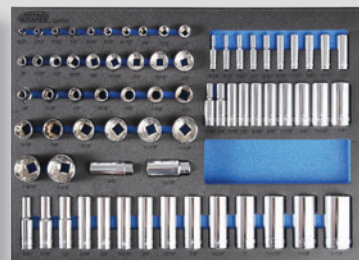
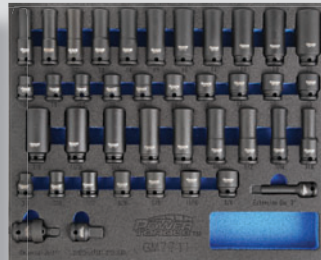
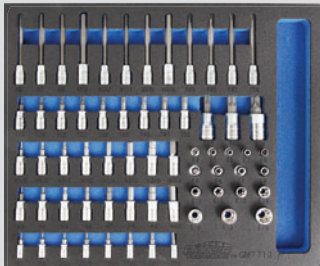
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