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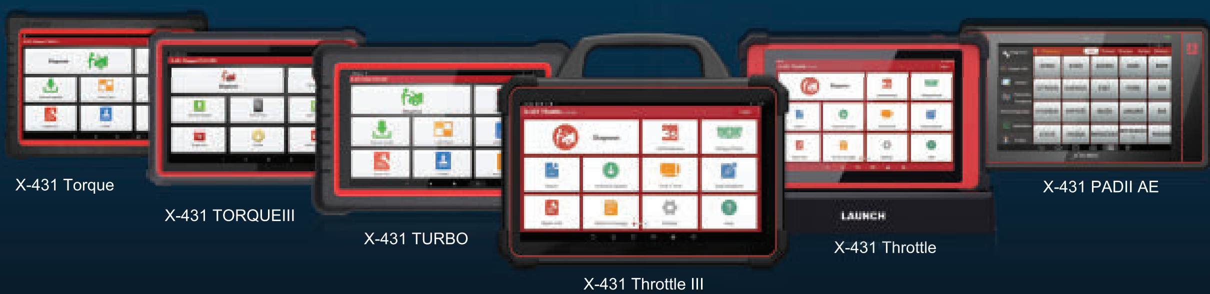

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MOTOR AGE, PTEN LAUNCH BEST YOUNG TECH AWARD PROGRAM

MOTOR AGE STAFF //

PTEN and *Motor Age* have partnered to recognize the next generation of technicians in the service repair industry.

The 2021 Best Young Tech Award program will honor those technicians aged 35 or younger who are moving the service repair industry forward, excel in their current role and are passionate about their work. Milwaukee Tool and Carquest Technical Institute + Worldpac Training Institute are Marquee Sponsors for the program. Autel is a presenting sponsor.

The grand-prize winner will receive a roundtrip flight and lodging for two nights for the AAPEX and SEMA shows in November in Las Vegas, a trip for two to the STX Supplier and Training Expo in March 2022 and prize packets from the program sponsors that include power and diagnostic tools and professional training opportunities.

He or she will also do a video interview with *Motor Age* Technical Editors Pete Meier and Brandon Steckler and be featured in the December issues of *PTEN* and *Motor Age*. In addition to being honored at AAPEX during an awards ceremony, the winner will be celebrated on social media and gifted a

patch to display on their uniform.

The judging panel is comprised of *Motor Age* and *PTEN* staff and representatives from Milwaukee Tool, Advance Auto, the TechForce Foundation and the National Institute for Automotive Service Excellence. The deadline for contest nominations is July 31. The winner will be named in September.

The contest will be promoted through the summer months. TechForce Foundation is working as a partner with *Motor Age* and *PTEN* to help spread the word about the contest through its newly created Peer Network, raising awareness among auto technician students, young alumni from vocational tech programs and auto service training instructors.

Nominate yourself or someone you know now! The entry takes 10 minutes or less. Go to **vehicleservicepros.com/bestyoungtech**.

BREAKING NEWS

EMPLOYEE RETENTION

TOP 6 WAYS TO KEEP THE BEST TECHS AT YOUR SHOP

There's a big skills gap in the automotive industry and shop owners need to put effective strategies in place to hold on to top talent. That's what attendees at the virtual ASA X50 conference heard Friday morning from the opening panel discussion.

"It's really hard to find good, skilled people right now," said Jay Goninen, president at WrenchWay and Find a Wrench. "[It's a] struggle trying to find those really talented people and because of this big skills gap, you need to step up your game — and talented people want to know you care about their future and you want to see them succeed."

The panel identified several ways that shop owners can recruit and retain talented workers.

How to keep the best technicians in your shop:

1. Have clear career paths

>> CONTINUES ON PAGE 6

TRENDING

RENEW ASE CERTIFICATIONS

With more techs than usual scheduling tests before their certifications expire on June 30, the National Institute for Automotive Service Excellence recommends registering as soon as possible for a test time.

TOP 20 STATES MOST EQUIPPED FOR EVS

With a noticeable push toward an increase in electric vehicles, a nationwide study looks at how well each state is doing, which ones have the infrastructure and how EV take up compares to other vehicles.

WOMEN OF THE YEAR OPENS NOMINATIONS

Women in Auto Care is now accepting nominations for the 2021 Women of the Year awards, which include Woman of the Year, Woman of Excellence and Female Shop Owner of the Year.

GET THE SCAN TOOL SPEC GUIDE

Sister publication *PTEN* has released its annual Scan Tool Spec Guide, which can help guide shop owners and technicians in purchasing the right Global OBD-II, Professional Diagnostic or Heavy Duty scan tool.

AAPEX 2021 OPENS REGISTRATION

Attendee registration is now open for AAPEX 2021, Tuesday Nov. 2 through Thursday, Nov. 4 at the Sands Expo and Caesars Forum Conference Center in Las Vegas. Sign up to attend now!

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>> CONTINUED FROM PAGE 4

Goninen's biggest tip for finding and keeping talent is to have a clear career path. If individuals don't have a career path, it drives uncertainty, frustration, and disengagement, he said. Start by having a conversation with the employee to determine if their personal goals align with those of the business.

"Maybe they are starting out as a boot tech and their ultimate goal is to be a service manager…obviously they've got a long way to go but it's good they are driven to that point. Be candid about their actual skill level and some things they need to work on. Then reverse engineer their career — start with the end in mind and work your way back to where they are today and lay out those milestones and those different types of roles they should be looking at to grow to that point," Goninen said.

Make sure individual career goals align with your business goals, and look down the pipe to know what's coming from a staffing perspective, such as a looming retirement.

"Understanding how your shop looks today and what you want it to look like in five years is really important to your long-term success," he added.

2. Include staff in decisions

Mike Reynolds, owner/operator of Mobile Automotive Service Solutions who also sat on the panel, stressed the importance of including staff in decision making. For example, if you're buying a new scope, involve them in the process of selecting between the Picoscope, Snap-on and Autel, he suggested. Ask what they are more likely to use and feel comfortable with, rather than just making the decision for them.

3. Define your shop's mission statement

During the panel discussion, Kevin Allen of the Automotive Training Institute said if attendees only get one thing out of this presentation, it should be the importance of ensuring they have a mission and vision statement for their company. The statement needs to be in writing, communicated to the team and updated regularly. This helps employees and candidates know where you want your company to go and how you're going to get it there, Allen said.

"If you haven't defined your company's mission or vision statement, none of this other stuff matters," he said.

4. Recognize your employees

Allen also spoke about the importance of recognition — and this goes deeper than having a team lunch. For instance, he recommends going all out for tenure celebrations with a nice plaque, letter from the employee's manager and presentation at an all-employee meeting.

Reynolds suggests showcasing quality work on the company's Facebook page and giving a shout-out to the technician who completed the work.

Recognizing work performance is important, but Allen also recommends celebrating birthdays, major life events (such as a wedding or the birth of a child) or achieving a certification.

5. Get technology in front of students

A major problem in the automotive industry is people are entering and then leaving, said Reynolds. They are looking at that lead technician who isn't into diagnostics and is just doing front-end work and they know that's not where they want to be.

"We are losing the best of the best. These are the people that know they have a big future in whatever they want to do and they want to engage, they want to excel but they enter our industry and they don't see a future for them," he said. "They want the scan tools they want the tech, so we have to 1) make it available to them and 2) put them on a path so they can see the picture of that's where they can end up."

6. Be industry ambassadors

All panelists agreed on the importance of promoting the industry on social media, speaking at your local high school and tech schools and doing whatever you can to get people excited about the automotive industry.

"Are there opportunities to show off how cool this industry is? Some of that technology would blow the minds of young people," Goninen said. This is complicated stuff to work on; this is not easy. We need smart people in this industry and the more we can promote the industry, the better people we are going to get."

ATI ANNOUNCES 2020 TOP SHOP WINNERS

The Automotive Training Institute has announced the winners of its annual Best of the Best Awards program, recognizing exceptional shops and individuals across the country.

The Top Shop 2020 award went to Graham Auto Repair, owned by Troy and Kori Vaninetti in Graham, Washington. Twelve other shops also were chosen as top shops.

ATI's Best of the Best Awards include many different categories, including the ATI Humanitarian of the Year award, which went to Haglin Automotive, owned by Dana and Judi Haglin, in Boulder, Colorado. This award recognizes individuals who donate their time or money to those in need.

Other awards include most improved collision center, best tire sales, best gross profit margin, and many more.

All awards were presented at ATI's SuperConference 2021 on May 8.

ASE EDUCATION FOUNDATION PARTNERS UP TO OFFER FREE TRAINING

AMANDA SILLIKER // Contributing Editor

The ASE Education Foundation has partnered with several companies, including Mercedes, Ford and General Motors, to offer free online learning resources for its auto, truck and collision instructors and students.

"Our partners have provided a wide range of training resources and classes that not only help students with their classroom work, but also help prepare them for ASE Entry-Level Certification tests," said Mike Coley, ASE Education Foundation president.

Many car manufactures and auto parts suppliers are offering free online training, including recent partners Carquest Technical Institute (CTI) and Worldpac Training Institute (WTI) which are giving ASE instructors unlimited access to their virtual classroom events. This allows career and technical instructors to share the information with their students.

Through Daimler Truck's Get Ahead program, schools can have access to curriculum anytime. Schools with an ASE Accredited truck program can have free access to the curriculum and earn a system certification that is recognized at any of Daimler's 770 network locations.

WD-40 is offering their course on cleaning, storage and maintenance of tools and equipment. Instructors will learn valuable tips on how to clean and maintain tools along with the safety hazards of poor maintenance.

The Truck-Lite Training Institute is a free online series of technical courses that have been developed to educate and train the highest caliber technicians and parts associates. The program consists of training modules focused on product knowledge, technical expertise, diagnostics and systems solutions.

"We can't thank these companies and organizations enough for making their online educational offerings available to our ASE instructors," said Coley.

For a comprehensive list of free e-learning offerings from ASE Education Foundation partners, visit https://www.aseeducationfoundation.org/elearning.

Why employees leave managers, not shops

As a leader you are responsible for connecting with your employees

BY KOOLE BOLINA //
Contributing Editor

"Hey, Boss, can we talk in your office for a minute?" As a shop owner, this statement will make a flurry of thoughts enter your mind. Is there a vacation request coming? Is there a shop efficiency recommendation being made? Do we need a new latest and greatest tool that will benefit everyone? Wait…deep breath…. am I about to lose someone?

When the door closes on your office, and you both take a seat, you don't need words to explain what's about to happen. The body language from your soon-to-be ex-employee, Hank, is something you recognize from talks in your office in the past. You've been here before but didn't see it coming this time. "I thought Hank was happy here," you think. "I've treated him so well." Initially to break the ice, Hank makes a comment about how great it's been, and how it's not something specific. However, in his mind it is specific, and you missed what's been transpiring in his life for months. He ends with giving you the "…so two Fridays from now will be my last day here."

So what's really wrong? Check out ATI's Happy Employee Checklist. For a limited time, this checklist provides easy tips that shop owners can do today to increase employee retention and engagement. To receive your copy of ATI's Happy Employee Checklist to use in your shop, go to www.ationlinetraining.com/2021-06 for a limited time.

In this scenario, Hank is a hard-working, does-what-he's-told, productive member of your staff. Regardless of what you think was the motivation for Hank to move on, your knee-jerk reaction will be to salvage this conversation and persuade him to stay. You can only do this effectively if you handle the conversation as an exit interview, without allowing Hank to think you're OK with his decision to leave. Asking questions about his mindset and what he found beneficial elsewhere are the only ways to tackle his objections, or realistically, at least find out what you didn't know: why isn't he satisfied with what your shop provides? What aren't you offering to keep valuable employees? What if Hank's answer isn't about those things at all? Instead, Hank said, "I've had enough of Ted. I warned you that he's making it tough to work here!"

AS A LEADER, YOU SHOULD KNOW YOUR TEAM'S SATISFACTION LEVEL IN THEIR PERSONAL LIVES.

We've all heard the cliché of how a cancer in the shop spreads. The effect of Ted cannot be understated. Ted thinks he's better than others, refuses to do certain work, manipulates the schedule to his advantage, takes excessive breaks, and doesn't follow standardized rules. This is a hardship and frustration felt by all. But one thing you didn't see past your frustrations with Ted is your staff knows you're the one letting it happen. They may or may not say it, but they know it. How to handle a "Ted" is different on a case-by-case basis. How quickly to fix Ted, however, must have an immediate timetable to it. I used a name in this example, because most likely, you've renamed him as you read this.

The warning signs

After Hank leaves the office, you start thinking about what you could have done to predict this talk coming your way. You remember seeing a drop-off in his productivity a few months back that never really recovered. Sure, you had talks about it, and pointed out things that Hank could've done better, but he never really recovered when compared to what he used to produce in years past. He also started showing up late, when you used to use him as an example for others to follow when it came to work ethic. Maybe you were blinded by these changes because of a drop in car count, an efficiency change in everyone shop-wide, or maybe something you missed.

You remember it's been weeks since you've held one-on-one meetings, but that's because you've been busy. Initially you were doing them on schedule at an exact interval, but the appeal and effectiveness wore off after you felt the sit-downs got redundant. You remember Hank's dad had a medical emergency midsummer, but you didn't follow up with him as to how his dad was doing. You also remember that his dealership buddy, with whom he used to speak only when a technical problem came up, started showing up at the shop out of nowhere on a regular basis. Even if you pressed Hank for answers when he gave you the two weeks' notice, the effects of what he felt were too strong and

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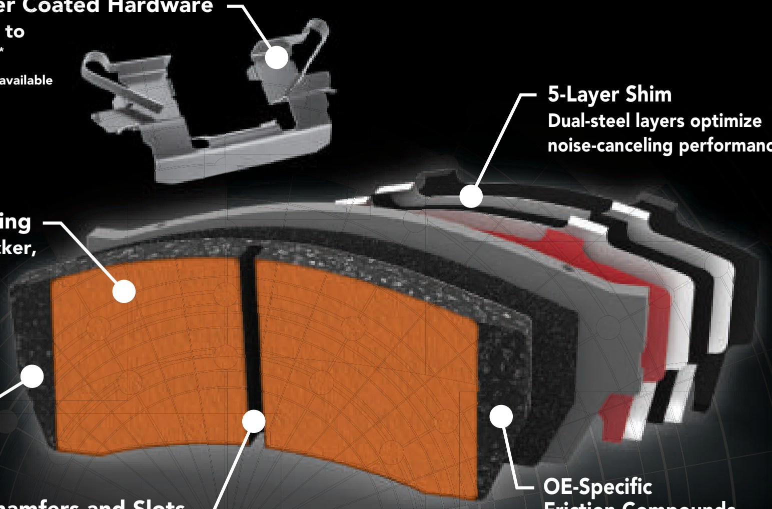

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too long-lasting to overcome now. This scenario is now at a point of no return.

How to keep employees engaged

As a leader, you should know your team's satisfaction level in their personal lives, because we all know those shortcomings can sometimes spill into our professional lives. Not to mention that it is a necessary tactic to control situations like this. If your environment is a punch-in, punch-out kind of place, the engagement level from your employee is going to be predictably low, and because of that low engagement, their days at your shop are surely numbered. What can you do to connect on a higher level with everyone both as a team and at an individual level? Let's see what options we have.

Let's start at the beginning of an employee's relationship with the employer. At the time of an interview, an opening statement like "it's best for both of us to be honest with each other, so there's no surprises later" sets a precedent of honesty and clear communication from the get-go. You should have already done your preliminary research on the candidate through their resume and social media presence, among other things. If they prepared properly, they researched you and your company as well. In the initial or subsequent interviews, you will discuss pay scale, hours of operation, and expectations. But what about what's in it for them — benefits?

Beyond what employees believe are the bare necessities in comparing prospective employers — health insurance, retirement savings, holidays off, vacation — there's one large factor: what's the environment like? Hopefully, you know the answer to this question before posting a "help wanted" ad. What is your leverage versus other shops hiring? Meaning, what sets you apart and makes you more appealing than what every other shop is providing? Unless you were creative in making the ad to the point where candidates were surprised by what they read, from the applicant's viewpoint, almost all ads look the same.

Hopefully, you have examples of what sets you apart from the crowd and are eager to explain to a possible candidate these differences during the interview. One example may be lunches every Friday where the employees have a chance to contribute meaningful, more efficient ways to go about business (not gripe about the last customer or any other negative circumstance). Last month you all went bowling together and divided into two teams, where everyone wins, and team growth is maximized. When arranging team-building events, you let the employees pick where they're going, because allowing employees to brainstorm and then vote on what event they would like raises their level of engagement. Oh, don't forget you recently cleared out an unused area within the building and now it houses exercise equipment (and maybe you even built in a shower!). The are many examples, but unless they happened, the benefits of working with you may be outshined by a shop down the road.

Moving on to existing employees, shame on you if you didn't follow up on the condition of their family member who recently had a medical emergency. Shame on you if you didn't give them their birthday off, celebrate their tenure anniversary, or send their daughter or son a congratulatory card on their recent graduation. Don't think for a minute that when that employee is griping at home about their job and possibly going elsewhere, that their spouse isn't going to remind them of all the personal touches you've extended and how much you care about not just the employee, but their family as well. The engagement will extend not only to the person you work alongside everyday, but to those they share their personal lives with. Going above and beyond is what makes the connection to our inner customer stronger, not just transactional.

So, you did the team-building exercises, gave Hank his birthday off with a gift waiting for him at home, and he takes showers at work before heading out for the day. How come he still sat you down and gave you the dreaded news? An employer's inherent way of thinking will almost always point to pay deficiencies first. But it's a known fact that employees don't leave an employer to gain a dollar down the road; there are bigger factors at play. Nothing beats an honest conversation between two people when you don't allow inclusion of rank or background. If your employee's demeanor, work ethic, and body language have changed, what outside factors might have caused that? You won't know unless you ask.

There are personalities out there that

don't share their personal problems easily in a social environment. Sometimes as a leader, you have to be persistent, but in a careful way. There are also factors you can't control — relocation for any number of reasons, issues at home, a death in the family, to name a few. The best you can do is navigate these with a personal touch. In these examples, you're doing these things as a friend, not as an employer. In the end, it's possible that the shoulder you provided for them to lean on may be what was needed for them to get through those tough times.

Last, and probably the easiest to remedy, are shortcomings on your pay plan. Only if you're operating your business with the latest best practices will you have the room to adjust these pay plans and pay scales for your employees if you do find yourself not competitive in your area. If the shortage on your end isn't on the dollar, but something that is noticeably less than your competition, be proactive in the change. See what's out there. Look at your competition's want ads. Take it a step further — go on some interviews at your competitors. This may sound drastic, but you will get your eyes opened for you. You'll get first-hand knowledge of things that have changed in the industry because you've been busy being an owner for years. Benefit packages, pay plans, system processes, are all there for your picking! Each and every day you should be doing things from an outside-the-box thought process — "It's hard to see the big picture when you're stuck in the frame."

Put the plan in place

Hank is gone now, and you'll have to get his replacement in the door pronto. Now you are forced to reflect on the shortcomings you have as an employer and should have changes in motion to correct those problems. Now the way you look at treating and keeping your employees is different. Now the way you conduct the interview process is different. Now we just have to find the right replacement, which begs the question — what's your bench looking like?

To help you answer these questions, increase employee retention and build engagement, get ATI's Happy Employee Checklist at www.ationlinetraining.com/2021-06 for a limited time.

KOOLE BOLINA has been in the automotive industry since 1998, starting with a personal interest in automotive repairs, and he continues to be part of car clubs, drag racing, and keeping up with industry trends. Koole's strong points are long-term retainment of valuable employees, high customer feedback scores, and maintaining a safe working environment—all while exceeding revenue and profit goals. These achievements were possible by making decisions, and changes on a shop-specific basis and not a "one size fits all" approach. ATI's 33 full-time, certified coaches, including Koole, have helped ATI's members earn over TWO BILLION DOLLARS in return on their coaching investment since ATI was founded.

PREPARING TO TAKE THE ASE CERTIFICATION TESTS

Take time to study in a manner that works best for you

BY JOHN BURKHAUSER //
Contributing Editor

The first step in taking ASE certification tests is deciding which tests you wish to start with. Additionally, you want to decide how many tests you can handle at one sitting. But be aware that the amount of time (tests) available may be limited by the testing center. So even if you wish to do all the tests at once, the testing center may not have the time or seats to allow you to do that. If you are working with a deadline, I highly recommend that you start looking for a test center as soon as possible so that you have a better chance of choosing how many tests you can take at once.

Even though I always felt that I had a good handle on the information that I would be tested on when taking an ASE test, I knew that it was in my best interest to study for them. Another reason to study for the ASE tests was due to the fact that my employer would pay for my tests, but only if I passed them. If I failed the tests, the cost was on me.

I advise that you start studying for the ASE tests early on. My experience has been that waiting to the last minute never really works out well. Also, starting early allows you to spread the studying out overtime. I noticed that doing a little bit of study each time was more productive than trying to do marathon study sessions.

My first step in starting to study is to scour the internet for "free ASE practice test" sites. I do this because "if it is free, it's for me!" You will see many results pop up including the ASE Study Guides on the actual ASE website that you can download. It is not only the cost factor that makes me do this, but also the fact that I can access these guides and study anywhere, even when having a few minutes to pass — like waiting in line for lunch or something important like that.

Be aware that with many of these practice test sites, you get what you pay

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for. You will find that the guides and questions might be outdated based on technology that has long since gone the way of the horse and carriage. But even with this, I still see merit in using these sites for practice in refamiliarizing myself with the different types of question formats that are used on the tests.

Even with the great amount of available study information on the internet, I still opt to buy the study guides on each of the different categories I am taking tests on. Again, trying to save a buck, I look to buying used study guides. But buyer, beware — be sure that you get the most recent editions of the books, not older versions.

Of late, I have just gone and purchased the newest versions of the study guides online. The extra expense of the purchase is offset by the reduced hassle of making sure that I am getting good books — not to mention getting books that are not marked up from others studying. Also note that some of the companies selling the books also offer online resources to use for study, too! When I have passed the tests, I will put the books up for sale for someone else to use them and recoup some of my investment.

I sit down with the books, and right up front I take the practice tests without any studying. I do this because I want to gauge where I stand with the knowledge in my head. Additionally, I make myself aware of the clock, watching how long it takes for me to get through each test. This helps me to assess how well I am doing time-wise since the tests have time limits.

Once completed, I go back and score how well (or not so well) I did with the test that I just took. This helps give me an idea of what subject matter I need to focus on, study and practice.

A couple of ASE re-certifications ago I used this same method of study. I went through and took the study guide test for each ASE test. Going back and just grading them, I was mortified at how poorly I had done. I mean, I was really surprised at how low my scores were. At this point I went back to the books and looked at each question, noting the ones I had gotten wrong. I then looked up the correct answer and description of why I got them wrong.

Seeing the answers to the questions I selected compared to the correct answers, I realized I knew most all the information I was questioned on when taking the test. I was confused as to why I did so badly. Then it dawned on me. I was not taking my time to read the questions and/or the answers correctly. I was more or less skimming across them, missing important hints and information that the questions and answers could give me.

With this realization, I went and did another practice test. This time focusing on reading the questions and all the answers carefully. Even with this approach in mind, I had to stop myself a few times when I noticed that I was going through the test too fast again.

When I went back and checked my answers this time, I did quite a bit better when I compared my answers to those in the book. I repeated the first test a few days later with the same approach and also came through with a much more decent score this time.

The lesson learned here also brings another reason as to why you should use all the study sources you can to practice. You need to get used to the different types of questions that ASE uses on these tests. As I have demonstrated above, not being careful on reading both the questions and answers can have a significantly negative effect on your score — even if you know the material!

While we are at it, here are a couple of hints on how to approach the question types for your maximum score. On multiple-choice questions, look over the given answers. If you can eliminate one of the answers right away, even with three left to choose from, you have a better chance of getting the question right even if you guess. Eliminating two out of four answers gives you even better odds at guessing the correct answer.

Yes, I said, "guess the answer." You never want to leave any question unanswered because it will be marked as incorrect. If you can eliminate two out of four answers, you have a 50/50 chance of guessing the right answer. I like those odds and will take them over a 0 percent chance of being right.

Tech A-B questions can be confusing too. (Who the heck are these guys?) My suggestion to help you overcome the question itself is to break it down. Look at the statement about what these guys are talking about. Then look at each tech's answer individually and determine if they are correct or not. Then choose the proper answer. Breaking these questions down into little parts will help you to get the right answer and lessen making a mistake based on the question structure.

The bottom line: Take time to study and study in a manner that works best for you. Practice taking sample tests just to get the actual testing process out of the way of getting the correct answers. The more times you do the practice tests, the more you will be able to relax when taking the real test. You will be used to taking 40, 50, or more question tests and watching the clock without panicking. You will be able to focus on the material and not the test procedure, hopefully resulting in getting the certification you want.

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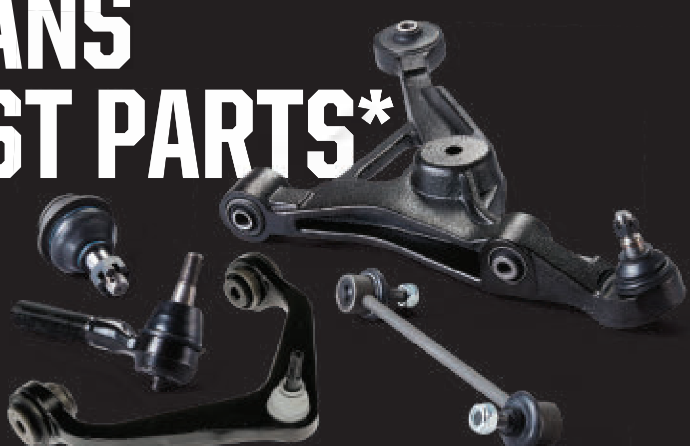
MORE TECHNICIANS CHOOSE DURALAST PARTS*



TOUGH ENOUGH FOR THE EXTREME, BUT MADE FOR EVERYDAY DRIVING. DURALAST PARTS ARE ENGINEERED TO MEET OR EXCEED OE PERFORMANCE, AND THEY'RE TESTED TO HOLD UP IN EVEN THE MOST EXTREME CONDITIONS ON OUR PROVING GROUNDS. BECAUSE YOUR REPUTATION DEMANDS IT, AND YOUR CUSTOMERS DEPEND ON IT.

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* Source: Proprietary Consumer Study of Automotive Aftermarket Parts Conducted by The NPD Group, 2019

Does your website reflect your uniqueness?

Make sure your website is user friendly and portrays your business in a positive light

A website is one of the most important components to a successful business today. However, not enough shop owners spend the time and money on website upgrades that match their underlying brand identity.

An effective, functional website can be a very valuable tool, and it can also help you strengthen existing customer relationships while building new ones, too. But, for many shop owners, especially in light of the COVID-19 pandemic, website management is a bit of an afterthought, as securing sales and providing exemplary customer service remain at the forefront.

A quick Google search reveals that there are many free website building tools that allow the user to secure a domain and design their own website or select from a range of pre-built templates with integrated marketing and business tools for a set monthly fee.

Sometimes, it's worth the investment to hire an outside firm that specializes in aftermarket development and to have the extra peace of mind knowing that your site will be professionally managed and updated regularly by a third party. These companies specialize in website monitoring and can break down the analytics so that you can see which website pages are performing the best, where most of your website visits come from (for example, your online booking form, the contact page, etc.), and where the website traffic could be improved.

If you decide to hire a third party to build out and manage your business's website, it's important to view this business decision as a long-term project, rather than a quick fix to draw attention to your brand. While having a website built is convenient, like all digital media, business websites are fueled by content, and as a small business owner, you must be willing to engage with your clients and ensure that your website is a combination of informative, educational, and entertaining content that will make your customers stick around. If your website is unresponsive or lacks user-friendly features, do not expect your customers to linger on the page.

HAVING A USER-FRIENDLY WEBSITE THAT ENCOURAGES CUSTOMERS TO VISIT FOR A NUMBER OF REASONS WILL GREATLY POSITION SHOP OWNERS FOR THE ONGOING E-COMMERCE BOOM.

Website checklist: dos and don'ts

To attract new customers and keep existing clientele engaged, shop owners should first and foremost conduct some simple market research on their competitors to compare website offerings.

Evaluate strengths and weaknesses: what is missing from your website? Is all of the information up to date, such as contact information and any promotional offers? At the end of the day, with most clients still shopping online and making appointments online, a user-friendly experience matters more than price. Although you might have the best deal in town, if the information on your website is impossible to find, a customer will have no problem going elsewhere to have their needs met.

Before you get started on overhauling your website, consult with your team members and listen to their feedback regarding its design. You likely have a diverse team with many unique talents — give them the floor to get creative!

Times are rapidly changing, and while it's always good to stay on top of vehicle technology, it's also important to keep an eye on the back-end operations of your business. Having a user-friendly website that encourages customers to visit for a number of reasons, including to access online exclusive deals or promotions, book an appointment, or to access information will greatly position shop owners for the ongoing e-commerce boom.

To keep your website performing at its best, consider the following:

Ensure that all contact details, including hours of operation and phone numbers, are valid.

If you haven't already done so, add an email address alongside the contact number. The majority of clients like to book online or submit questions via email or text messaging, not by telephone.

If you run weekly or monthly product promotions or specials on your website, make sure that all of your staff members can answer questions relating to those offerings.

Create a staff page with a photo and a bio of each team member or use this down time to update your staff photos if you have an existing staff page.

SEARCH ENGINE OPTIMIZATION

Quality search engine optimization means your website will appear more often and be listed higher up in the search engine result pages (SERPs), which leads to more clicks, phone calls, scheduled appointments, and ultimately more cars in your shop bays, says Autoshop Solutions in a recent blog.

It all starts with a great website that delivers an awesome experience no matter if it's a smartphone, tablet or desktop computer. Read on at VehicleServicePros.com/seonow.

Add an online booking platform if you haven't already done so. In case customers can't reach your shop by phone, a form will secure the sale, rather than them taking their business elsewhere if it's a last-minute request.

Consider adding a blog to your website! This is a great place to share photos of your shop, and it's a space to share updates, contests, and promos, which can also be shared to social media.

Set a clear business objective under your "About" section: who are you, what value does your business offer, and what sets it apart from others in the area?

Clearly define your products, services, and pricing.

Consider posting industry-related content to your blog, such as the "Your Car. Your Data. Your Choice." campaign. Most consumers are not aware of industry-specific issues and how it affects them, so posting educational content can go a long way.

Update your digital repair order and ensure warranty information is legible.

Finally, whatever "image" you portray on your website, make sure the customer's experience is beyond the website and exceptional on each and every visit. Remember it is always about the value and relationship you bring to the table for every customer and client. MA

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MACS 2021 MOBILE A/C UPDATE

MUCH HAS CHANGED IN THE MOBILE A/C WORLD. MAKE SURE YOU'RE UP TO SPEED!

BY STEVE SCHAEBER //
Contributing Editor

Wow, what a year we all just had! In February of last year in the mobile A/C world, we had just come off one of our most successful annual events (the MACS 2020 Training Event and Trade Show was held last year at Nashville's Gaylord Opryland Resort), and then two weeks later COVID-19 happened! Like you, we've had to adjust for the health and safety of our industry and our MACS members, and one of the biggest changes we made this year was to postpone our 2021 event until September 30 (we're still going to the Rosen Centre in Orlando).

New year, new MACS!

During the last year or so, the MACS Board of Directors, along with key staff, have been working on a rebranding project to bring MACS into its next 40 years. No longer will we be the Mobile Air Conditioning Society. Rather, we are now the Mobile Air Climate Systems Association (MACS) – a better reflection of the whole of our efforts as system technology experts and as an inclusive organization dedicated to advancing the next generation of professionals **(Figure 1)**. Our tagline, "Cooling What Moves You," encapsulates mobility and speaks directly to climate control in a short, memorable statement. Our new website is www.macsmobileairclimate.org. Check it out to learn more about the new MACS!

Regulatory update

Let's begin with an update on EPA's MVAC servicing program (motor vehicle air conditioners), which falls under Section 609 of the U.S. Clean Air Act (CAA). In March 2020, the EPA issued a proposed rule to incorporate by reference three existing SAE Standards for R-1234yf servicing equipment. The Standards are:

1. SAE J2843: R-1234yf (HFO-1234yf) Recovery/Recycling/Recharging Equipment for Flammable Refrigerants for Mobile Air Conditioning Systems **(Figure 2)**
2. SAE J2851: Recovery Equipment for Contaminated R-134a or R-1234yf Refrigerant from Mobile Automotive Air Conditioning Systems **(Figure 3)**
3. SAE J3030: Automotive Refrigerant Recovery/Recycling/Recharging Equipment Intended for use with Both R-1234yf and R-134a **(Figure 4)**

Since the establishment of the 609 program back in 1990, the EPA has adopted various SAE Standards for the servicing equipment that we use out in the shop each day. Now that we've had R-1234yf ("yf") for so long, it's funny to think that there has been no "regulatory requirement" in place, which says that we are "required" to use yf equipment to service yf vehicles. That may sound like a no-brainer (of course you have to use a yf machine to service a yf vehicle), but up until now, there was no specific rule or requirement for technicians and shops to do so.

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MACS
MOBILE AIR CLIMATE SYSTEMS ASSOCIATION

PHOTO: MACS

NEW LOGO FOR THE NEW MACS!

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PHOTO: STEVE SCHAEBER

J2843 IS THE SAE STANDARD for R-1234yf RRR machines.

Even though there was no rule per se, you were still not allowed to use (for example) an R-134a machine or an R-12 machine to service an R-1234yf vehicle. The existing rules that have already been in place say that you must use an approved machine that's design certified for a particular refrigerant to service that particular refrigerant in a vehicle. So, if one should ask, "Can't I just take my old R-134a machine and convert it over to work with R-1234yf?" the answer would be no, because even if it could work (which would not be recommended due to the lack of yf safety considerations in R-134a equipment), that R-134a machine was originally designed and certified to work with R-134a, and not R-1234yf. This distinction makes converting an older machine illegal.

In the end, this new EPA rule just makes it a requirement to do what we are already doing: use equipment designed and certified for a particular refrigerant to service that particular refrigerant (and don't mix them up!). The official rule was signed on 1/11/2021.

Turning to the SNAP rules

Most of the refrigerant regulations that pertain to MVACs are part of the EPA's SNAP (Significant New Alternatives Policy) Program. Over the years, the EPA has issued new rules, and we're going to cover one of them here. Rule #20 was issued in July 2015, which changed the listing status of certain HFC (hydrofluorocarbon) and HFC-blend refrigerants from acceptable to unacceptable in some refrigerant, aerosol, and foam blowing uses. In our case, the EPA's rule said that beginning with the 2021 model year, vehicle manufacturers would not be allowed to use R-134a refrigerant in new light-duty passenger vehicles. The EPA was sued in federal court over this, and in August 2017 the DC Circuit Court of Appeals vacated their 2015 Rule, "to the extent it requires manufacturers to replace HFCs", and remanded it back to the EPA. In April 2019, the court issued a similar ruling for EPA's 2016 rule.

We've been expecting to find out what the EPA plans to do about this, but to date, we haven't heard much. There was talk of a revision last year, but then COVID-19 happened, and at our last fall update we received no new information. But it may be a moot point at this time. The purpose of that 2015 rule appeared to be aimed at nudging the industry away from using high GWP (global warming potential) refrigerants, and instead towards more environmentally friendly ones like R-1234yf. A recent MACS study calculated that approximately 83 percent of new model vehicles are being manufactured with yf, and while we haven't been able to conduct our annual survey yet for 2021 (the auto shows have either been canceled or pushed off until the end of the year), we expect those numbers to be even higher this year.

Off-road yf

EPA continues to get submissions under SNAP for the use of R-1234yf in various MVAC applications. Two recent submissions were for the use of yf in small cans for DIY use (which is why you've probably seen small cans of the new refrigerant available for sale at many auto parts stores). They also received five submissions for the use of R-1234yf in heavy-duty MVAC, including off-road construction and agricultural equipment. These include agricultural tractors under 40HP, self-propelled agricultural machinery, compact equipment (like skid steers), construction, forestry, and mining equipment. Reviews for these submissions have now been completed, and manufacturers can begin using yf in these systems. To date, however, EPA has not received a submission for yf in busses or trains, nor heavy-duty, on-road trucks (Class 4 through 8, including over-the-road trucks and tractor trailers). Thus, using R-1234yf in these vehicles is not allowed.

PHOTO: MASTERCOOL

THIS SPARK-FREE RECOVERY MACHINE meets SAE Standard J2851, for contaminated mobile recovery machines for R-1234yf.

PHOTO: STEVE SCHAEBER

SWITCHING FROM R-134A TO R-1234YF requires changing the rear tank on this CPS FX3030 recovery machine.

Safety alert: Small cans for MVAC servicing

The EPA has been made aware of online sales of a product marketed for use in MVACs which has not been approved under SNAP. Specifically, a product marketed as "Cool Penguin F-12" brings forth safety concerns, as its use may pose a safety risk. It's primarily because they don't know the chemical makeup of the various cans **(Figure 5)**. Certain cans tested by the EPA were found to contain a mixture of ozone-depleting substances (ODS), such as CFC-12, CFC-114, HCFC-142b, and HCFC-22, along with non-ODS, including R-134a and R-40 (Methyl Chloride). These cans have a variety of substances that may or may not be flammable or toxic, so the EPA wants to notify the public about the risks associated with these cans if used to service their MVAC systems. Under current CAA regulations, it is illegal to import cans containing any percent of the ODS listed above into the United States. No person may sell or distribute, or offer for sale or distribution, any regulated ODS that they know, or have reason to know, was imported illegally. There is also a growing concern about small cans of hydrocarbon refrigerants, such as propane, which are highly flammable and are not acceptable alternatives for MVACs. EPA wants to get the message out that these cans should not be used for MVAC servicing.

2020 ozone layer protection milestones

EPA has been running a new website that highlights the many achievements and projects made possible because of Title 6 of the U.S. Clean Air Act, which focuses on Stratospheric Ozone Protection (and in our case, motor vehicle air conditioning servicing. They even have a special section dedicated to celebrating the MVAC servicing program under Section 609, so if you have a chance to check it out, here's a link: www.epa.gov/ozone-layer-protection-milestones-clean-air-act. There's also an interactive webpage where users can explore how ozone layer protection affects many aspects of everyday life. You can view that at www.epa.gov/ozone-layer-protection-milestones-clean-air-act/strat-city-usa.

Celebrating the CAAA's 30th anniversary

It was 2:30 in the afternoon on Friday, November 15, 1990, when politicians and the media met in the East Room at the White House to greet President George H. W. Bush just moments before he would sign the most comprehensive update to our nation's environmental laws in 30 years. Of course, I'm talking about the Clean Air Act Amendments of 1990, which received overwhelming bipartisan support. Specifically, the amendments were designed to curb four major threats to the environment and public health: acid rain, urban air pollution, toxic air emissions, and stratospheric ozone depletion. The amendments also established a national operating permits program and strengthened enforcement. They featured several progressive and creative new approaches for effectively achieving the air quality goals and regulatory reform expected from these far-reaching amendments. A summary of EPA documents explains.

Air quality

- Air quality has improved significantly in our nation, reducing health threats such as lung damage, asthma, heart attacks, and premature death. All 41 areas that had unhealthy levels of carbon monoxide pollution in 1991 now have levels that meet the health-based national air quality standard. More than 90 percent of areas originally identified as not meeting the 1997 ozone air quality standards now meet those standards. Since 1990, particle pollution levels have improved by 36 percent.
- Performance standards for new

PHOTO: DARWIN GODEMANN

EPA HAS CRACKED DOWN on sales of an illegal (and potentially dangerous) refrigerant called Cool Penguin F12.

PHOTO: MARY FRATANGELI

MOBILE A/C SERVICE TECHNICIANS help protect our environment each day by using trace dye and electronic leak detectors to find and fix refrigerant leaks.

vehicles are met by a combination of cleaner fuels and vehicle technologies. Under the 1990 amendments, new cars, SUVs and pickup trucks, heavy-duty trucks, and buses have become dramatically cleaner. The same is true of non-road engines such as those used in industrial, farm, and recreational equipment, locomotives, and marine vessels.

- State and EPA programs to cut interstate air pollution have reduced pollution regionally and have helped most downwind areas to meet the 1997 and 2006 air quality standards for ozone and fine particles.

Acid rain and regional haze

- An innovative market-based system of pollution allowances has dramatically cut sulfur dioxide emissions, reducing acid rain as well as fine particle pollution that contributes to premature death. This federal program also has significantly reduced damage to water quality in lakes and streams and improved the health of ecosystems and forests.
- Also, the scenic vistas in our national parks are clearer due to reductions in pollution caused by haze.

Toxic air pollution

- Industrial and other stationary sources emit about 1.5 million tons less toxic air pollution per year than in 1990. These standards set a level playing field by requiring higher emitting sources to achieve the cleaner level of performance achieved by the best performing similar sources.

Ozone layer protection

- To protect the ozone layer, the U.S. has phased out the ozone-depleting substances that Congress identified as "most damaging," including CFCs (in our case, R-12 refrigerant) and halons while promoting cost-effective alternatives. Actions to protect the ozone layer are saving millions of people from fatal skin cancers and eye cataracts over periods of several decades (**Figure 6**).

A peer-reviewed EPA study found that the 1990 amendments are achieving large health benefits that will grow further over time. For example, the study estimates that in 2020, the Clean Air Act Amendments will avoid more than 230,000 early deaths, as well as large numbers of other adverse health effects, through improvements in fine particles and ozone levels. The economic value of the air quality improvements is estimated to reach almost $2 trillion for 2021, a value that vastly exceeds the costs of efforts to comply with the 1990 Clean Air Act. Although important air pollution challenges remain, and we have much work left to do, the 1990 amendments have had impressive results.

Electric yf

Let's take a closer look at what's happening with R-1234yf in hybrid and battery electric vehicles (BEVs). We surveyed almost 180 vehicles at the 2020 Philadelphia Auto Show, and more than 75 percent of them use yf (**Figure 7**). Twelve of those were either hybrids or full battery electric vehicles, all of which use an electric compressor. Of those 12, eight systems use R-1234yf, which comes out to about 67 percent.

Looking at those which are still using R-134a, we find Volvo's XC60 and XC90 T8 hybrids, Hyundai's Loniq hybrid, and the iconic Toyota Prius. All of these have been around for a while (Prius since 1997, XC60 and Loniq since 2016, and XC90 since 2017), and so they were developed at a time when R-134a was still mainstream. Now we're in the fourth generation of Toyota's Prius family, and going by their history, we should see a new generation in either 2021 or 2022 (their gens usually last six or seven years on average). We're expecting with the next iteration we'll see the most popular green vehicle finally change to yf. The same goes for Loniq and the Volvos — as

MACS Refrigerant & Oil Survey
Hybrids & Electrics
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MAKE	MODEL	Refrigerant	Refrigerant Oil
Chev	Bolt EV	R-1234yf	POE
Ford	Escape Hybrid	R-1234yf	POE
Ford	Fusion Plug-In	R-1234yf	POE WSS-M2C31-B2
Honda	Accord Hybrid	R-1234yf	ND-OIL 11 (POE)
Honda	Insight	R-1234yf	ND-OIL 11 (POE)
Hyundai	Ioniq Hybrid	R-134a	POE
Kia	Nero	R-1234yf	POE
Toyota	Corolla Hybrid	R-1234yf	ND-OIL 11 (POE)
Toyota	Prius	R-134a	ND-OIL 11 (POE)
Toyota	RAV4 Hybrid	R-1234yf	ND-OIL 11 (POE)
Volvo	XC60 Hybrid	R-134a	Volvo-PAG (SP-A2)
Volvo	XC90 Hybrid	R-134a	Volvo-PAG (SP-A2)

PHOTO: STEVE SCHAEBER

HERE'S A LIST of all the hybrid and electric vehicles we saw at the 2020 Philadelphia Auto Show. We expected all of them to be using POE oil and were surprised to see Volvo under hood labels calling for "Volvo-PAG" refrigerant oil. Closer inspection on the compressor itself indicates they use Sanden compressors, and the label says to use SP-A2 oil, which we have learned is a specially formulated, high dielectric PAG oil made especially for these compressors.

their platforms advance, we expect them to also use yf going forward.

Just as a side note, some of these electric A/C systems are getting feature-rich. Take the XC60 for example. It uses what they call a "preconditioning" algorithm that can prepare the cabin climate with a few simple settings in the dashboard screen or an app that you can install on your smartphone. It can use direct start or be set via a timer, and the function uses several systems in different cases. When it's cold outside, the parking heater can warm up the cabin to a comfortable temperature, and when it's hot, it switches to A/C cooling. You can also select activation of the steering wheel heater and heated seats. The heated windows and mirrors are activated automatically. Preconditioning for heating is only available when the vehicle is plugged in, but the A/C can work anytime.

Electric compressor oil

Since these systems are using electric compressors, you might expect them to also use POE (polyol ester) oil (since we've been taught for years now that PAG + motor windings = no good), but you'd

be wrong about that. The main concern we've had with oil and electric compressors is that even minute traces of PAG oil (as little as one percent) can contaminate the system to the point where it won't work — or worse, you run the risk of electric shock or even death. The reason of course is that PAG (polyalkylene glycol) oil is hygroscopic, which means that it absorbs moisture, sometimes right out of the air. And if it were to be mixed into an electric A/C system, the moisture it could contain may be enough to provide an electrical path from the compressor's motor windings to the ground.

Depending on the system you're working on, the vehicle's PCM may detect this electrical leakage and report it through the check engine light with an associated trouble code(s), along with disabling the high voltage compressor system. The 2013 Toyota Prius, for example, will output DTC P0AA6-611 (Hybrid Battery Voltage System Isolation Fault) if there is insulation trouble with the high voltage circuits in the A/C system. This code may indicate a problem with either the compressor or the HVAC inverter, but can also show up if any oil other than ND-OIL 11 is used. Their service information also says that, if it can be confirmed that any oil other than ND-OIL 11 has been used in the vehicle, "replace the air conditioning cycle" (which is a mistranslation that means "replace the air conditioning system").

That may sound far out, but you have to think about it from an OEM point of view. Their premise is that even one percent contamination can cause a problem. So, in a system like the 2013 Prius, which calls for 4.4-4.9 ounces of oil, one percent is about 0.05 ounces. So that's, what — maybe a few drops? It's about the amount you'd get out of a glass medicine dropper. I use the ones pictured for putting mineral oil onto O-ring seals that call for it, and they can hold 0.03 ounces. Not much more than that is enough to contaminate an electric A/C system, and since most OEs want to build a quality product that's going to last while maintaining their warranty, integrity, and legal liability, they do what it takes to make it happen.

That's why so many compressor manufacturers and vehicle OEMs are using some type of POE oil formulations. Denso's ND-OIL 11 which is mentioned above, is a formulation of POE oil. It has higher dielectric properties than PAG, which helps it to be more electrically insulating. This is required because the high voltage motor is built into the compressor and is cooled directly with the refrigerant. Since the oil is carried by the refrigerant, it's also going to be all over those motor windings. Plus, some amount of the oil is going to spread throughout the entire system, and since it's not possible to flush every internal surface of every component, the only way to be sure that you've removed all traces of an incorrect oil is to replace each system component (hence Toyota's recommendation above).

What about the non-POE oil?

But as I hinted above, not all OEs are using POE oil with their electric compressor systems, and Volvo is the first example that we've found. Two of their hybrids that we saw in Philadelphia use a Sanden electric compressor with R-134a refrigerant, but they don't use POE oil. Instead, they use what's called "Volvo-PAG" as indicated on the under hood label. The compressor label, however, says that SP-A2 oil should be used, which is also what it says in the owner's manual.

Mechanics like things to be simple, and this throws a monkey wrench into training. Now we have to add the caveat that Volvo hybrids that use either R-134a or R-1234yf and that use Sanden electric compressors, don't use POE oil, but instead, use a very specific PAG oil called SP-A2. Sanden gave a presentation about this oil at the MACS 2020 Training Event and Trade Show, and a question from the audience pretty much summed it up: "What type of oil is that SP-A2, and what is the viscosity?" The presenter, José Miguel Díaz Sastre, Regional Manager for Spain and Portugal for Sanden Europe, said that it is made with the same base oil as SP-10 (which is a 46 viscosity PAG oil), but that they have engineered it with special additives to increase its electrical insulation. He also remarked to another question as to how an electrical leak is detected in their compressor circuits. Asked if there is a special sensor that is looking for a certain amount of ohms, or is there another way they are detecting the fault, Díaz replied that the compressor does have to be connected to the vehicle chassis for the detection to work (which is accomplished through the compressor's mounting brackets to the engine block itself), but that no discrete sensor signal is used for this detection.

Now, this doesn't mean that you can go ahead and use PAG oil in a pinch in an electric vehicle. That could be one of the worst mistakes you'd make in working on one of these systems. I mean, sure, there have been plenty of reports about guys who've done this (usually by mistake) and later said that nothing ever happened (so then it must be ok, right?). But you'd be taking a huge risk that simply isn't worth the added expense of buying the right oil as called for by the OEM, nor the time it takes to get the oil (even if no one in your area has it in stock and you have to wait a few days for it to come in). Think about it — you can either wait a few days (which takes no effort at all, other than maybe having to close up the system and put the vehicle outside until the parts arrive), explain the situation to the customer (in which it may be tough having to "hear it from them"

if they aren't happy about the delay), or you can use the wrong oil, risk an immediate or future failure (which will surely be blamed on you or your shop) and have to make more costly repairs at your expense.

In the end, we just have to repeat what we say pretty much any time that we try making sense out of a complicated and potentially costly topic like this: Always check with the vehicle manufacturer's service information for the specific vehicle you're working on to find out exactly which oil they recommend (and their recommended replacement procedures). Particularly when it comes to hybrids and battery electrics, it's just not worth taking a chance.

Back to basics

No doubt that when it starts getting hot outside, your shop gets slammed with customers asking for help with their A/C systems. The same thing happens here at MACS, except we get slammed with A/C tech support calls. Most calls are nothing special to talk about. Refrigerant charge amount, oil type, and sensor locations are pretty common, particularly for oddball vehicles and trucks with limited information resources (and technicians unfamiliar with a particular make/model/system).

We get lots of requests for wiring diagrams and pressure gauge troubleshooting help, too. Plus, there are the many not-well-known TSBs that seem to keep coming up (Ford Escapes come to mind here).

Every once in a while, I get a tech call from one of our local member shops near MACS HQ, and when it's a tough problem, I like to stop by and check it out for myself. A local shop owner called me asking for help with a 2004 Honda CR-V with the 2.4-liter, four-cylinder engine. The technician had already replaced the compressor (the clutch would not engage), condenser with integrated receiver dryer, and discharge line, but even after evacuation with an overnight leak test and proper recharge amount, the system still was not cooling. He said every time they started the engine and turned on the A/C, the high side pressure gauge would almost instantly climb up to around 400 psi.

Now, I know these guys, and they're pretty good at service work, especially when it comes to popular daily drivers like this one. But their technician was relatively new to A/C work, so I wasn't surprised by his answer to my first question. Of course, I'm talking about cooling fans, and were they running along with the compressor clutch? He said no, and that he didn't think they were supposed to be. He thought that the system would have to run for a while, and then when it was necessary, the computer would turn on the cooling fans at the right time. I explained that in fact, the cooling fans should come on all the time (or at least within a second or two) of when the clutch is engaged. Since they were only a few blocks away, I offered to stop by and take a look.

The install looked typical — the bumper cover, headlights, and other front-end components had been removed for access and care was taken not to damage any fins of the condenser. They hooked up gauges to show me what was happening, and sure enough, after starting the engine and pressing the A/C button, the condenser fans did not turn on. Just like they said, the high side gauge jumped to 400 psi, and we shut the system down.

Something had to be done about those fans, and a quick voltmeter test indicated that voltage and ground were indeed going to each fan's wiring connector, but neither one would spin. A new set of fans solved this perplexing problem. In the end, they were surprised that both fans failed at the same time, but more so to find out just how high (and how fast) the high side pressure gauge can get when air isn't flowing over the condenser. Sometimes, it's good to get back to basics.

STEVE SCHAEBER is the Manager of Service Training for the Moible Air Climate Systems Association (MACS) and Technical Editor of Action Magazine. *steve@macsw.org*

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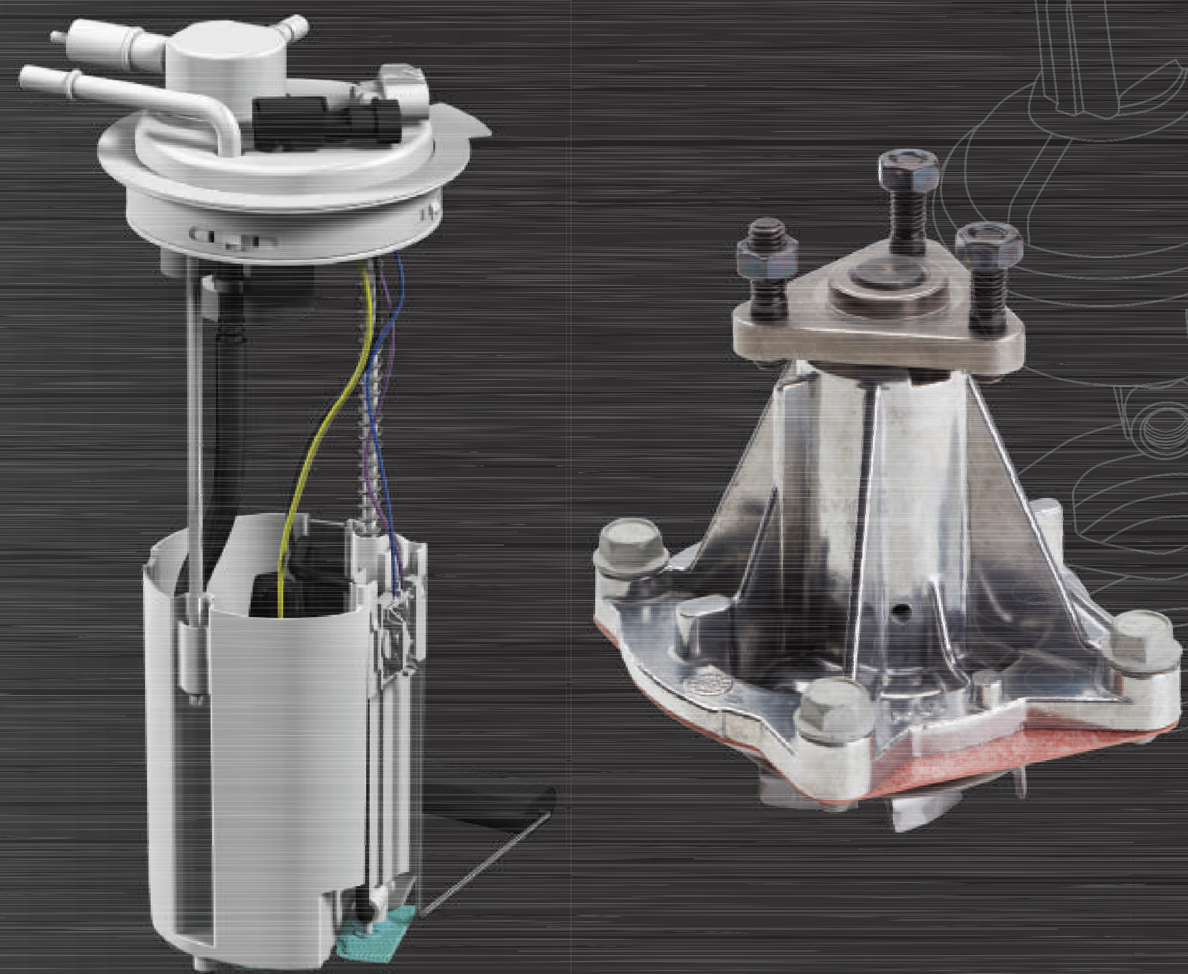

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ENTHALPY AND HVAC: VISUALIZING ENERGY MOVEMENT

LEARNING TO EVALUATE INFORMATION IN DIFFERENT WAYS IS HOW TO DEVELOP AN EDGE

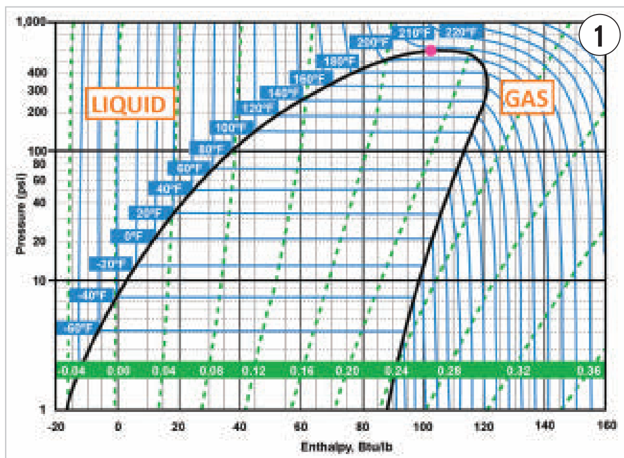
BY JIM COKONIS // Contributing Editor

An accurate refrigerant charge provides the most efficient operation in a normal system and promotes lubricant flow. Even slightly undercharged systems can suffer from a lack of lubrication. Reduced system capacities in newer vehicles have made charge accuracy more critical to proper operation, and it's crucial we as technicians get it right.

Accurate evaluation sets the course for proper analysis

Q: When presented with a system to evaluate, what tools do we have?

There are manufacturer-specific performance tests that are made for specific make, model, and year applications. These are found in service information and are designed to help place the vehicle and system in a specific state. Only then can the performance of the system be measured accurately under the conditions present. Examples of vehicle conditioning may specify if the vehicle is in the sun or the shade. Are the doors or windows open or closed and by how much? The system settings are specified and allowed to stabilize under those conditions. Then the temperatures and pressures are measured and compared to published specifications based on ambient temperature and humidity levels. Again, this test is platform-specific and based on system design, volume, and refrigerant. There is no generic HVAC system performance test that fits all. There are less precise tests like "temperature difference between ambient and vent," with a goal of a specific drop. These may not be as accurate an assessment of a system as the manufacturer-specific performance test.



Q: If the results of a test are substandard what is the next step?

There are specific temperature tests like "temperature delta across the evaporator" on an orifice tube system. A properly operating system should measure very close to the same temperature at the inlet as the outlet. It is hard or nearly impossible to use this test on an H-block system. We can measure the temperature delta across a condenser and apply the old rule of thumb, looking for a 20-50 degree Fahrenheit change. Some vehicles have built-in scan tool tests or data we can turn to for guidance. Examples would be Toyota vehicles with a "refrigerant volume check" utility or Chrysler Jeep vehicles with a "Cool Down test" utility.

All too often we see vehicles hooked up to recovery and recharge machines. The system is recovered and recharged with the specified quantity of refrigerant as a starting point in diagnostics. This prompted the search for other techniques of evaluating vehicles.

Enthalpy charts for a faster dynamic evaluation of HVAC performance

Q: What if there was a way to watch the system work?

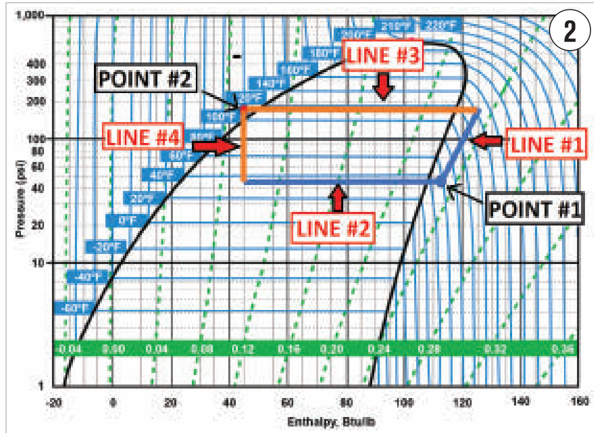
What if we could graph the data and gather a direction pointing toward an in-

PHOTO CREDIT

ternal or external cause of poor performance? The use of an enthalpy chart for a specific refrigerant system is another tool we can use. This can be done manually with a printed chart, or we can use a tool that gathers data and plots it for us.

Q: What are we seeing when we look at a plot on an enthalpy chart?

We are seeing the energy in the closed system change as it exchanges heat with the surrounding environment. Knowing what a good system looks like, we can identify where we should look for performance concerns. The first step is getting familiar with the elements of an enthalpy chart. For our purpose, we will not be using the full charts, as they have elements that are not necessary for evaluating a system. The level of information can make them extremely hard to read and distracting. The simplified dome-shaped chart (**Figure 1**) was designed for use in Carquest Technical Institute (CTI) classes.



The left side of the chart is scaled in PSIa (or, absolute). This is important if one is filling in their own chart. Reading the gauges on our tooling, we may need to convert from the gauge reading to an absolute value. If we are at sea level, we would need to add 14-15 pounds to the PSIg (or gauge) readings for them to then equal a PSIa reading. The numbers on the bottom scale will not directly be used in creating our chart. The green scale and lines are for entropy and when we chart the compression of the gas, it will parallel these lines to the right of the dome and help us draw an accurate chart.

Q: What is this dome on the chart?

Staying OUTSIDE of the dome, everything to the left of the dome is representing the refrigerant in a completely LIQUID state. Everything to the right

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of the dome is fully converted to a GAS state. Everything INSIDE the dome is in transition. It is either changing from a liquid to a gas (as it does in the evaporator). Or it is changing from a gas to a liquid (like it does in the condenser). Notice that there are blue lines, indicating the temperature of the refrigerant. Each line represents a change of 20°F in temperature. Notice the temperature lines inside the dome are flat, indicating a stable temperature.

In the condenser, the gas condenses to a liquid. While doing this, the gaseous refrigerant gives off the heat it absorbed from being compressed. It will cool some and then reach a stable temperature while changing to a liquid. Then when the hot high-pressure liquid moves through the orifice of the metering device, the pressure is rapidly dropped and the refrigerant boils, changing from a liquid to a gas again. During this change of state, the refrigerant can absorb tremendous amounts of heat from the cabin without the now gaseous refrigerant increasing in temperature. Therefore, we could measure the temperature of the inlet (on an orifice tube system) and measure the outlet and see little change in temperature from inlet to outlet on a properly operating system.

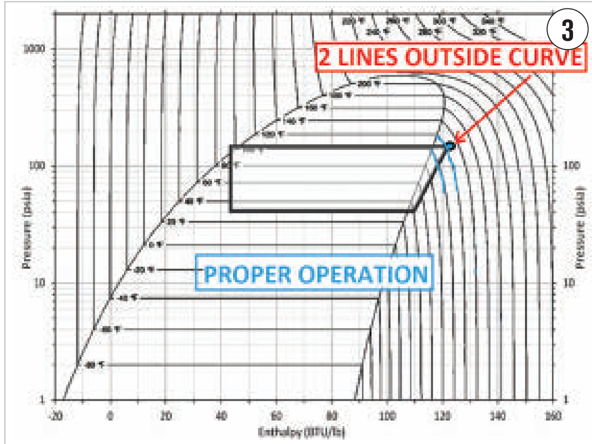
Only four pieces to this puzzle

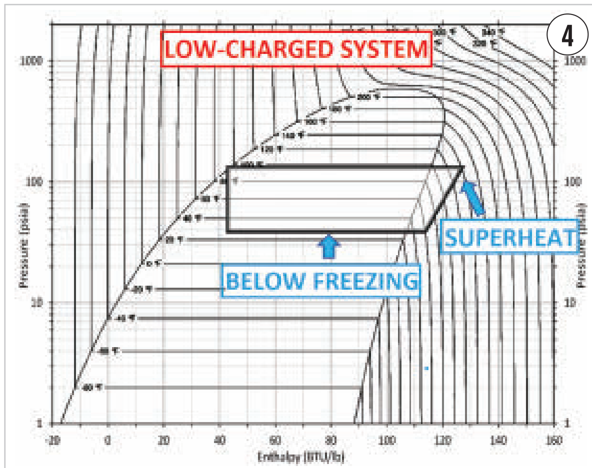
Q: How do we use this tool to see how our system is performing?

We need four pieces of data:

- The high side pressure (absolute)
- The low side pressure (absolute)
- Temperature near the compressor inlet
- Temperature just before the metering device

This will establish two points on our chart, and the rest of the data can be drawn in (**Figure 2**). Once we have entered our two points on the chart, it will have what we need to draw in the rest of the information. From the lower right point (representing the inlet temperature and pressure at the compressor), we will draw two lines. The first line will project up and to the right parallel to the entropy lines in green. The other line will be level with the temperature lines INSIDE the dome and project directly to the left into the dome. The upper left point representing the temperature and pressure just before the metering device will project the last two lines of the complete cycle. This is a representation of a very efficient refrigeration system. The lower flat line inside the dome is representing the temperature inside the evaporator. In this instance, it is representing a low- to mid-thirty degree temperature. The point at the lower right is indicating superheat of around 20°F. Superheat occurs when a vapor is heated above its boiling point. Where the lines join at the top right indicates the condition of the system's refrigerant exiting the compressor. It shows 20-30°F outside the dome to the right as a fully saturated gas. Once it moves to the condenser and drops that 20-30 degrees of excess heat, the gas will change state to a liquid and the temperature will flatten out as described in A/C theory. Once it is fully saturated as a liquid (as indicated by the upper left point we plotted), it will pass through the orifice and change to a blended state where it will boil off absorbing heat.

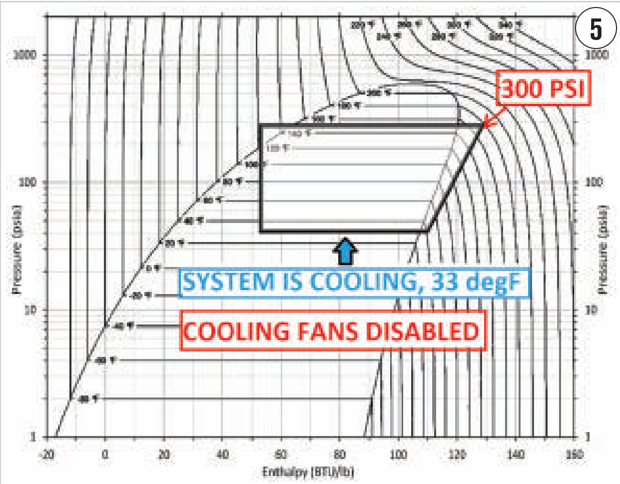


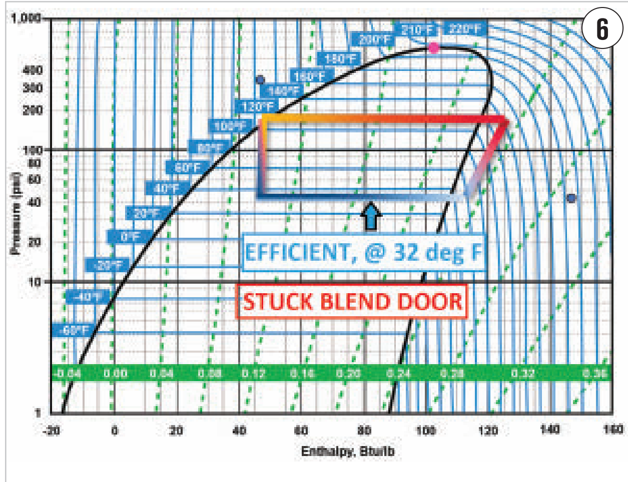


A picture is worth one thousand words

Just like other systems on the vehicle, we can look at the information in different ways. For example, we can measure battery voltage at a moment in time with a DVOM. We can also graph voltage over time with a DSO. We can read scan data in digital form or we can graph. A picture can sometimes be easier to comprehend when we are trying to evaluate information, and HVAC data is no different.

The following will be a series of charts to introduce this type of evaluation. This type of analysis can save time and money if the fault with the system is not due to low refrigerant and is instead an airflow or other external issue (like a blend door control). Looking at the chart on a system that is running well, one should notice that





there are no large excursions outside the dome (**Figure 3**). A system that goes far out to right into "Superheat territory" is using a lot of energy that should not be needed. The point at the top right should typically be within two or slightly more temperature lines. Most systems will have temperature drops across the condenser of less than 50°F. More than that and we should be looking for a low charge or air in the system.

The next chart shows an example of a low charge (**Figure 4**). One of the clues to low charge is the bottom line of the chart. It is indicating the evaporator is operating BELOW freezing, but the system is not performing that well.

These charts are captures from the Yellow Jacket Mantooth wireless manifold set. The screen capture runs live so you can see changes during operation. Cycling fans and setting changes will cause the chart to change accordingly. To review, **Figure 3** shows a fully charged, properly functioning system. The chart is very close to the dome with little wasted energy. They will not all be that close to perfection, but it is a good baseline. **Figure 4** shows a system with a low charge. The increase in Superheat and the evaporator line below freezing are both good indicators that the system requires service.

Figure 5 demonstrates another type of failure that we induced on the same vehicle as the vehicle in **Figures 3** and **4**. In this chart, the cooling fans are disabled. Notice a couple of things in **Figure 5**. The high side pressure has risen to the 300 psi range, yet the system is still cooling under current conditions. This can both be felt at the vents and is supported in the data of the evaporator line being just above freezing. The saturation temperature is still 32.4°F, yet the system is working hard to get there. This quickly indicates there is something wrong.

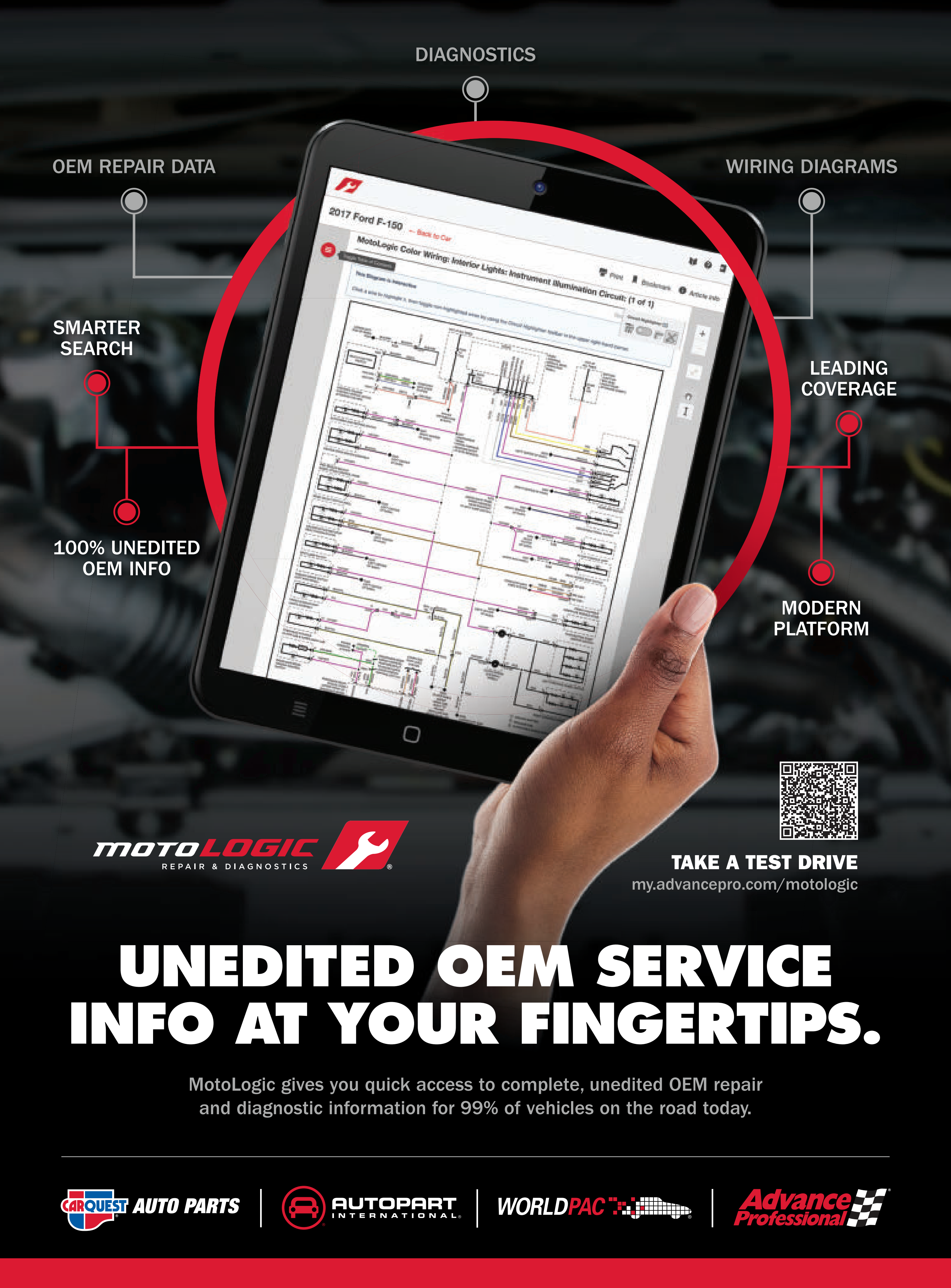
Expert evaluation instills confidence in your customers

The last example I want to share with you is an example of how a technique like this can change the conversation with a customer and provide diagnostic confidence. This chart was one created with testing a vehicle with a failed blend door (**Figure 6**). The vent temperature on MAX A/C was 133°F once the engine was fully warmed up. The vehicle came in hot and was checked out with the client waiting. This question was asked: Will the A/C be cold once the blend door is fixed?

The door on the vehicle could be repaired externally. The A/C system did not need to be disturbed, but did it require attention? Remember our methods of testing? We cannot verify the actual temperature change from ambient to vent for this vehicle (blend door stuck) and we cannot get data for a specific system performance test. Plugging our numbers into an enthalpy chart showed the A/C evaporator was showing a good saturation temperature for cooling (about 33 degrees F). The client can be told with confidence that the system will perform well once the blend door is working.

Learning to evaluate information in different ways is the way to develop an edge. Providing efficient service experiences to our clients helps build value in our business. Whether you plug numbers into a chart you create or pick up a tool that helps graph the data, I encourage you to give this method a try. Like any other testing technique, it takes a little practice to get comfortable. Once that is accomplished answers are only minutes away.

JIM COKONIS is the Senior Curriculum Developer for Carquest Technical Institute and Advance Professional. His career has spanned work in diesel fuel system repair and service, large fleet maintenance and repair as well as support services. He has provided on-site service for other shops and started teaching part time in 2007.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SOMETIMES MORE INFORMATION IS NEEDED FOR AN ACCURATE DIAGNOSIS

BY SCOTT SHOTTON //
Contributing Editor

Occasionally, we all get one of those vehicles that throws us a curveball. When this happens, the best way to deal with it is to take a breath, step back for a moment, and reassess the situation. Think logically, decide what piece of information you need to know, and then jump back in with the additional test to find your answer. This will help avoid a wild goose chase or going down the proverbial rabbit hole. This is one of those situations where I almost made the wrong call, stepped back to scratch my head, and jumped right back in with the extra tests needed to be completely accurate with my diagnosis.

The vehicle in question was a 2006 Nissan Xterra equipped with a VQ40DE 4.0-liter engine and manual transmission and is rear wheel drive **(Figure 1)**. It was towed into the shop because it had stalled while driving and now exhibits a "crank/no-start" condition. The customer stated that there were no lamps lit up on the dash before this problem occurred. Relatively quickly the technician diagnosed that the timing chain had jumped teeth. A timing chain replacement was approved by the customer and the timing cover was removed. The technician's diagnosis was correct, because none of the plastic from the timing chain guides was existent. The lack of tension allowed the timing chain to jump teeth. This is nothing new to us as technicians. The service advisor sold the job, with all the appropriate extras, and shipped it off to the technician. The technician completed the repair and then the vehicle exhibited new symptoms. First, the vehicle intermittently "runs poorly." Second, the MIL is illuminated and the ECM has stored two DTCs: P0011 – "INT/V TIM CONT-B1" and P0021 – "INT/V TIM CONT-B2"

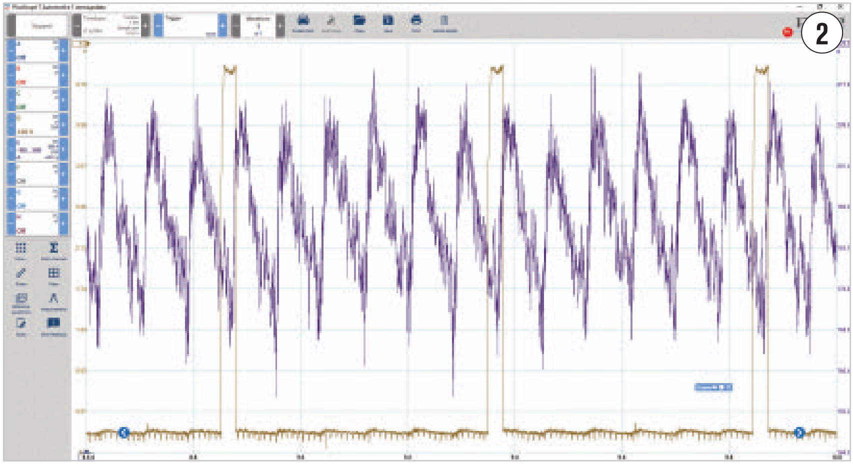
THE SUBJECT VEHICLE was a 2006 Nissan Xterra equipped with a VQ40DE 4.0-liter engine and manual transmission.

Duty calls

At this point, the shop gave me a call. Upon my arrival, I started my diagnosis as I quite often do —with a scan tool. I confirmed that the DTCs previously mentioned were present and that they were the only codes stored in the ECM. Next, I observed live data with the engine running. The camshaft data PIDs suggested that both camshafts were retarded 15 crankshaft degrees while both VVT solenoids had command of zero percent. I was beginning to believe that the timing chain had been installed incorrectly. However, I had to question myself because I believed that the technician was skilled and competent. I also knew that the shop had access to the correct service information, that I was told was followed exactly, and the technician swore the timing marks were lined up correctly. It was time to move on with more testing.

My first scope test was to perform a relative compression test. I chose this test not because I was concerned about the compression of the engine but about the general ignition timing.

PHOTOS: SCOTT SHOTTON



A RELATIVE COMPRESSION TEST confirmed that our ignition timing is not retarded.

In **Figure 2,** you can see that the ignition trigger signal (gold) occured just before the top dead center of the relative compression (purple) trace and does not appear to be an issue. (Note: this ignition timing test was only a ballpark measurement.) The next test to be performed was a CKP/CMP sensor correlation.

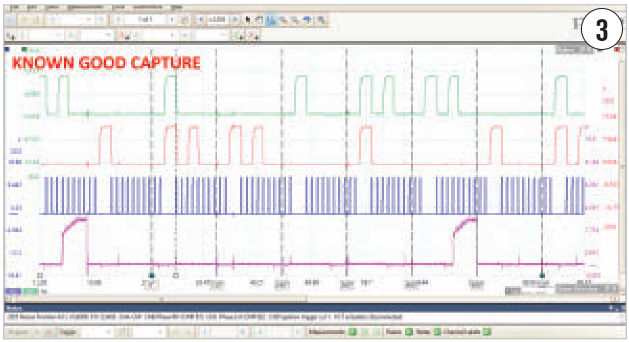
If we are to compare CKP and CMP sensor signal synchronization, we will need a known good example. Most manufacturers do not provide this in service information; however, Nissan is one of the few that does (although it is an illustration and not an actual scope capture). In my database, I happened to have a known good capture from an extremely low milage 2005 VQ40DE that I captured a few years back. It had all the information that we needed to perform this analysis **(Figure 3)**.

Using the known good capture, I found a place to compare all three signals that would be easy on the eyes and then used that point to make a comparison. I made the same connections to the broken vehicle, obtained the capture, and proceeded with the analysis **(Figure 4)**. I performed some measurements and confirmed that both CMP sensor signals were retarded approximately 17 degrees in relation to the CKP sensor signal.

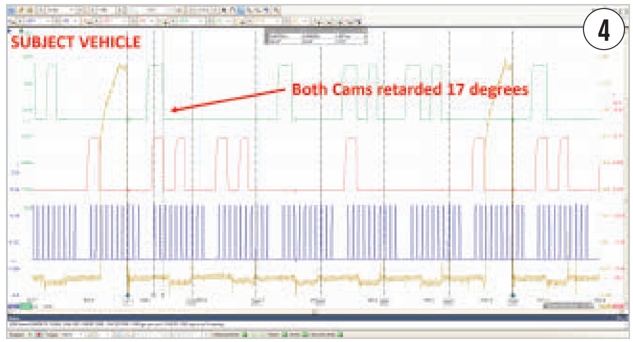
In this test, the 15 degrees of camshaft retard reported by the scan tool and what appears to be normal ignition timing still suggested improper timing chain installation. I needed to know before I told the shop to remove the timing cover again, so I moved forward. Luckily, when I took my known-good capture of the low-milage 2005 Frontier I had installed a pressure transducer in one of the cylinders. I decided to dig a little deeper and use the information I had gathered previously to make some more comparisons. First, I wanted to know a more accurate ignition timing measurement.

The ignition timing from the known-good capture measured to be 13 degrees advanced **(Figure 5)**. The procedure was repeated on the broken vehicle and the measurement came out to be 39 degrees advanced **(Figure 6)**. This seemed a bit odd to me because usually when ignition timing is off on a modern vehicle it is retarded. Either way, ignition timing is dictated by the CKP sensors input to the ECM.

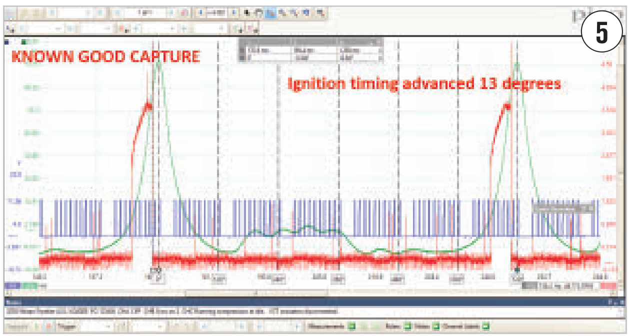
Second, I wanted to know how the CKP sensor signal lined up with top dead center. Using the same captures, with a little different zoom, I made this comparison. The known good capture showed the top dead center lining up with the rising edge of the last CKP



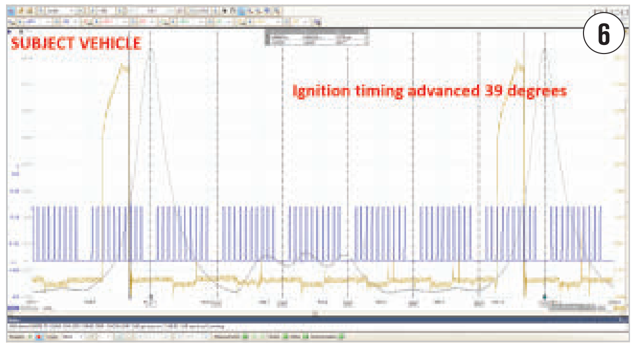
A KNOWN GOOD CAPTURE was used to observe proper synchronization of the CKP and CMP sensors.



CURSOR MEASUREMENTS CONFIRM that both CMP signals were retarded 17 degrees.



MEASURING IGNITION TIMING of the known good vehicle at idle.



MEASURING THE IGNITION TIMING of the broken vehicle at idle.

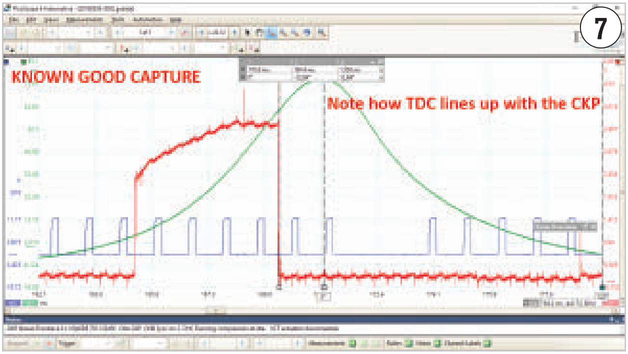
pulse before a large gap **(Figure 7)**. In the bad capture, the CKP sensor signal had moved to the left, indicating that it was advanced **(Figure 8)**. More measurements were performed and a difference of 19 degrees was observed. At this point, I was thinking that the timing chain was not the issue, but was there another test we could perform to definitively take incorrect timing chain installation off the table?

Using the same captures already obtained, we can make another comparison: verification of camshaft timing by observing valve events in the in-cylinder capture. Since this vehicle is of a single overhead camshaft design, I opted to measure the timing of the opening of the exhaust valve since it is relatively easy to pick out. On the known good capture, the exhaust valve opening (EVO) was occurring at approximately 36 degrees before bottom dead center. On the broken vehicle EVO was occurring at approximately 38 degrees BBDC. I am not going to sweat two degrees and was then totally confident that the timing chain installation was not the issue. Now it is time to investigate the CKP sensor reluctor.

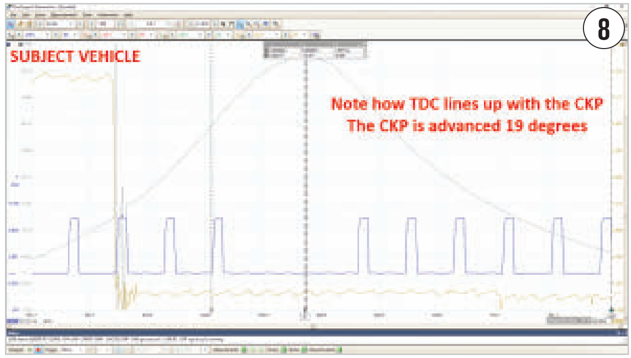
Following the clues

The CKP sensor on this vehicle was located at the back of the engine and its reluctor is on the flywheel. The transmission was going to have to come out to confirm what was going on with the reluctor and subsequently repair the vehicle. Upon removal, it was noted that there was a locating pin on the rear of the crankshaft. This locating pin's purpose is to facilitate correct flywheel alignment. However, the forward face of the flywheel had five possible locations for the locating pin to fit into. This meant that the flywheel could be installed randomly in five possible positions of which only one would be correct. This also meant that there was a 20 percent chance of being correct if we were to just slap the flywheel into place.

We know, from our previous captures, that there are three large windows in the CKP sensor pulse train for every 360 degrees of crankshaft rotation. This means that a large window occurs every 120 degrees of crankshaft rotation (360 divided by 3 = 120.) We also saw that the flywheel was held on by eight evenly spaced bolts. This meant if the flywheel were to be rotated one bolt hole it would have moved 45 degrees (360 divided by 8 = 45.) If the flywheel were to be installed three bolt holes off (3 multiplied by 45), the large window in the CKP sensor signal will be changed by 135 degrees. So 120 degrees off would work, but that is not where we are (135 degrees minus 120 degrees = 15 degrees). Almost all of our scope measurements, and the data PIDs in the scan tool, were all off by 15 to 17 degrees. The



THE ALIGNMENT OF TDC to the CKP sensor signal on the known good vehicle.



THE CKP SENSOR SIGNAL on the broken vehicle was 19 degrees advanced.

flywheel was indeed installed three bolt holes off. Since the CKP reluctor was technically off only 15 degrees, the vehicle still started. If another indexing had been chosen, the vehicle probably would have been a crank-no-start.

The shop removed the transmission, installed the flywheel correctly, and reassembled the vehicle. The issue was resolved, no DTCs returned, and the vehicle ran fine. A later conversation with the customer revealed that a clutch had been replaced about a year ago while living in a different state. This was when the time problem originated. However, the customer was still adamant that there was no MIL illumination up until the point that the engine stalled. This raised two questions:

Why was there no DTC P0011 or P0021 current before the timing chain gave up the ghost? Is the customer lying?

Employed logic uncovers the mystery

With a little research into the code set criteria for the P0011 and P0021, I think we can theorize why the customer was probably telling the truth. According to Nissan, there is about a 10-degree window of error before these DTCs will set. This would be the code set threshold. When timing chains stretch, the camshafts retard. If the Xterra was advanced 15 degrees due to the incorrect flywheel installation, the timing chain would only have to be stretched enough to cause a little over 5 degrees of camshaft retard to bring it back into the acceptable range and not set the DTCs. That being said, I believe a stretched timing chain was covering up the flywheel that was incorrectly indexed during the previous clutch repair. When the timing chain and guides finally failed, the engine was repaired and the camshafts were brought back into proper time, the ECM caught the 15 degrees of discrepancy that fell outside of the code setting threshold. Of course, this is just an educated guess because I never had access to the vehicle before the failure of the timing chain. Whatever the case is, that's my story and I'm sticking to it.

Since I am a mobile technician, I rarely get a chance to do follow-up testing on the vehicles I diagnose. In this case, the customer did not need their vehicle back right away, and the shop was more than willing to let me come back to repeat my testing on the repaired vehicle. I scanned the vehicle and confirmed that the camshaft timing PIDs had returned to zero degrees. I also repeated all the DSO captures and the test results matched my known-good captures exactly.

This case study also reinforces an important point: the value of having, or obtaining, known good captures. This particular issue would have been very hard, or at least time-consuming, to find if we did not have the known good data to compare to the broken vehicle. Sure, we could have pulled the timing cover to double check the work, but that would have been a waste of time and money. We could have also searched some databases that may have suggested the issue was the flywheel, but I do not want to remove a transmission just to look, which could potentially be another waste of time and money. The non-intrusive testing I performed did not take very long. It involved just a few scope connections, known good data, and the time to analyze the captures. My point is: when opportunities present themselves that allow you to obtain known good data, take the time to get it. Save the data in an organized fashion so the information can be found quickly next time you need it. You will not regret the time you spend gathering data when the day comes that you need it. Besides, the act of obtaining said data gives you practice with the tooling, makes you faster the next time you have to perform the testing, and makes you a better technician in the long run.

SCOTT SHOTTON is owner of The Driveability Guys, and he performs mobile diagnostics, reprogramming, industry training and has been a college instructor for the past 14 years. With a degree in Automotive Service Technology, Scott holds more than 21 ASE certifications.
scott@driveabilityguys.com

Autolite spark plugs meet the needs of today's high-performing engines

Vehicle engine manufacturers are constantly striving to create models that improve efficiency, capacity, horsepower and overall performance, meaning that the manufacturers of the spark plugs that outfit them must keep pace with these innovations.

Autolite® satisfies this need with its Iridium Ultra® and Iridium XP lines of spark plugs, which combine to provide coverage for up to 94 percent of the nearly 84 million domestic and import vehicles in operation (VIO) in the United States today.

Iridium Ultra spark plugs have been designed to be a practical, cost-effective competitive alternative to late-model double-platinum or iridium original equipment (OE) spark plugs, which were included in 98 percent of the new cars sold in 2018. They feature a laser-welded 0.5-mm iridium finewire electrode that creates optimal fuel efficiency, acceleration and focused ignitability, and are backed by a limited lifetime warranty. Other differentiating features of Iridium Ultra spark plugs include a nickel-plated, corrosion-resistant shell; a high-alumina ceramic insulator that increases strength and reliability; and Autolite's proprietary platinum-sidewire technology.

In side-by-side tests against competitive brands that were conducted by an independent lab, the Iridium Ultra spark plug was shown to burn – at maximum brake torque (MBT) of minus 4 degrees of timing – the first 10 percent of the fuel mixture in just more than 38 degrees of crank rotation, while the competitors' plugs required more than 40 degrees of crank rotation to achieve 10 percent Mass Fraction Burn (MFB). The ability of the Iridium Ultra flame kernel to burn faster during the first 10 percent of MFB means that more of the fuel gets converted into operational energy quicker, resulting in improved fuel economy and reduced emissions.

All of these design and performance enhancements combine to make Iridium Ultra spark plugs the best alternative to premium OE iridium laser-welded plugs, but at a lower price point for repair-shop owners, technicians and do-it-yourselfers.

For the drivers of older vehicles, with the average age of VIOs in the United States having recently reached an all-time high of 11.8 years, Autolite offers the Iridium XP spark plug. These plugs, which can be used on vehicles from model year 1967 and up, have been designed to be a high-performance entry-level iridium plug for older engines.

They achieve OE-level performance in older engines through a construction process that features a balanced blend of iridium, platinum and palladium, resulting in a plug that precisely focuses its spark energy at the optimum ignition point to deliver high power, long life and exceptional value. Like the Iridium Ultra, the Iridium XP plugs have an iridium-enhanced finewire center electrode, nickel-plated shell, high-alumina ceramic insulator and platinum-sidewire technology, and are backed by Autolite's unmatched limited lifetime warranty.

Autolite, a division of First Brands Group, is the No. 1 manufacturer of ignition products in North America. Autolite manufactures and markets ignition products, including spark plugs and glow plugs, for U.S., Japanese, European and Korean cars, as well as plugs for Lawn & Garden and Powersports that meet or exceed OE fit and function requirements. For more information, please visit autolite.com.

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Iridium Ultra®, the OE replacement spark plug from Autolite®, is engineered for optimal performance, durability, ignitability, and fuel efficiency.

Find YOUR spark at **autolite.com**

Keep technicians productive in the heat

In many parts of the country, auto shops have service bays outside, open to the weather and without air conditioning. When temperatures get high, employees at these shops can overheat and become ill with heat stroke, heat exhaustion, heat syncope, heat cramps, or heat rashes. Heat can also increase workers' risk of injuries, because it can lead to loss of focus, sweaty palms, fogged-up safety glasses, dizziness, and reduced brain function.

Not only is providing a safe work environment for employees the right thing to do – it's the law. This includes protecting them from heat-related hazards that could potentially cause sickness or death. Every year, dozens of workers across the United States die, and thousands more become ill while working in extreme heat or humid conditions. There are a range of heat illnesses that can affect anyone, regardless of age or physical condition.

Traditional shop safety programs often focus on slip, trip and fall hazards, which are important, but they also need to address heat stress because it can be a major contributor to accidents and work-related injuries, especially in the summer months.

The Occupational Safety and Health Administration (OSHA) holds employers responsible for protecting workers from extreme heat under its General Duty Clause.

OSHA, the National Institute for Occupational Safety and Health (NIOSH) and state regulations provide extensive resources on heat illness prevention. General guidelines include providing workers with water, rest and shade; allowing new or returning workers to take more frequent breaks as they acclimatize, planning for emergencies, training workers on heat illness prevention and monitoring workers for signs of illness.

In addition to federal law, Washington, Minnesota and California also have specific state laws governing on-the-job heat exposure.

As the global climate changes, many parts of the country are experiencing longer and more intense heat waves. Areas where working outside may have been pleasant or only occasionally hot in the past are suffering from increasingly severe heat events. While it may not be practical or cost-effective to move all service bays inside or install central air conditioning, there are affordable steps shop owners can take to protect their workers from extreme heat.

For example, a portable evaporative air cooler such as the Cool Boss™ offered by BendPak can reduce the air temperature surrounding it by up to 26 degrees Fahrenheit in a shop or covered outdoor work area for just under $1 per full eight-hour workday. It's easy to use – fill the high-capacity reservoir with tap water (or connect to a garden hose), plug it into a standard 110V outlet (or optional 220-volt available) and enjoy the cool work environment. Thanks to its wheels, Cool Boss™ in particular can be moved around the shop as needed or stored when it is not.

Shop owners also can make it easier for technicians to access cool fluids and encourage proper hydration. In some areas, they may want to look at changing schedules to incorporate more frequent breaks or work earlier or later in the day when it is cooler.

These are simple, but critical, steps that can be taken to provide a cool and comfortable work environment where techs can be at their best. The improved air quality boosts employees' efficiency and attitude, protects workers' health and boosts shops' bottom lines.

For more information regarding the BendPak Cool Boss™, visit

http://bendpak.com/shop-equipment/swamp-coolers/

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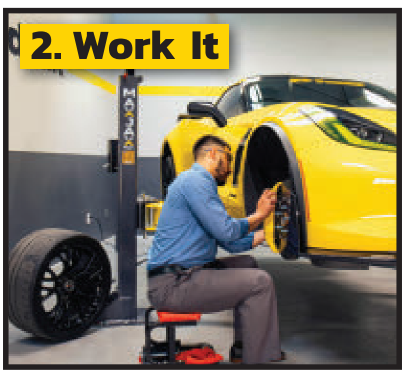

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TECH TIPS ADVERTORIAL

Steps to a proper diagnosis

Diagnosis is a series of logical steps to ascertain the cause of a failure or issue. The first step of any diagnostic routine is to verify the issue. Because how can you fix or repair something you cannot experience or see?

The next step in the process is to compare the vehicle's insufficient functionality to how the system is supposed to work. Is the concern a normal operating characteristic or an actual problem that requires more attention? Understanding how a specific part functions when operational, helps guide technicians to the source of the malfunction when challenges arise.

In addition to knowing how the system works, it is important to look up information on how it is known to fail. Technical Service Bulletins (TSBs), special service messages and additional resources are provided by many original equipment manufacturers to save time and diagnose known issues.

Many service information providers such as ALLDATA, ProDemand, and others also compile information on how different vehicle makes and models fail. There is also a collection of information available where other technicians share how issues were identified and repaired.

Our experience as drivability and electrical diagnostic technicians should have taught us that these listed steps are critical to properly diagnose and repair any concern on a vehicle. Shortcutting on any of these steps will more than likely result in a misdiagnosis and is not worth it.

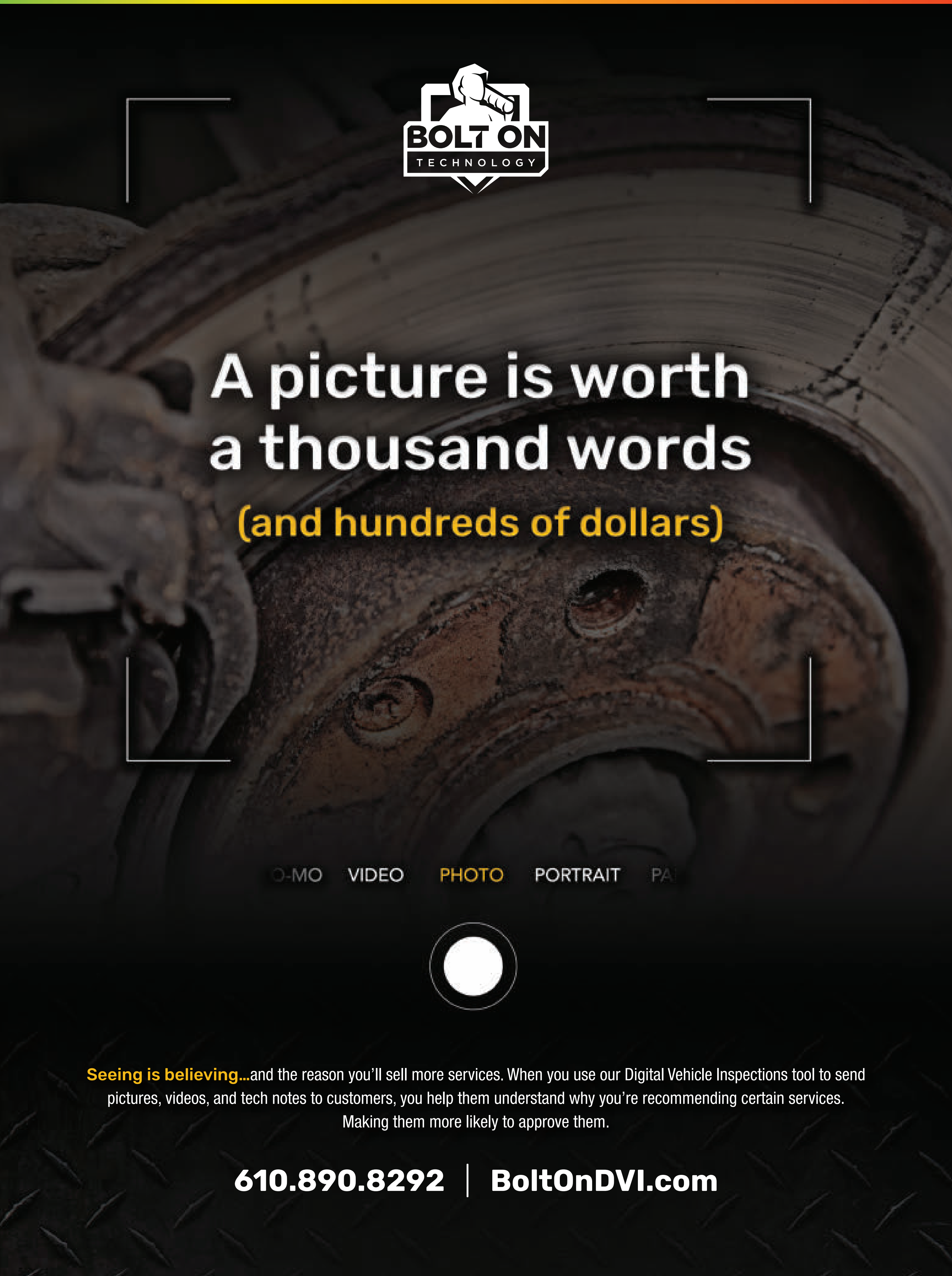
As a matter of fact, with the high levels of technology built into every vehicle, it is not only dangerous— it is an unnecessary liability for shops to have limited to no access to repair information. With the degree of accuracy required for many of today's driving systems, such as adaptive cruise control or even the danger of high voltage hybrid systems, lack of information may become deadly not only for the technician, but also for the driver.

With today's modern technology, there is no justifiable reason for a shop and its staff to not have access to information as crucial as this.

The good news is technology (like, automotive software) has come a long way over the last couple decades. While technicians now have unlimited access to a library of valuable information, it is accessible with mobile devices most shops have at their fingertips — literally. Even further, shops are now going paperless, providing digital vehicle inspections, and inputting VINs via scanner with 100 percent accuracy.

The diagnostic process is imperative to every car that rolls through one of our bays. The tools and knowledge are yours for the taking — to diagnose, repair, and verify every fix, correctly and safely the first time, every time.

BOLT ON TECHNOLOGY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5 steps to a more accurate diagnosis

In today's vehicles, there seem to be fault codes available for virtually every monitored system. Because these systems interact with each other, it's not uncommon to see multiple codes being set.

In many cases, diagnostic procedures will indicate whether additional fault codes may be set that share circuitry or depend on the actions of another system. As a rule, we expect the diagnostic procedure to lead us down the most efficient path to identifying and resolving the immediate problem, as well as the root cause of a fault code. Repairing a damaged circuit is likely only a temporary fix if we don't determine what caused the damage in the first place.

Diagnostic procedures usually help us to dot our i's and cross our t's when we take the time to follow them. Having a diagnostic path to follow is a great help, even though it may appear a bit laborious at times. Some steps just sound pointless but should not be ignored.

For instance, why do we need to check the battery voltage when the voltage at the component is either clearly within specification or it is not! Well, perhaps some other system up the line to the circuit we are testing needs battery voltage to function. So, step-by-step diagnostic procedures can be a pain, but generally help to resolve concerns with the least amount of effort.

What happens when the problem we are confronted with does not have any published diagnostics — hope it gets assigned to another technician? Let's say the concern ends up in our bay after all. What we can do is have a plan. And that plan can include these five steps to help lead to an accurate diagnosis.

1. First, gain information about when and how the problem occurs. This is especially critical with intermittent issues. Having real-world information is essential. ProDemand with SureTrack from Mitchell 1 delivers information based on over 45 million actual repairs and returns the information specific to your vehicle. This includes Real Fixes for concise diagnostics for common failures along with causes and fixes related to multiple, simultaneous codes.

2. Learn as much as possible about a system through the service information description and operation. ProDemand is an example of a resource for this type of auto repair information. SureTrack also offers an interactive community where you can ask questions and get answers from other professional techs who may have encountered the same issue you're facing.

3. Review the system wiring diagrams for circuits in the system as well as those circuits that tie in through shared power and ground connections. When possible, note harness routings to see potential movement or pinch points where damage may occur during operation. Also, be aware that splices tucked away inside a harness can be difficult to spot.

4. Check for any heat sources near the circuit that may not be properly guarded or just routed too close. In addition, missing and damaged water shields could be allowing water to enter connections and result in short-circuits.

5. Sometimes it may be necessary to systematically check a circuit. When that need arises, put together a checklist to indicate that a section of a circuit was inspected for an open, short to ground, short to power, or short to another circuit.

Granted, going to all this effort to identify a problem takes time and patience. Yet, these diagnostic skills pay off in the long run and make you as a technician all that much more valuable to your employer. And of course it's always rewarding to track down and fix problems that go beyond the everyday fault codes.


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The cabin air filter effect

Top 3 ways to protect your car's HVAC unit & cabin air

What in the world is a cabin air filter? Does my car have one? Where is it?

These are the most common questions about the most mysterious filter in your car: the cabin air filter.

If your car was manufactured in the last 10 years, then yes, it most likely has a cabin air filter, which is often found hidden behind your glove box. (See your owner's manual to make sure.)

A cabin air filter's purpose is two-fold:

1. Keep outside air contaminants (such as dust and pollen) from clogging up your HVAC system. If you've ever heard a loud rattling when you turn on your heat or air conditioning, that's a sign that it's time for a new cabin air filter. The better the airflow, the better your HVAC system runs.

2. Keep outside air contaminants (such as pollution, bad odors and dust) from entering your car's cabin (and thus, into your lungs). We've found pollen, soot and even insects inside a used cabin air filter, so they get dirty quickly. The more you drive, and the nastier the driving conditions (such as dusty air or standstill traffic), the dirtier your cabin air filter gets.

So now that you know a cabin air filter keeps the "bad" stuff out of your HVAC system and your lungs, why not put any old cabin air filter in and call it a day? Well, you could, but most cabin air filters come with only one layer of protection. That's one layer against 12,000 miles of exhaust fumes, pollen and dust. Not good.

The NAPAPlatinum™ cabin air filter is uniquely designed with three layers of protection for your HVAC system and your cabin air:

- Layer 1 prevents odor-causing bacteria, mold and mildew growth on your filter, and it comes with N95 grade filter media[1], antibacterial and antimicrobial properties.
- Layer 2 comes with activated carbon that absorbs odors, exhaust fumes and other air pollutants.
- Layer 3 filters up to 99% of allergens, pollen, dirt and fine dust particles.

The results: Air flows up to six times better through a NAPAPlatinum™ cabin air filter when compared to traditional cabin air filters. It's better for your car and your family.

To see if your cabin air filter needs replacing, visit your local NAPA AUTO PARTS Store or NAPA AutoCare Center. It only takes about 20 minutes on average to install. Just be sure to replace your cabin air filter every 12,000 miles or 12 months.[2] The cleaner your cabin air filter, the cleaner the air.

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1 Filter media achieves 95% filtration efficiency at 0.3 microns. Not NIOSH certified and not intended for use as a respirator or medical device.
2 Check your owner's manual for manufacturer-recommended intervals.

Pedal pulsation caused by moisture buildup

A Ford Edge recently came into the shop with a complaint of high-speed pedal pulsation. The owner said the vehicle doesn't get used much and does a lot of sitting around in the elements. A quick look through the wheels didn't show any signs of concern. The rotor surfaces looked clean and smooth. The front brake pads showed plenty of life. However, once the wheels were taken off and the brakes were inspected, the problem was quickly found.

Pad and Caliper Inspection:

After removing the caliper, we saw that the inboard pad seized in the caliper on both front wheels. Excess moisture caused rust buildup in the caliper bracket. This rust wasn't as prominent on the outboard pad because it received consistent airflow through the wheels. When looking at the life of the two pads, the outboard pad had plenty of life left on it. The inboard pad was almost worn down to the backing plate and had grooves on the friction surface (see image). The excessive wear was due to it seizing in the bracket. The pad was stuck in place up against the rotor, causing it to wear down at a quicker rate than the outboard pad.

Rotor Inspection:

Like the friction, the rotor surface told a different story when looking at the outboard versus the inboard. As mentioned, the outboard surface looked fine and was clean. There was not much, if any, rust buildup.

However, the inboard side was a mess with prominent rust buildup. It was also showing signs of a condition known as rust jacking, which can occur on rotors when paired with ceramic friction. Ceramic brake pads leave a thin layer of material on the rotor's surface when applied. When excess moisture builds up on the surface, it can creep under this friction layer. Over time, the moisture causes some of that material to pop off the rotor, leading to an uneven surface. This condition, known as a thickness variation, is what caused the high-speed pulsation that brought the vehicle into the shop. Since the vehicle was sitting around in the Chicago elements, including rain, snow and sleet, it makes sense that the moisture buildup would lead to this problem.

Repair Procedure:

This condition illustrates the importance of a thorough brake inspection. If the inspection had stopped after looking through the wheels, the issue would not have been identified. It is important to inspect each part of the assembly to diagnose a problem in the brake system.

There are two steps to prevent this problem in the future. First, put coated rotors on the vehicle. Coated rotors help protect against the damaging effects of rust and corrosion by preventing moisture from creeping under the friction layer, which can lead to rust jacking. Second, lubricate any metal-to-metal contact points in the system, including the areas where the pads contact the caliper bracket. This will prevent the pads from seizing in the caliper in the future.

This is cost efficiency

DanAmAir compressed air aluminum piping system

The DanAmAir is a fast, flexible and easy to modify aluminum pipe system for compressed air in any shop or garage. DanAmAir components are reusable and interchangeable, which enables immediate and easy layout modifications. Unlike the performance of steel or copper, which degrades over time due to corrosion, DAA provides clean air quality with optimum flow rate performance

DAA also offers significant savings on installation, maintenance and operating costs when compared to traditional pipe. The quick connections eliminate the need to thread, solder or glue pipe. DanAmAir's aluminum pipe system also significantly reduces plant energy costs by increasing efficiency, reducing pressure drops and eliminating leaks. Inquire with your local authorized SATA/Dan-Am dealer for more information.

	DanAmAir	Threaded Carbon Steel	Copper
Pipe Schedule	Aluminum	Sch 40	Type L
Material			
Pipe	$ 2,073.75	$ 1,935.60	$ 2,880.00
Fittings	$ 1,207.15	$ 113.38	$ 250.30
Material Total	$ 3,280.90	$ 2,048.98	$ 3,130.30
Labor Hours	22.35	82.21	60.42
Labor Cost at $65/man hour	1,459.90	5,343.65	3,927.30
Total Cost	$ 4,740.80	$ 7,392.63	$ 7,057.60
DanAmAir Savings			
Man-hours Savings		73%	63%
Total Installed Cost Savings		36%	33%

MATERIAL LIST: 500 feet of pipe, 16 elbows, 7 tees, and 10 couplings (unions). Comparison is DanAmAir 40 mm versus 2" pipe. Labor rates from MCAA manual are factored by 0.70, which is typical for estimating field jobs.

DanAmAir benefits

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Tips for successful tire mounting and balancing

Whether a technician has mounted and balanced tires for years or a shop is adding tire service work as a new revenue stream, there are several tips tire technicians can follow to help avoid costly tire mounting and balancing mistakes.

Check for technology in the tire.

Tires have become more advanced with tire-pressure monitoring systems (TPMS) in newer tires that constantly measure tire pressure and report it back to the Controller Area Network (CAN). As a vehicle operator, this is beneficial, but as a tire tech, it's important to understand where TPMS sensors are located, as they can easily be damaged.

Know when reverse mounting is necessary.

Reverse-mount wheels are more common with chrome or anodized wheels. These are often specialty wheels that have a wider lip or a deep-dish design style and require reverse mounting. Ensure techs are using a reverse-mount adapter to help avoid scratching the wheel's surface and inviting rust or corrosion onto the rim.

Properly clamp.

Avoid wheel damage with proper clamping. All aluminum wheels should be externally clamped; however, to save time, some operators will internally clamp a wheel, which causes scratches on the inside of the wheel. A center clamp changer can prevent this type of damage.

Determine the right amount of lubrication.

The amount of lubrication used when removing a tire and mounting it is important. Not using lubrication when demounting can damage the tire, while using too much during mounting can create tire-to-wheel slippage later, causing wheel vibration problems.

Eliminate old wheel weights and ensure proper weight placement.

Remove all old wheel weights before starting new service. Once a steel clip is used, it will never retain its grip like a new clip. This can lead to the weight falling off and causing unnecessary wheel vibration.

Most aftermarket and OE wheels require stick-on weights for balancing. These weights need to be placed on the wheel at a precise location. Even a slight miscalculation in weight location can cause wheel vibration.

Back coning mount to the wheel.

All wheels should be back coned—that is, the cone/collet should be placed on the shaft first, then the wheel, then a finger plate or pressure cup, and then the wing nut. Most aluminum wheels have a taper on the back of the hub bore that helps center the wheel on the collet.

Correctly mount the tire assembly

Even after the assembly has been pulled from the balancer, there is one more step required. The assembly has to get back on the vehicle. Torque it to the manufacturer's specifications so that vibration doesn't become a problem.

Proper tire mounting and balancing can help prevent uneven tire wear, vibration and unsafe driving conditions.

Download Rotary's Wheel Balancer Buyers Guide to learn more about selecting a new balancer, or check out Rotary's full line of wheel service equipment at www.rotarylift.com. From wheel balancers to tire changers to alignment systems, Rotary has everything shops need for efficient and safe tire jobs.

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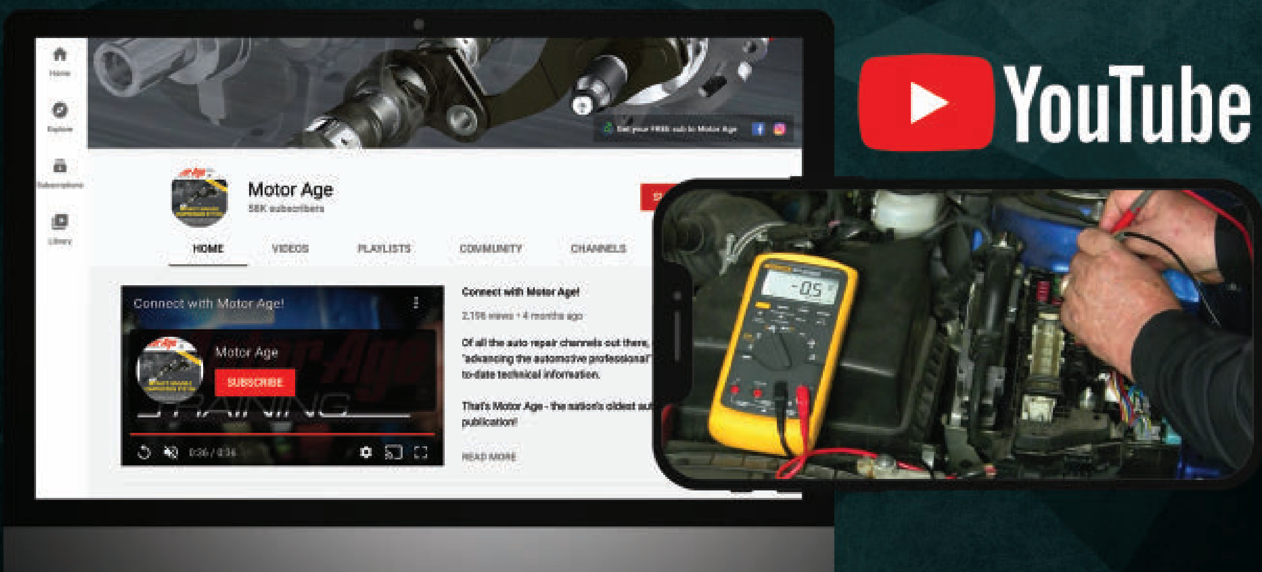

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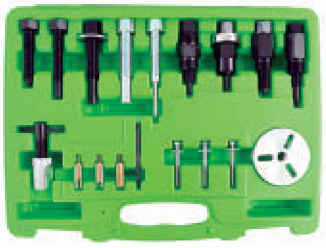
A/C CLUTCH HUB PULLER AND INSTALLER



The OEMTOOLS A/C Clutch Hub Puller and Installer, No. 37150, provides the tools necessary for the removal and installation of pressed on A/C clutches on many domestic and import vehicles. The set also includes an orifice tube extractor and comes in a sturdy molded plastic storage/carry case.

OEMTOOLS.COM

BRAKE DISCS

Textar has developed a perfectly matched brake disc that ensures the ultimate braking performance. The Textar range of brake discs is manufactured to precise German specification and are application engineered for cars driven in North America. Textar brake discs, brake fluids, anti-squeal pastes and brake tools are available exclusively at WORLDPAC, as well as a full range of premier Textar brake pads, e-pads and brake shoes.

TEXTAR-WORLDPAC.COM

ANGLE DIE GRINDER

The AIRCAT 115 Degree Angle Die Grinder, No. 6295, features a .6hp motor and the company's silencing technology. The rotational rear exhaust with internal silencing reduces noise level to 87 dBA. The tool has a spindle lock to provide quick accessory changes and as a speed control switch at the top of the tool for added control. The 6295 offers 18,000 rpm and a standard 1/4" Erickson-style collet.

WWW.AIRCAT.COM

COMPACT BOLT CUTTER

The KNIPEX CoBolt S Compact Bolt Cutter with Blade Recess is designed for cutting thicker materials with ease. The cutters feature a compact size, measuring 6-1/4" in length, and provide high cutting power, easily cutting bolts, nails, and rivets up to 11/64" in diameter. It has laser-cut edges on the blades which prevent material being cut from slipping.

WWW.KNIPEX-TOOLS.COM

MOBILE JACK STAND

BendPak's MLS-18 mobile jack stand provides added support when heavy-duty vehicle work on a lift may cause a shift in its center of gravity. Each MLS-18 jack stand has a rated capacity of 18,000 lbs. and can be adjusted from 48.75" to 74.5" in height. With a tripod design, foldaway transport handle and 3" diameter wheels, this highly mobile stand is easily one of the best accessories in a shop.

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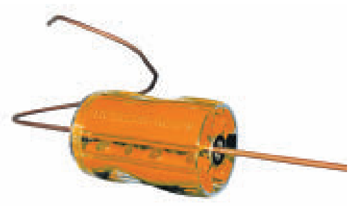
DUAL LAYER FACE COVER

The Honeywell Dual Layer Face Cover with Replaceable Filters is equipped with a hidden pocket for convenient filter replacement. It offers adjustable ear loops and features a 3-D knit construction that minimizes gaps and enhances comfort. When used with a disposable insert, the face cover is capable of blocking 97 percent of 0.3-micron-sized non-viable particles and 0.1-micron-sized aerosolized particles.

WWW.HONEYWELLSAFETY.COM

BRAKE LINE STRAIGHTENER



The Mueller-Kueps 1/4" Brake Line Straightener, No. 462 046, is designed to straighten 1/4" brake line when it's bent. Using 16 ball beared precision rolls, the tool removes bends out of the line, resulting in a straighter line while saving the technician time. Simply feed the brake line through the tool, hold the line, and with the other hand move the tool back and forth.

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PRODUCTS

TRAINING

TROUBLESHOOTING WITH THERMAL IMAGERY

EVER WISH YOU COULD "SEE" THE CAUSE OF A CUSTOMER'S CONCERN? IN MANY CASES, YOU CAN!

PETE MEIER // Director of Training

Thermal imagery, or "thermography," is a non-contact method of detecting infrared energy. Infrared is part of the electromagnetic spectrum and is just beyond our ability to see. In fact, the word "infrared" comes from "infra," meaning "beyond" and "red," which is the low end of the visible light range.

And while we may not be able to see it, we can feel it — as heat.

Thermography is not new, either. It was first developed for military use more than 100 years ago and is still in use by the military, law enforcement, firefighters, and other first responders. It is also used in certain ADAS systems, like pedestrian detection.

Technicians have been using temperature comparisons to diagnose customer concerns since the first car pulled into the first garage. Anyone reading this remember wetting their fingertips and touching exhaust runners to help identify a misfiring cylinder? Certainly, you've grabbed a low side A/C line to see if it was cold or a heater hose to see if it was hot!

Thermal imaging takes this diagnostic concept to the next level by allowing us to "see" heat relative to the objects in the sensor's view. One popular use for the tool is to identify the circuits and/or components responsible for a parasitic battery drain. After all, current flow generates heat so any circuit that is "on" when it isn't supposed to be is easy to spot by its heat signature.

But that's not the only use for the tool! In this edition of The Trainer, I'll explain some of the limitations of the tool and show you a few applications that can make your life easier in the shop. In the end, though, the uses of a thermal imaging camera is only limited by your own creativity. Please share any new uses you come up with! MA