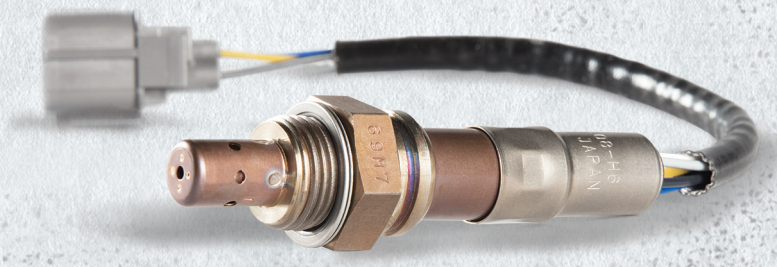
Motor Age®
ADVANCING THE AUTOMOTIVE SERVICE PROFESSIONAL SINCE 1899

COMMITMENT TO TRAINING
ADAS IS NOT A FOUR-LETTER WORD, DESPITE CHALLENGES 36

UBM
OCTOBER 2018
VOL. 137, NO. 10 // MOTORAGE.COM

THERE'S NOTHING NEW ABOUT THIS O2 SENSOR.

Because it's exactly the same as the one you're replacing.



Since 1925 NINETY YEARS OF KNOW HOW

Our O2 sensor program is one of the most robust in the world, meaning we will have the exact match for what you need—no matter the make, year or model. Now that's NAPA KNOW HOW.

NAPA KNOW HOW

Motor Age

ADVANCING THE AUTOMOTIVE SERVICE PROFESSIONAL SINCE 1899

COMMITMENT TO TRAINING

ADAS IS NOT A FOUR-LETTER WORD, DESPITE CHALLENGES 36

UBM

OCTOBER 2018

VOL. 137, NO. 10 // MOTORAGE.COM

THE EVOLUTION OF TRANSMISSION FLUID 60

BASIC INSTINCT

Five lessons to help you properly diagnose challenging vehicle problems 84

NOTHING SHAMELESS ABOUT THIS PLUG.

The facts speak for themselves. Reliable Motorcraft® spark plugs are designed to optimize power and efficiency. They're the factory-installed plugs in every new Ford engine. See your dealer or distributor to learn more.

Ford Motorcraft.

Right part. Priced right.

Motor Age

ADVANCING THE AUTOMOTIVE SERVICE PROFESSIONAL SINCE 1899

Talk Shop Anytime

OCTOBER 2018

VOL. 137, NO. 10 // MOTORAGE.COM

OPERATIONS

TECHNICAL

IN EVERY ISSUE

SPECIAL SUPPLEMENT

KIA QUALITY CONNECTION

The latest issue of the Kia Quality Connection is now available online:

MotorAge.com/KQCSummer18

WEB EXCLUSIVES // MOTORAGE.COM

SIMPLIFY YOUR EVAP TROUBLESHOOTING

Have you ever considered just how small a leak the 0.020" test represents? To easily and quickly locate the source of the leak takes more than just one approach. In this webinar, G. Truglia and Pete Meier share tips on various techniques you can apply to make finding that small leak a lot easier!

For example, do you know how to use the bar gauge on your smoke machine? For that matter, do you know how to properly use the machine? Adding too much smoke in an attempt to locate a problem can actually ruin the canister! If you can tell by the machine that there is a leak present, but you don't see smoke, do you know what to do next? Watch the webinar and you will!

MOTORAGE.COM/SIMPLIFY

Motor Age

MOTORAGE.COM

Millennium Place East // 25115 Country Club Blvd. // North Olmsted, OH 44070
Phone: (440) 243-8100 // Fax: (440) 891-2675

Motor Age (Print ISSN: 1520-9385, Digital ISSN: 1558-2892) is published monthly, by UBM LLC 131 W. 1st Street, Duluth, MN 55802-2065. Periodicals postage paid at Duluth, MN 55806 and additional mailing offices. POSTMASTER: Send address changes to Motor Age, P.O. Box 6019, Duluth, MN 55806-6019. Please address subscription mail to Motor Age, 131 W. 1st Street, Duluth, MN 55802-2065. Canadian G.T.S. number: R-124213133RT001. Publications Mail Agreement Number 40612608. Return Undeliverable Canadian Addresses to: IMEX Global Solutions PO Box 25542 London, ON N6C 6B2 CANADA One-year rates for non-qualified subscriptions: U.S. $70.00; Canada/Mexico $106.00; International surface $106.00. For information please call (866) 529-2922 (Domestic inquiries); (218) 740-6395 (Canadian/Foreign). Printed in the U.S.A.

AD DEADLINES: Insertion orders–1st of month preceding issue date. Ad materials–5th of month preceding issue date.

To subscribe, call toll-free 888-527-7008. Outside the U.S. call 218-740-6477.

Premium Line.
Superior Formulations.
Full Coverage.

Element3™ Automotive Brake Pads

Together, the EHT™ Enhanced Hybrid Technology and PG™ Professional Grade™ superior formulations offer a comprehensive but complete array of premium brake pads. Make Element3™ your choice for industry-leading coverage and braking performance.

Element3™ EHT™ Enhanced Hybrid Technology

- The best attributes of ceramic and semi-metallic all in one pad
- Engineered for maximum control in aggressive stopping situations
- Formulated for long life, less noise, reduced dust and better wear and durability

Element3™ PG™ Professional Grade™

- Premium semi-metallic or ceramic materials comparable to OE
- Superior shims for maximum noise damping
- Extreme stopping power and maximum safety

Raybestos® The best in brakes®

www.raybestos.com

INDUSTRY TRAINING

AUTOLOGIC RESURRECTS NCTS TRAINING EVENT AFTER 3 YEARS

PETE MEIER // Technical Editor

ORLANDO — In August, team members and officers of Autologic welcomed more than 200 technicians to the Omni Orlando Resort in Orlando, Fla., as they arrived to attend the 2018 National Conference and Tech Sessions (NCTS). Hosted by Autologic, and with the support of the WORLDPAC Technical Institute and Carquest Technical Institute, NCTS featured 44 training sessions held over the two-day event.

Sessions held were primarily focused on European models, but new in 2018 were more specialized diagnostic programs like John Thornton's "Electronic Engine Mechanical Testing" and G. Jerry Truglia's "Critical Thinking Diagnostic Skills." Also included were a few domestic-specific sessions like "GM Networks And Diagnosis," presented by Gary Machiros and "Toyota Hybrid Technology Update," presented by Dave Macholz. Additionally, specialty sessions that applied to most manufacturers were offered. These included sessions on Stop-Start technology, ADAS and J-2534 programming. And of course, there were sessions offered for shop management featuring Jeremy O'Neal and Cecil Bullard.

Instruction was provided by top independents and team members from Autologic, WTI and CTI, including some new faces recruited from the ranks of an increasingly active group of young

>> NCTS CONTINUES ON PAGE 6

BREAKING NEWS

DATA PRIVACY

ASA TARGETS SHOP DATA PRIVACY PRACTICES

BRIAN ALBRIGHT // Contributing Editor

As the automotive repair and service business becomes more heavily reliant on data and electronic communication, protecting customer information has become a more important concern in the industry. The Automotive Service Association (ASA) recently cautioned members that third-party vendors may be reselling customer data to other organizations, and has created a new Data Security Policy Agreement/Addendum for repairers who want to both protect that data and shield themselves from potential liability.

"The protection of personal information and proprietary technical data is a priority for consumers, regulators, legislators and class-action attorneys throughout the United States and abroad," says attorney Patrick J.

>> DATA CONTINUES ON PAGE 6

TRENDING

MITCHELL 1 INTRODUCES TEXT MESSAGING FEATURE

Mitchell 1 has enhanced its productivity solutions by adding text messaging features in its Manager SE shop management system and SocialCRM shop marketing products.

MOTORAGE.COM/TEXT

WIX FILTERS ANNOUNCES TOP 20 SCHOOLS IN CONTEST

WIX Filters and O'Reilly Auto Parts announced the Top 20 schools selected from 221 nominations and 91 schools for the 2018 School of the Year competition.

MOTORAGE.COM/TOP20

DENSO LEADS FUNDING TO CREATE AUTONOMOUS CARS

DENSO and Temasek have led a $65 million series C funding to AI hardware startup company ThinCI in hopes of furthering autonomous vehicle developments

MOTORAGE.COM/65MIL

KARL ROVE JOINS SPEAKER LINEUP AT AAPEX 2018

Political strategist Karl Rove will speak as a keynote during "Breakfast with John King and Karl Rove: How trade and the elections could impact the aftermarket."

MOTORAGE.COM/ROVE

REGISTRATION NOW OPEN FOR MACS 2019

A/Ccess is the theme of MACS 2019 Training Event and Trade Show, to be held Feb. 21-23 at the Anaheim Marriott in Anaheim, Calif., featuring 35 hours of training classes.

MOTORAGE.COM/MACS19

PARTSOLOGY.com

FREE NEXT DAY DELIVERY

~~$175.08~~ *EACH

$88.39

2005-2015 / Chrysler, Dodge, Jeep, Ram
5.7L, 6.4L / V8 / 16V / OHV / **[HEMI]**
FRONT / 2 Sets Req. - REAR / 2 Sets Req.
w/ MDS 4 Lifters w/ Yoke Assembly

~~$118.43~~

$59.79

2003-2015 / Chrysler, Dodge, Jeep, Ram
5.7L, 6.1L / V8 / 16V / OHV / **[HEMI]**
w/o MDS 4 Lifters w/ Yoke Assembly 4 Req.

ORDER ONLINE!
ENGINE PARTS

www.partsology.com

BBB ACCREDITED BUSINESS
BBB Rating: A

QUESTIONS?
TOLL FREE 1-844-800-6866
HABLAMOS ESPAÑOL

>> **NCTS** CONTINUED FROM PAGE 4

technicians banded together in the group known as "Trained By Techs." In addition to the training opportunities, attendees spent a lot of time networking with each other with some active discussions taking place until the wee hours of the morning!

And that is what "live" training offers that no other form of training does. The ability to interact — with your instructors, with represented vendors, with the host organizations and most importantly, with each other.

Kevin Fitzpatrick, Autologic CEO, was pleased with the success of this renewed event, last held in 2015, and announced at the closing dinner that NCTS would be held again next May, with the intention to host a bi-annual event that would be held in the years opposite of the Supplier and Tech Expo (STX) event held by training sponsors, WORLDPAC and (now) Carquest.

For more information about the event, or the line of Autologic products and services, visit https://us.autologic.com.

>> **DATA** CONTINUED FROM PAGE 4

McGuire of Patrick J. McGuire Law Offices, Mt. Prospect, Ill. "As an industry, everyone should be doing everything within their power to prohibit the unapproved/unsolicited sharing of estimates and repair data that goes beyond the scope of what is necessary during the normal course of doing business."

The new data security policy document states that all information (data) provided to outside vendors is "owned exclusively by the shop and provided for the sole purpose of conducting business." It does not grant the authority to share the data, sell it or repackage it without the express written consent of the shop.

The development of the policy was prompted both by the recent national focus on the security of vehicle and owner data (particularly for connected vehicles) and by a recent incident involving an ASA board member. In that case, estimate data made its way to CARFAX within 48 hours of an estimate being created. The customer was angry with the shop because the updated CARFAX report reduced the value of his vehicle (which he was about to trade in).

The shop was not aware the data had been shared, so ASA helped the shop follow up with CARFAX about the source of the data. CARFAX indicated that it gathered information from more than 34,000 sources. Without specifying the source of the information, CARFAX also stated that they did not get information from CCC Information Services, the estimating system used by the shop.

"We thought there ought to be a policy in place within a shop that clearly states to vendors that if you don't already have a transparent data privacy policy telling me how you are using the data, then maybe I ought to have a form for you to sign," says Tony Molla, vice president of the Automotive Service Association.

"Shops need to take control of their data," adds Scott Benavidez, ASA's Collision Division Operations Committee director. "Situations like this aren't unique, and the potential for class-action lawsuits should cause everyone to lock down their data. Nobody should be profiting from the data we are generating on behalf of our customers."

According to Molla, it's still unclear what types of liability issues the sale of customer data could generate. If the data is hacked or stolen, the shop could be liable for any damages to consumers (like identity theft or vehicle theft). If the data is sold to a third party without permission, customers could potentially come back and sue the shop.

"These are the types of things we're thinking about," Molla says. "It can expose the shop if they haven't taken the steps or reasonable precautions to protect data and customer information that they collect in the course of a repair."

Shops that aren't sure about how their vendors are using customer data should take the first step and ask about data sharing and selling policies. "Most vendors that collect data generally have a privacy policy in place," Molla says. "They will tell you that they do not share data at all, or that they do share it, but in aggregated form so it can't be used to identify a particular customer. But ask the vendor; getting an answer to that question is a step in the right direction."

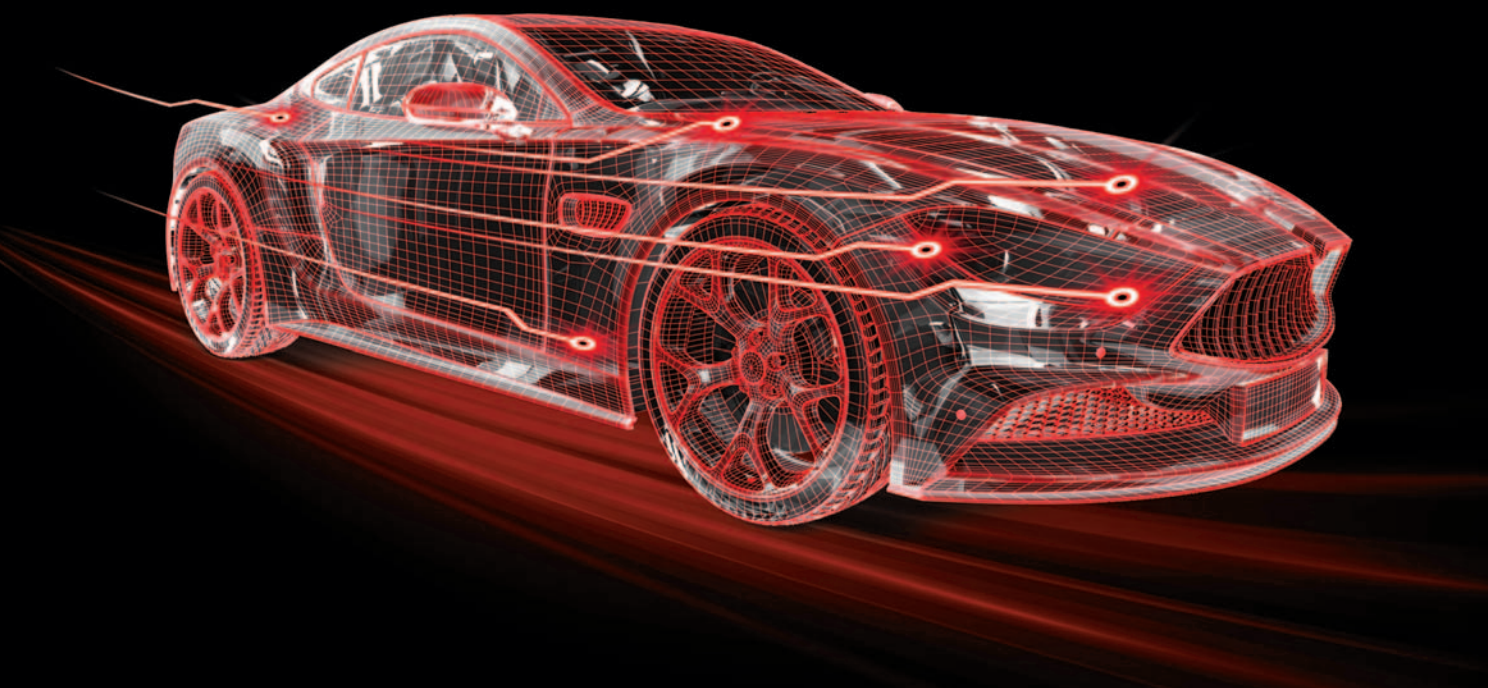
As more vehicles become connected, as more drivers connect their smartphones to their vehicles, and as OEMs and repairers wrangle over vehicle data pertaining to repairs, these data privacy issues will be even more important. An increasing number of companies also want to buy that vehicle data. McKinsey estimates that the market for automotive data could reach $750 billion by 2030.

"The reality is that data is being collected right now that you might not even be aware of," Molla says. "The ASA is partnering with other associations to define exactly what is being collected, what is being used, and who has access to it."

In addition, repair shops should take other security precautions like ensuring that their Wi-Fi connections and network firewalls are properly secured. "Is your office or business network as robust as it should be?" Molla asks. "If you don't know, you should be asking. It's time to take a look at all of your enterprise functions and see if there are security holes you have not anticipated that may have been introduced by the advancement of technology."

ADVANCED VEHICLE ELECTRONICS

Precision engineered to perform.



Vehicles on the road today depend on a complex system of electronics. As this category continues to evolve, you need a reliable supplier who can keep up with the changes in the market.

That's where WVE comes in. We offer high-quality switches, relays and other important components backed by rigorous testing and validation — so you know our products are built to perform.

Visit **ngksparkplugs.com/wve** to learn more.

Visit us at AAPEX booth #1832 and SEMA booth #23343

WVE™
Vehicle Electronics

NGK SPARK PLUGS | NTK TECHNICAL CERAMICS
NGK SPARK PLUGS (U.S.A.), INC.

CALIFORNIA EV SALES INCREASE, BUT GAS-POWERED VEHICLES STILL DOMINATE

MOTOR AGE WIRE REPORTS //

The California green vehicle market continues to experience growth throughout the state, especially with increasing electric vehicles sales that now make up 3.1 percent of total new vehicle sales year to date (an increase from 2.4 percent this time last year). However, according to the California Green Vehicle Report, the overall California vehicle market is still overwhelmingly dominated by gasoline-powered vehicles, making up 83 percent of new vehicles sold so far in 2018.

While the San Francisco Bay Area is experiencing the most growth in electric vehicle sales, at 7.7 percent year to date, other regions of the state are lagging. LA and Orange Counties, along with San Diego County, are seeing nearly 50 percent less electric vehicle sales than the North, at 3.3 percent and 3.9 percent year to date. The difference is even more significant in the Central Valley, where only 1.8 percent of new vehicles sold are electric.

"The disparity of electric vehicle sales in various regions of the state is significant, especially in the Central Valley. While California residents in Northern California seem to be adopting to the idea of electric vehicles more rapidly, we have a long way to go in other regions of the state. It's clear that consumers still prefer gasoline-powered vehicles, while convenience, affordability, range and choice continue to be factors for consumers when selecting a new vehicle to purchase," said California New Car Dealers Association Chairperson Taz Harvey of Dublin Mazda. "While many manufacturers are getting on board with developing new electric vehicle options, they must continue to take all of these factors into consideration for consumer adoption to continue to increase."

Additionally, brand share in the alternative powertrain market is still heavily dominated by Toyota, making up nearly 27 percent of green vehicle sales year to date. Tesla comes in second, bumping Chevrolet to third, at 21.1 percent and 10.2 percent year to date. Rounding out the top five selling brands in California for hybrid, plug-in hybrid, electric and fuel cell vehicles are Ford and BMW.

The California Green Vehicle Report provides comprehensive information on the state's green vehicle market. The report includes a segment watch, including top 20 best-selling alternative powertrain vehicles; best sellers in market segments including hybrid, plug-in hybrid, electric and fuel cell; market trends by powertrain type and brand shares in alternative powertrain markets. The complete report can be accessed on CNCDA's website at: www.cncda.org.

LEGISLATION

TARIFFS COULD RAISE MECHANICAL, COLLISION REPAIR RATES

BRIAN ABRIGHT // Contributing Editor

Almost every sector of the automotive industry has been critical of tariffs that the Trump Administration has imposed on aluminum and steel, as well as a number of products imported from China, and proposed tariffs on automobiles and parts have received an equal amount of pushback.

Both the existing and proposed tariffs could significantly raise the cost of automobiles and repairs. The insurance industry has also chimed in on the current U.S. Department of Commerce Section 232 investigation on proposed tariffs for vehicles and auto parts.

"Tariffs on auto parts could have a significant adverse economic impact on consumers, automobile repair providers, businesses and insurers," said Robert Gordon, senior vice president of policy research and international affairs at the Property Casualty Insurers Association of America (PCI). "Tariffs on auto parts could cost the consumers $3.4 billion in personal auto insurance premiums alone."

Those concerns were echoed in testimony from Auto Care Association President and CEO Bill Hanvey in testimony before the U.S. Trade Representative regarding the most recent Section 301 tariffs on Chinese imports.

"The greatest impact from this action will be on U.S. consumers who will experience higher repair costs, likely leading to the delay of critical vehicle maintenance procedures that

may result in serious highway safety concerns," Hanvey said. He used brake rotors as an example of a part that is no longer manufactured in the U.S. despite increased demand.

"Considering that there are over 2,600 different part numbers in the brake rotor sector, there is no viable option to meet the demand, nor any source of the parts in the U.S. market for every year, make and model vehicle on the road," Hanvey said. "Therefore, regardless of any tariff imposed, brake rotors will continue to be imported, the vast majority from China."

Using data from the U.S. Bureau of Economic Analysis, PCI has estimated that 60 percent of auto parts used in the U.S. are imported, and the proposed tariffs could raise auto repair costs by 2.7 percent. Additional costs could also affect commercial insureds and consumers who pay out of pocket for vehicle repairs.

"Increasing the price of automotive parts and causing disruption in the supply of auto replacement parts could also impede consumers from promptly repairing their vehicles and getting back on the road," Gordon said. "Should the Administration impose restrictions on imports, we urge the Administration to exempt closely aligned markets that supply substantial percentages of U.S. auto part imports or to establish a process through which interested domestic parties can petition for product exemptions in a timely and transparent manner."

In August, the Driving American Jobs Coalition, a group representing auto manufacturers, parts suppliers, auto dealers, parts distributors, retailers and vehicle service providers, announced an initiative to oppose the tariffs.

The coalition includes the American Automotive Policy Council, the Auto Care Association, the American International Automobile Dealers Association, the Alliance of Automobile Manufacturers, the Association of Global Automakers, the Motor & Equipment Manufacturers Association, the National Automobile Dealers Association and the Specialty Equipment Market Association.

"The proposed tariffs are an unwelcome tax on every sector of the auto industry," said Christopher J. Kersting, President & CEO of the Specialty Equipment Market Association. "From the automakers to the many small businesses that comprise the specialty auto parts industry, tariffs on imported vehicles and auto parts pose an unexpected threat to a healthy American economy."

FACING THE FUTURE

Industry professionals discuss ADAS, cybersecurity, tech shortage

CHELSEA FREY // Senior Associate Editor

For this year's roundtable, *Motor Age* gathered industry professionals (see sidebar "Who was at the table?" on page 14) to discuss the biggest challenges facing the automotive aftermarket today, such as advanced vehicle technology, cybersecurity and the technician shortage.

Here are some of the highlights of this year's roundtable. Responses were edited for length and clarity.

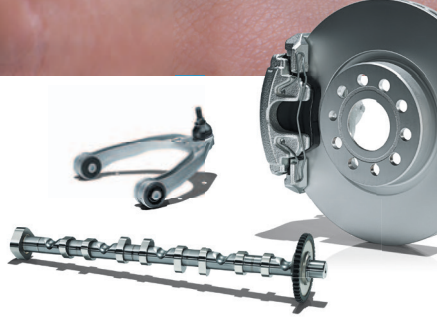
Motor Age: How do you see advanced driver-assistance systems (ADAS) affecting the automotive aftermarket?

Chris Chesney: The industry is faced with a large challenge to become competent with respect to many of the basic services that we've done for years, including alignments, brake service, suspension service, etc. The lack of accuracy with those services in the past that we've been able to get away with won't be allowed when dealing with ADAS systems, because those basic services and systems are assumed to

PHOTO: RAWPIXEL.COM / SHUTTERSTOCK.COM

Fast answers and easy ordering?

WE'VE GOT TOOLS FOR THAT.



If you need help on a job, just call our NO-CHARGE Volkswagen repair hotline, powered by Identifix®, at **855.828.4016** for timely answers and friendly advice. Then, order the parts you need from RepairLink, our easy-to-use online parts ordering system. You'll get upfront pricing, detailed illustrations, and more. **How convenient.**

Call today or order Genuine VW Parts at RepairLinkShop.com.

Parts

Volkswagen

be functioning as designed in order for the ADAS systems to work properly. Much like we tried to preach when anti-lock brake systems (ABS) came out, if the base brake system wasn't working properly, the ABS couldn't work properly. The same thing is coming into effect with ADAS. If those systems don't know where the car is pointed, and we don't align the cameras in the proper orientation, then those systems may be looking off to the right and not see a vehicle approaching from the left, and thus won't react — or it could overreact. I see these technologies really changing the window of tolerance for the basic services we already provide.

Pete Meier: A young man at NACE Automechanika Atlanta this past August shared a story where he deliberately set the targets off line, and the vehicle accepted that calibration. There were no hints of codes or issues in the system because the car, as far as it was concerned, was looking straight down the road. But in reality, it wasn't. It was enough of an angle that when the vehicle's ADAS system did go into play, it would cause the vehicle to veer out of its lane rather than stay in it.

PETE MEIER

I agree with Chris — we've been at a point for many years where you can't go by generalities when you're repairing these vehicles. A message that we have to get out to our audience is that you may decide that you're not going to align cameras or get involved with the radar systems as a shop or technician, but even routine, basic services are affected by these advanced systems. Another part that comes into play is if you're not doing it right, what kind of liability are you exposing yourself to? I would think it's going to be quite a bit if a vehicle that you recently aligned is involved in an accident and evidence shows that the thrust angle was not correct. And that's what we really have to push to our audience — you can't just get by anymore. You either need to be doing it right or you shouldn't be doing it at all.

Robert L. Redding, Jr.: We at the Automotive Service Association (ASA) think this whole movement towards autonomous vehicles and ADAS should increase the importance of safety inspections for the aftermarket and consumers. As of now there are only 16 states that have safety inspection programs. Another aspect of this rapidly changing technology is the value of shop licensing or certification, whether that is done via OEs or state or federal governments. Particularly for associations and training, the move towards these new technologies is a critical juncture. Some repairers have gotten away with not focusing on training in their shops and not participating in meetings, webinars and educational conferences. We don't see how you can escape these issues and still have a viable business in the future. It's more critical than ever before to participate and train.

ROBERT L. REDDING, JR.

Chesney: Another challenge for the aftermarket is the gap between new technology and the corresponding education. In the past and still today, education comes after a supplier develops a new technology and sells it to an OEM. That technology is implemented into their vehicles and the supplier trains the OEM staff on how it works and how to service it. Those OEM trainers then train their dealer network. Somewhere in that mix, that content eventually makes its way to the aftermarket where repairers will either use the OEM content or use the service information and the content to build tools for the aftermarket so that technicians can work on those vehicles when they show up in the bay. For the last 40 years we've

NEW REPAIR AGE: YESTERDAY'S FIXES ARE NOT TODAY'S

BOB HEIPP //
Contributing Editor

There are many traditional repairs that are just not viable today. This is becoming more and more evident with advanced driver-assistance systems (ADAS), especially as they evolve.

With the advent of ADAS, it is becoming more important than ever to change how we address vehicle repairs. We must be sure the vehicles are leaving with the proper OEM service procedures followed, including any calibrations.

If vehicles are not repaired properly, a driver could end up with potentially life-threatening consequences. Yesterday's repairs are not measuring up to today's requirements. As time goes on, we are going to see a need to slow down the process a little to ensure a properly repaired vehicle.

Take the time to verify OEM procedures before beginning a repair. Someday in the near future, having access to OEM scan tools and calibration tooling will be a requirement. Finding the people to fill these needs has already become disturbingly difficult.

always maintained a stable gap between when the technology was developed and when we would learn about it. But over the last three or four years especially — and for the foreseeable future — that process does not serve us fast enough. The technology is advancing so quickly that the aftermarket is falling further and further behind to the point that we're put at a disadvantage. That needs to change.

Motor Age: How has the need for cybersecurity impacted you or your organization and what should the industry as a whole be doing to be proactive?

Redding: This is something that is really important to us. We need to be sure that the bulk of the repairers are educated about these issues and that the baseline for protecting data evolves in a way that does not put legitimate professional shops out of business. In other words, we want to make sure that legislation dealing with cybersecurity is not created in a way that prevents repairers from accessing data.

One thing that is important in this window of time is the Inhofe Amendment, which is included in the U.S. Senate AV legislation. It's not the only path to an end-game to resolve some of these issues for the automotive aftermarket, but it would be a positive step forward. The language would require NHTSA, with the Federal Trade Commission, to put together a stakeholder group on data access and cybersecurity. All of our interest would be represented from the aftermarket as well as other groups, such as car rental companies, dealers, auto manufacturers and insurers.

Important for all of us is that the elections in November could impact the things that we're talking about today. Even though we had unanimous support of the AV legislation in the U.S. House of Representatives, if the House flips — or not — due to the November elections, then we may be moving into 2019 without some type of AV guideline for states and the federal government, so getting it passed before the election is important.

Chesney: I deal with issues related to cybersecurity on a daily basis because our research and development center that is based in Raleigh does not have an internal corporate network. The reason we are so protective of that and don't have an internal network is because we don't want potential malware from vehicles — or anything we connect to — to impact or threaten our internal data and vice versa. We teach data security in many of our classes, such as the J2534 class or data network class in which we show the importance of protecting your network internally so that customers are protected.

The real risk for repair shops are your technicians walking in with their smartphones. If at any point they accidentally download malware on their phones elsewhere and then connect to the same network that your scan tools are on, there could be big issues. Those things need to be looked at and validated.

Motor Age: How do you foresee ridesharing services affecting the automotive aftermarket over the next five years?

CHRIS CHESNEY

Chesney: It's already affecting the miles driven for that group of vehicles. I have a habit of getting into an Uber or Lyft or other rideshare and asking the driver how long they've been driving for the company, how many miles they've put on their car, and whether they bought it or are leasing it. It's alarming how many people have leased vehicles for these purposes and put 50-60,000 miles a year on it. For the independent shops, the challenge is marketing to that segment of drivers and attracting them in for regular service so that they can keep value in their vehicle by maintaining it over a period of time.

Meier: GM just announced plans for their autonomous EV-based vehicle for more urban environments, and these

types of vehicles will likely be used for rideshare purposes. Down the road that could result in fewer vehicles, but even if there are fewer vehicles, they'll still be in almost constant use. There's still going to be plenty of work for the aftermarket to perform, and with the evolving technology, it's going to be highly skilled and — I hope — highly paying jobs.

Motor Age: A recurring challenge within the auto repair industry is the technician shortage. What are you or your organization doing to build a workforce to meet the demands of today and the future?

Meier: We've been talking about the technician shortage since I started in the business 40 years ago. Now it's really manifesting itself. When shop owners complain about not having enough people in the shop, I invariably ask, "Are you involved in your local school? Are you on the industry advisory board? Are you taking part in helping shape what that educational picture is going to look like?" And invariably the answer is no, they're not. On the other side of the coin, while there are several exceptional automotive schools and programs across the country, there are also many that are outdated and stuck in the late 70s or mid 80s — whenever the instructor left the bays and transitioned into teaching. That's an area that needs to be addressed as well.

Chesney: My organization is totally committed to the industry to help bridge the gap that we have today with respect to the technician shortage and the aging workforce and, more importantly, the ever-increasing gap between technology and the skillsets of the techs in the bays. For many years we've expected two years' worth of vocational education to prepare a technician effectively to be able to be a competent entry-level technician at a shop. That just isn't the case and hasn't been for nearly 20 years.

The most important work right now is with the National Automotive Service Task Force (NASTF). The education team has been charged with designing a framework of education for all roles within the industry that will provide visibility for those thinking about entering the industry and for those who are already in the industry of the opportunities that are available.

Here's where we've landed currently — we've filled out a list of skills that an entry-level tech should possess and be able to do without supervision. We've vetted it already with 25 shop owners across the country, and they have validated that we're on the right track.

The problem that we see with education is that education today is outcome-based. Outcome-based is defined as delivering the content to the student in a way that the student can figure how to apply it in the bay appropriately, but there is no validation that they can do it. Competency-based education, on the other hand, is taking those courses and that content and putting it into action unsupervised in the service bay. That's where we have to get. We're taking those entry-level skills and we're building a list of competencies that apply to those skills and then aligning learning objectives so that curriculum developers can evolve and enhance their current curriculums to accomplish that competency and proof of skill. So when a tech gets a job straight out of vocational school, they can go in and they can show that qualification that, in our mind, should be delivered by ASE. They can show that credential and the shop owner can recognize it and know that that person knows how to change the oil and do a courtesy inspection, etc. We're actively working on that as we speak.

Redding: For me, professionally, we can't do this by ourselves. It's hard. I think this has to be a public-private partnership on developing policy, helping with recruitment and helping us with retention. We have affiliates running excellent apprenticeship programs, but we're seeing that that's not enough. They vary wildly and the participation rate of shops is not high enough. From our perspective, we want to do more and we have to develop a better framework of a policy in this area as well as take a bigger look at having state and federal partners in this process.

On another note, at NACE Automechanika Atlanta this past August, we invited schools to come in on the floor of the show. To see these students rush through the doors together was very cool and encouraging. That doesn't mean that everyone rushing through those doors has plans to be an automotive technician, but just seeing kids looking and being interested in the automotive aftermarket within that age range was very encouraging. We need to be able to build upon and sustain that interest.

WHO WAS AT THE TABLE?

Chris Chesney is the Senior Director of Customer Training for CARQUEST Technical Institute (CTI).

Pete Meier is the Director of Training for the UBM Automotive Group and *Motor Age* Technical Editor.

Robert L. Redding, Jr. is the Washington, D.C. representative for the Automotive Service Association (ASA).

CHELSEA FREY is the Senior Associate Editor for *Motor Age* and for its sister publication, *ABRN*, in the collision repair segment.
chelsea.frey@ubm.com

Follow the Blue Brick Road...

We're not in Tulsa anymore.

There's no place like Dayco.

Come see the new global Dayco at **AAPEX booth 4026.**

DAYCO®

MOVE FORWARD. ALWAYS.™

Baby boomers are sinking your ship

Those exiting our industry on a daily basis are far surpassing those entering

I have been in the automotive industry for over 40 years now, and the one thing I can say that has never changed, is change itself. For example, cars are being built so much better. Consumers are more educated and more demanding than ever as the internet has become the go-to for almost everything. Technology, hybrids and electric vehicles are totally changing the game. These are the obvious changes, but the not-so-obvious changes are usually the most vital changes to focus on. In addition, they are often the most difficult to overcome. I was listening to one of our coaches who helped me start ATI — Geoff Berman — share with a class he was teaching on interviewing technicians when I thought you would want to hear what he said.

Stop technician recruiting frustration

According to Pew Research Center, Baby Boomers are retiring at a rate of 10,000 a day and have been since Jan. 1, 2011. This trend will continue until Dec. 31, 2030. In my 30-plus years in this business, I have never experienced a more difficult time than now to find good, qualified staff. The consensus from the shop owners I speak with is the same.

EVERY BLUE COLLAR INDUSTRY IS FACING THE SAME CHALLENGE — THEY CAN'T FIND QUALIFIED STAFF — FOR THE SAME REASON: BABY BOOMERS ARE RETIRING.

When I ask, I always get the same answers: "There aren't as many vo-tech schools out there." "No one wants to work in our industry." "The schools are pushing all the kids into college." "If they aren't headed to college they are going into the computer field." And the list goes on and on. My answer is always the same. These are the same challenges we have faced for the last 20-plus years. We are still seeing the same 5 percent coming into our industry that we always have. What has changed? What has created this giant hole in our labor pool?

Every blue-collar industry out there is facing the same challenges. This means plumbers, electricians, HVAC companies, truck drivers, machine operators, etc., all desperately need skilled laborers. We all have the same challenge and for the same reason: Baby Boomers are retiring.

In January 2008, EveryCRSReport.com reported that 55.5 percent of the labor force for repair and maintenance business across the country was made up of Baby Boomers. More than half of our industry is made up of Baby Boomers and over the next 12 years they will be gone. Ever wonder why the same people you don't want to hire keep answering your ads? These are the ones no one will hire. There are so few good ones left you'll never get them, because their employers will do anything to keep them. Wouldn't you?

If you think it is tough to find people now, you ain't seen nothin' yet. From today on, this is a 20-year challenge. My guess is that up to 25 percent of the current shops out there will go out of business for no other reason than they can't find qualified staff. The bulk of the rest will hang on by their fingernails and survive. But there will be a smattering of shops that will do something about it. These are the shops that will thrive because they have figured out they can't keep doing the same things they did 20 years ago to find staff. The world around them and their challenges have changed, and so must they.

There are two very important things that any shop must consider if they want to be one of those shops that thrive, not just survive, during this mass exodus from our industry.

Most shop owners make the mistake of only advertising when they have a position to fill. This may have worked in the past, but it is unlikely to work now. All it will do is attract the ones you don't want. Remember, the ones you want already have good jobs. They aren't looking at those ads. You need to find other ways to attract them.

Recruiting vs. advertising

The first way is recruiting. Recruiting is the act of attracting, engaging, assessing and onboarding talent. The key is in the attracting and engaging. It is not one interaction. It could take months or even years of networking and staying in touch with any potential candidate before they decide to come onboard. I'm sure you have experienced something like this in your career already. Go look at qualified past applicants, call them up periodically, and stay in touch. One day, something will happen in his current position and he will think, "I'm out of here." When he does, who's he going to call?

The second thing is a big shift that is hard for most. You must learn to stop looking for people only when you need them, but to always be looking. If you have embraced recruiting in the manner I have suggested, then you will have many opportunities for interviews. Interview everyone, especially when you're not hiring. This gives you the opportunity to start the recruiting process and stay in touch with the ones you like. This also gives you another opportunity. If you're asking the right questions in your interview, you will also find other potential recruits through the relationships they have. If done right and done consistently, you will easily be able to grow your bench, and before you know it, the best of what is left will find themselves on your team.

Help them get what they want

Now I must be clear about one very important thing. What I have suggested here will only take you so far. You must have a shop environment that attracts the people you want. These are good people that are fed up with the way their current employer runs his shop and the way they are treated. They are looking for something better. The money that has been thrown at them time and time again is no longer adequate, because nothing has really changed. Promises have been broken too many times in their current position. Promotions, raises, equipment and the lists go on! You must provide a path to what they are looking for and they will find it easier to make that change. You must discover what they really are looking for through the interview process and they need to see you as that solution. If they do, it is only a matter of time before they decide to come aboard.

Technician recruiting questions to always ask

Many shop owners get frustrated with the interview process. One reason for that is the difficulty in knowing what questions to ask to get the person you really want. If you skip these questions, you run the risk of hiring the wrong person, which will cost you more money in the long run than turning down work today. These questions will work for hiring advisors, managers, bookkeepers or technicians. Let's make it easy for you. Simply go to ***www.ationlinetraining.com/2018-10*** for a limited time to receive the questions that make the difference in finding that "right" new employee.

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

DRIVE EMPLOYEE INERTIA

Keep your staff focused, energized and productive

DAVID ROGERS // Contributing Editor

It's no secret that we're facing a technician shortage in our industry.

I could write an entire article on why we're facing this shortage and how to overcome it, but the truth is, finding and retaining quality employees has always been a challenge for shop owners.

While there are some amazing things shops are able to do using technology to make employees more effective and efficient, the keys to finding and keeping those employees is unchanged: we have to create a culture that quality employees want to be a part of, we have to hire and train the right way, and we have to empower and incentivize them to become a valuable part of our team.

These goals all work hand in hand. Building a culture of success and a team of winners both start with the same first step: finding employees who want your shop to succeed.

Lay the groundwork early

This starts with the very first stage of the hiring process.

During the hiring phase, it's critical to effectively screen your candidates as thoroughly as possible. The biggest thing you're looking for? Character.

You can teach someone how to change a tire or an air filter, but one thing you can't teach an employee is how to be a good person — an honest, hard-working person who will be an asset to you and your shop.

Quality people are an invaluable natural resource, and just like drilling for oil, you need to put in a good amount of time and effort to obtain them!

You should always use a set of written questions when conducting initial

PHOTO: MICHAELJUNG / GETTYIMAGES.COM

job interviews — you need to have consistency in what you're asking the various applicants you're sorting through. The more questions you can ask, and the more you're able to learn up front, the better.

In addition to learning about their work history and experience, you've got to look for red flags.

Do they waver when you ask them about having an up-to-date ASE certification? Red flag. Are they reluctant to explain why they left their previous job? Red flag. Do they immediately ask about your recreational drug use policies? Red flag.

The more interviews you do, the better you'll get at identifying who will be a motivated, hard-working staff member and who will be a liability.

Remember — be selective. When I was hiring techs at Keller Bros. Auto Repair in Littleton, Colo., I'd typically interviewed one out of every 10 candidates and hired one out of 100. Obviously, not everyone has that luxury in their market, but you should be as picky as possible.

Train, train, train!

Once you've hired a new employee, you should spend as much time as possible training them during the first couple of weeks. A new employee needs to learn both the what and why of your processes and procedures.

You need to explain the reasons why your shop does things a certain way, especially if they're veterans of other shops and have picked up some bad habits at some point in their career.

For example, at our shop, we do a thorough inspection of every car we service, no matter what the car came in for. The reason? If that customer gets in an accident after leaving our shop, we could end up liable (the law has proven this time and time again).

Some techs don't want to do more work than they absolutely must, but this is a policy we insist on. Teaching that new tech why you have your policy, how that policy protects them, and even how that policy increases their paycheck are all critical parts of creating motivated team players.

For service writers, making sure they fully understand your shop's policies and procedures is even more important.

Having an advisor who works on the front lines of your business not completely aware of your shop's procedures will cost you customers and money. I've seen it time and again in hundreds of shops.

Your shop's communication flow and policies need to be made crystal clear. What are the shop's hours? What time should employees clock in and out? What is your dress code? What is the policy on cell phone use during business hours? All these things need to be issued in writing and discussed with new staff members on their very first day.

Disciplinary guidelines should also be outlined early in an employee's tenure with your shop. How many strikes an employee receives, what the penalties are for various offenses — all these things should be clearly expressed.

Just as important is enforcing those policies and procedures. The second you see an employee breaking policy, it needs to be corrected. It helps your team understand that your policies aren't suggestions — they're a critical part of making sure your shop runs efficiently and safely and makes everyone money.

(Em)power up

In addition to having your policies and procedures outlined and explained meticulously, you need to establish a culture of employee empowerment that new hires can buy into once they've been trained properly.

Measurement is a key part of this. Measuring your team's performance helps you retain good employees, plain and simple.

Imagine playing a game of football where you can't see the field and don't know the score. You probably wouldn't play, would you?

This is how winners think. They want to be measured. They want to be held accountable. In no small part, because measurement should go hand in hand with an incentive-based pay plan that rewards their achievements.

There's a big caveat here: incentive-based pay plans aren't something to play with lightly. Incentivizing the wrong number or using the wrong benchmark can ruin an employee and destroy a shop.

Set a good example

If honesty, integrity and dedication are the traits you'd want your employees to have, you must show them yourself. Be open, direct and fair with your staff and they'll follow your lead.

If things do start to slide, you need to take ownership of the cultural changes that are harming your shop's productivity. Recommit yourself to staying more on top of the day-to-day happenings of your business and make sure this is broadcast loudly for all to know.

Good leadership, good hiring/training procedures and good measurement/incentive systems are the keys to finding, hiring and retaining a motivated team…now motivate yourself to make it happen!

DAVID ROGERS is chief operating officer of Keller Bros. Inc., president of Auto Profit Masters and president of Shop 4D, the industry's first Artificial Intelligence (AI) -enabled, self-learning system for proactively managing repairs, customers, marketing, profits and employees. Reach David via email at *contact@shop4d.com,* toll-free at 1-866-826-7911, or *online at https://shop4d.com/.*

Mercedes-Benz
StarParts

Introducing Mercedes-Benz StarParts

An authentic parts option – at exceptional prices.

StarParts is a parts line for Mercedes-Benz vehicles 5 years and older, which is:

- Built for high functionality and fit
- Backed by a one-year warranty* that includes parts and labor
- Designed to enhance margins and help grow profits for your shop in the long run

To order StarParts, contact your Mercedes-Benz dealership today.

*To learn more, visit mbwholesaleparts.com/StarParts.

The impact of management decisions on tech wages

A tech's total contribution to profit should be considered, not just one category

Many shop owners look at only the technician's labor revenue, namely the total billed hours, for the period being measured and from that report, determine how productive the technician was, and whether a "bonus" or pay increase is warranted for the technician. Measuring total billed hours for each technician is a very key measurement; however, if this is the only guideline being followed, management may be conducting an unfair practice policy, which in turn, may lead to a competent technician moving on to greener pastures. No shop can afford to lose a good, competent technician or any competent people within the shop these days.

Perhaps it is time to review the total issues that management controls before blaming the technician.

Consider that a technician works on a vehicle and completes all work necessary. Consider it is the technician's total contribution to the shop gross profit picture that should be recognized also and measured, and not just one category.

The business guideline is that the technician's total gross earnings, before benefits and employer payroll costs, should come in at 30 percent of total gross profit produced by the technician, including gross profit from oil, tires, batteries, all parts and labor. Measure the technician's productivity against his/her total gross profit produced and not just the labor produced, or, management may be short-changing the technician's true productivity contribution to the shop. This is just another key step in looking at the total picture for each technician.

Now consider that it is management that determines what the client is going to be charged in terms of dollars and cents on the final invoice. If the client is given a deal or discount and the full labor time spent by the technician is not being charged out at the correct labor rate, then, in essence, management is short-changing the technician's labor productivity. Also consider that if management is going to give the client a discount on parts, and/or other hard goods, then management is, once again, short-changing the technician's productivity in terms of total gross profit contribution produced for the shop for the month or period being measured.

PERHAPS IT IS TIME FOR MANAGEMENT TO INVEST IN AND MAKE THE EFFORT TO GET INVOLVED IN UP-TO-DATE TRAINING.

Consider that it is management that determines the gross profit percentage policies of each revenue category for the shop, and if the shop's gross profit results in each category are below the industry's business operating guidelines, then management again is affecting the true gross profit productivity produced by the technician.

Finally, consider that it is management that sets the shop's labor rates. Today's shops require a minimum of three labor rates — maintenance, diagnostic and a re-flash rate, and if management sets the labor rates below the industry wage multiple or cost per billed hour guidelines for each labor category, then once again, it is management who is affecting the total labor revenue and gross profit produced by the technician. Also consider the internal processes to ensure the correct time on each labor category is captured fully and properly. A simple example to consider is whether or not test drive times are being captured at the diagnostic rate and being included on the final invoice. I find that this issue can average .2 in time on a typical invoice. That adds up to a lot of time over the course of a year. If all processes for capturing everything are not being attended to properly, then the technician is, once again, being short-changed.

Management should re-examine the shop's business practices, processes, policies and standards before stating that they have an unproductive technician or can't afford to pay the technician a professional wage package with benefits. If shop policies and practices are out of line with successful business practice guidelines, then the chances of losing good people are very real, because management "perceives" they are not productive.

We are in a new aftermarket era, and it is critical that all shop owners and managers truly understand all business

LAUNCH
TECH USA
CREATE • CHANGE

X-431 PAD II AE

It is a Professional Scan Tool, which utilizes easy to operate Android™ tablet technology to meet your needs and expand as your business grows. Full system diagnostics, printable reports for Pre and Post scans, online vehicle research, and even part ordering is no problem with the open Android™ platform.

"ONE SCAN TOOL DOES IT ALL"
DUST PROOF AND IP 65 RATED

WWW.LAUNCHTECHUSA.COM
1820 S. MILLIKEN AVE • ONTARIO, CA 91761 • PH : 1-877-528-6249

5 MISTAKES MOST SHOP OWNERS MAKE EVERY DAY

BOB COOPER // Contributing Editor

Despite good intentions, there are five mistakes that most shop owners make every single day.

1. You forget to say "Good morning!" You should greet every employee. Keep your employees inspired; it's not their responsibility to inspire us.
2. You forget Job #1. To grow a successful business, you need to have clearly defined goals. Then share those goals with all employees so that every day they know what to focus on.
3. You don't catch employees doing things right. By praising positive performance at the time it occurs you're reinforcing the behavior and improving morale.
4. You help in the wrong ways. Help employees do their job well, but don't do it for them. Lead employees to the answer, rather than providing it to them.
5. You try to be everything to everybody. There is value in telling some people that unfortunately, you're unable to help them with their particular needs.

aspects that are under their full control. Let's face it — a shop always wants to be able to retain the best technicians and people in the industry. The fact is it is very possible to retain and pay the top technicians a very professional income; however, management must clearly understand their own new role in the business. We all are now in a knowledge-based business and continuous education must be the new culture standard. Great technicians take a lot of pride and ensure they are on top of their technical knowledge. Management must do the same for their position they are responsible for.

Consider that perhaps it is time for management to invest in the time and make the effort to get involved in up-to-date management training and development and do the research now as to what management courses you must update yourself on.

Please don't be complacent on these issues, because once you have lost a great person, or great people, it is too late; they will be gone forever and that will affect the business's future.

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

O'Reilly FIRST CALL
DEDICATED TO THE PROFESSIONAL

INSTALL PREMIUM

BRAKE PADS & ROTORS

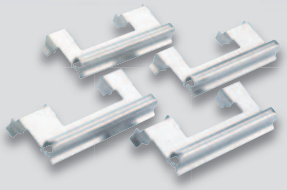
FROM BRAKEBEST SELECT

Let us be your Parts & Equipment Supplier

www.oreillyauto.com/professional-catalogs

CERAMIC BRAKE PADS

- Enhanced CERAMIC formulas; our BEST ceramic brake pad
- Ceramic formulations for quieter performance and low dust
- Integrally molded for increased durability
- Slotted and chamfered noise-reducing design
- Stainless steel hardware included where applicable

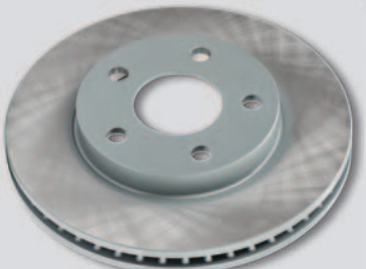


PREMIUM BRAKE PADS

- OE performance for all driving conditions
- OE-style friction material formulations
- Integrally molded for increased durability
- Slotted and chamfered noise-reducing design
- Stainless steel hardware included on select applications

NEW PAINTED HAT ROTORS

- Covers 2004 and newer models
- 1000+ painted part numbers
- Running change, availability may vary



AVAILABLE EXCLUSIVELY AT
O'Reilly FIRST CALL
DEDICATED TO THE PROFESSIONAL

O'Reilly PARTS PAYOFF **REWARDS FOR PURCHASING & INSTALLING THE BRANDS YOU KNOW & TRUST**
FOR DETAILS VISIT FIRSTCALLONLINE.COM

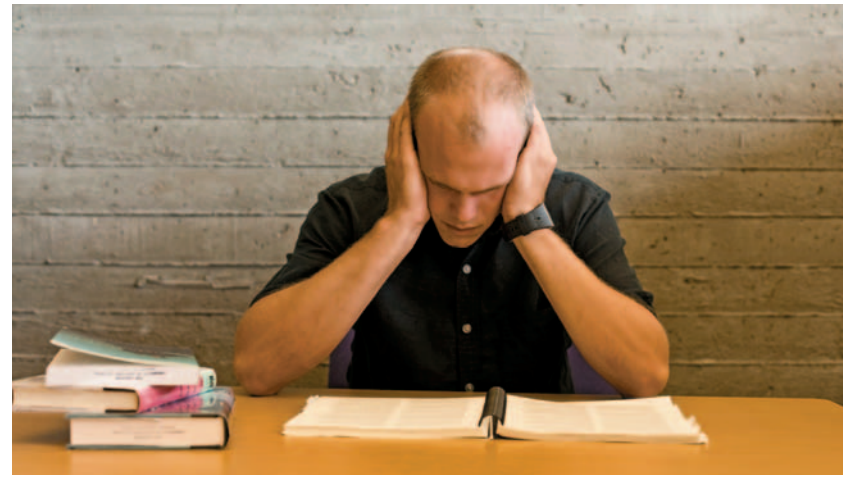
FIRSTCALLONLINE.COM
Visit our website for a complete, internet-based catalog designed exclusively for the Professional.

ADV 1330

AN ANSWER KEY TO ASE TESTING

Get tips and tricks to have the best outcome when working toward ASE certification

JOHN BURKHAUSER //
Contributing Editor



The National Institute for Automotive Service Excellence (ASE) was founded to determine the competency of technicians through testing. Those who have proper field experience and pass the tests get a certification that lasts for five years.

ASE certifications have been part of my career since I started tech school. Now, I find myself in need of recertification before the end of 2018 to maintain my ASE Master Technician status. I have used a process to pass the tests and remain ASE certified, and I think it's something that could help all techs.

The process

Get registered and select the testing center you wish to use. Keep in mind drive time, especially if testing is split over multiple days.

With test taking, you need a system that helps you answer questions. For many, knowledge isn't the problem; it's the questions that trip them up. I found I had this issue — I took a study guide test, and when I graded myself, I failed! I was shocked. I went back and reviewed the questions I got wrong and quickly realized that I knew the answers, but how I interpreted the questions was my problem, not the material.

I sought out every source I could, finding ASE-like tests and questions. I looked online, in study guides and in old school books. Online, I found tests with extremely dated technical information, but they still were in the common question formats I needed to work with. I practiced daily working with the questions. This has several advantages:

1. You get used to reading the questions and answers. It takes practice.
2. It prepares you for sitting and taking the tests. This helps to get the idea that the test is timed off of your mind. You build test-taking stamina.
3. As you go over the questions and answers, you are reviewing the material.
4. You get familiar with the different question formats you will be facing.

The questions

Completion/Direct: This type of question is the direct, or completion, kind. These describe the vehicle equipment and a symptom that can occur, then either ask a question or ask you to complete the statement with "the most likely cause" answer. Here is an example:

A customer states that the Traction Control and ABS Lights come on and stay on when driving a short distance after starting the vehicle. Which of these is the most likely cause?

A. Damaged tone ring on a front axle
B. Brake pads cracked
C. Coolant leak
D. Starter pinion

Read the question and note everything it tells you about the situation. Next, consider all the answers. Eliminate the answers that are obviously incorrect, then choose the correct answer.

True or False: Another type is the Technician A or B questions. These are basically "True or False" questions. Read each technician's take on the issue listed.

PHOTO: ©PURESTOCK / GETTYIMAGES.COM

Decide if they are either true or false, then choose the correct answer based on the tech's opinions. An example:

The starter in a vehicle cranks slower than expected. The battery tests good so the circuit is suspect. Who is suggesting the better way to check the circuit?

Technician A says that a resistance reading should be taken of the circuit.

Technician B says that a voltage drop test should be performed on the circuit.

Who is right?

A. A only
B. B only
C. Both A and B
D. Neither A nor B

Technician A's statement is false. Technician B's statement is true, which means that (B) only is correct. To help keep track of each tech's answer, you can use the provided scrap paper and have a "A – B" column as you look at each tech putting a T or F next to the tech letter. This way, you don't have to remember it, and you can focus on answering the question.

Except and Least Likely: Before each one, you will see an explanation of how to look at these questions based on whether it is an Except question or Least Likely question. An example:

This question uses the words LEAST LIKELY. Look for the choice that could NOT or would be LEAST LIKELY to cause the described situation.

Air conditioning is turned on but the air coming from the vents is not getting cooled. Which of these is the LEAST LIKELY cause?

A. No refrigerant
B. Clutch Relay Failure
C. Thermostat Stuck Wide Open
D. Blown Fuse

"Thermostat Stuck Wide Open is the LEAST LIKELY cause of this symptom," I say in my head, then select the answer.

The lesson

Taking the time to go over these questions from practice tests helps build your test-taking stamina. You build a system to approach each question. This helps take test stress out of the equation. You get to focus on the actual information you are being tested on, not the form of testing.

Consider only the provided answers to each question. Do not compare it to something you may have seen in the field, especially if no answers match your experience. Choose the best answer.

Eliminate the answers that you know are incorrect and focus only on the ones you feel apply. Reread the question and look at the remaining answers. Do not spend too much time on any one question. Choose the best answer you have at this time, mark the question number on the screen to return to it when you have completed the test.

As you go through the test, another question might give you a different point of view and possible answers to difficult questions you struggled with. When you've reached the end, you can go back to the questions you marked and reconsider your original answers. But be careful. Many times, your intuition on choosing an answer on the first pass is correct. Many test takers that go back and second guess themselves turn correct answers into wrong ones.

Answer every question! You have a one in four chances to get the right answer. Even if you don't know the correct answer, you may be able to eliminate some of the other answers, further increasing your chance of guessing right. Always answer the questions you want to come back to in case you don't have the time, or just plain forget.

Studying & preparation

Online tests are limited, but still find and do as many as you can. Purchasing study guides is also well worth the investment. Purchasing the current guides is best. Trying to save money and buying older versions may not completely prepare you for the test. Also, keep the new study guides in great shape so you can sell them after you pass the test, helping to defray their costs.

To study, take a practice test and grade yourself; then read the given explanations for both the right and wrong answers. This further prepares you for the test questions and makes you study the material at the same time. Don't forget to look over the Task List given for each test. Identify the tasks that you may not be so familiar with and focus more time on studying and learning them.

The L1 Advanced Engine Performance Specialist Test comes with a booklet that represents a Composite Vehicle (available in print or online.) The Composite Vehicle exists so that all persons taking the L1 test are on a level playing field since OEM-specific systems and sensors are eliminated. You do need to be familiar with the information provided about the Composite Vehicle and, just as importantly, where specific information is in the book. Knowing the booklet will save you time during the test. Spending less time searching for the location of the information in the booklet saves time for answering the questions.

This is my system for preparing for my ASE recertification tests. It works for me. Take what you want from it and add your own methods and ideas that work for you. Then practice and study even though you may work in the field every day. Go back to the basics — they will help, too. Read the questions completely and carefully. Relax.

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

Continental

The Future in Motion

MAKING

TENS OF THOUSANDS

OF CARS LOOK A

LOT COOLER.

Visit booth #2626 at **AAPEX**

and learn more about our full line of aftermarket products.

MAKING
TENS OF MILLIONS
OF CARS AND TRUCKS
RUN COOLER.

SURPRISED? Continental knows OE because our belts are OE on millions of Chrysler, Dodge, Ford, GM, BMW and Volkswagen vehicles that roll off the assembly line every day. Now with our OE Technology Series (OETS), you can install the aftermarket Multi V-Belt with the OE pedigree. Belts fanatically precision engineered for perfect fit, form and function. Plus, there's a Continental belt for 98% of the vehicles on the road in the U.S. and Canada. When your reputation is on the line, roll with Continental. **Get the full story at OETechnologySeries.com.**

The crowning touch

Shop revamps brand, services to treat customers and staff like royalty

ROBERT BRAVENDER // Contributing Editor

Royalty Auto Service wasn't always regal. For quite a while, this repair shop in St. Marys — "about as southeast as you can possibly get in Georgia without being in Florida" — was simply called Auto Care.

"Which was boring," comments Sherwood Cooke III, son of owner Sherwood Cooke, Jr., and the shop's service advisor. "My dad bought it like that back in 1996 and kept that name for a long time." But about five years ago 'S3' was moved from service work to management by 'S2' — verbal shorthand to keep things straight in the office — and the Cookes began making many changes to the company.

Up first was the lackluster label. "We have a good reputation," the younger Cooke notes. "We've been here a long time, but we had never really focused on the branding aspect and how important that is."

After some negotiation they came up with the nobler name. "As cheesy as it might sound, we treat people like royalty," he states. "We want to be the Ritz-Carlton of auto repair. To us fixing the car is a given; everybody brings their car in and expects it to be fixed right the first time. The way to really wow people is to go crazy with the service."

Their service emphasizes being family-owned and oriented. "Our slogan is 'let our family take care of yours,'" says Cooke. "When you go on our website, the first thing you see is our picture. The people who come here are joining our family, and it's huge to develop that relationship with someone."

Next, they began transitioning to European brands. "Honestly, I feel that this is a huge market that's growing very fast," Cooke explains. "I haven't done direct studies or research on it, but you can tell by looking in our parking lot that it's growing. Obviously, they're more expensive to fix, so they're going to make you more money. Plus, we're in a very unique spot in South Georgia — the only dealers here are GM, Ford and Chrysler. For anything else you're driving 45 minutes. We are the dealer alternative, so getting into the European market was a no-brainer."

Still, the Cookes eased their way into these cars; it took about two years before they got traction. "We didn't go out and buy the BMW factory tool right away," Cooke explains. "I don't think that would be a wise decision for anybody. You've got to build clientele up before you invest in something that big. Once we

ROYALTY AUTO SERVICE

Saint Marys, Ga. // www.royalautoservice.com

Sherwood Cooke Jr., Sherwood Cooke III Owners	**4** No. of technicians
1 No. of shops	**7** No. of bays
22 Years in business	**$545** Average repair order
10 No. of employees	**$976,000** Annual gross revenue

PHOTOS: ROYALTY AUTO SERVICE

consistently saw BMWs in our shop every week, then every day, it was worth making that investment."

Thirdly, the Cookes set up interest-free financing for repairs through Synchrony Financial. "Say a customer has an eight-year-old car," Cooke posits. "It's paid off, has 100,000 miles, and needs 400,000-mile servicing, like shocks and struts — about $3,600 worth of work. With financing, the customer has 12 months interest free. Without car payments they're looking at $300 a month — less than a normal car payment to make it perfect again."

Then about two years ago they started closing for lunch, something Cooke thinks could be the industry norm. "At a seminar not long ago they asked how many of us closed for lunch. Out of about 80 people, 10 of us raised our hands. Clients adjust to it, employees don't stress about getting something thrown on them during their break, and it makes scheduling a lot easier. I feel it's also good for rapport; with techs and front office people going to lunch together they're working on their relationships, which is good for business."

Then there's the piece de resistance, which actually predates the Royalty name change. "My dad's been doing this about nine years now," grins Cooke. "It's a small thing, but people love it. After a car gets worked on, we wash it inside and out…and put a rose on top of the steering wheel."

More recently Royalty began a serious push into the hybrid market. "People want specialty work on hybrids just as much as European brands," Cooke states. "Say a Prius gets the 'red triangle of death' on its dash; the battery pack has failed. A dealer will charge about $5,500 for a new one; we can refurbish the original one between $1,500 and $1,700.

"We have a company out of California that sends us cells, which we keep in stock," he explains. "After replacing the bad cells, we have two machines that discharge and charge the battery pack, balancing out all the cells, rejuvenating the life of the battery."

They've also started a hybrid maintenance program. "If somebody is going to keep a hybrid vehicle with less than 100,000 miles on it, we'll install a harness on the battery," says Cooke. "The customer then comes in two or three times a year to discharge, charge and

balance the cells. Right now this process takes a couple days.

"They'll pay about $700-$800 upfront, get the first year free, then pay $125 a year after that," he outlines. "Plus we do a lifetime warranty on the battery. It's basically cheap insurance. Everybody with a hybrid knows that at one point or another the battery will go bad. Typically its 8-10 years. Ten years under our program, you will have spent about $1,800 and you're warrantied forever.

"We're still working on the pricing," Cooke notes, "but we definitely think hybrids are a win-win for us and the client. On a website listing all licensed hybrid specialists, I only saw six in the Southeast. We've had people drive three and half hours to get here.

"When I started here in 2014," he recalls, "we were doing around $525,000 a year. Then I moved up front, we started doing European stuff, and this year we're easily going to break $1 million. In those four years we've almost doubled the business, and a lot of it has to do with specializing and getting the right vehicles in that you know you can work on. That's how you get those win-win situations."

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

BUSINESS JUST GOT EASIER.

INTRODUCING FMPDELIVERS.COM

SIMPLIFIED ORDERING

FVP SPLASH ACDELCO MOTORCRAFT WIX WAGNER DORMAN

BUILDING A BETTER CUSTOMER EXPERIENCE.

In your line of business, every minute matters, which is why we've developed FMPdelivers.com. You can now order parts more quickly, take online training or chat live with an FMP customer service representative. At FMP, we do everything we can to get you the right part – right when you need it. For more information on FMPdelivers.com, visit FactoryMotorParts.com.

FACTORYMOTORPARTS™

WE SUPPLY YOUR SUCCESS.

U.S. EPA highlights refrigerant regulations

Repairers must stay informed on requirements

Recently the U.S. Environmental Protection Agency (EPA) contacted the Automotive Service Association (ASA) on the importance of vehicle repairers staying informed about federal regulations governing mobile air-conditioning refrigerants. Section 609 of the Clean Air Act (CAA) governs the most important requirements affecting technicians, shop owners and refrigerant retailers.

EPA notes three general guidelines relative to refrigerant regulations:

Refrigerant: Must be approved by EPA and cannot be intentionally released (vented) to the environment

Servicing: When payment of any kind is involved, any person working on an MVAC (Motor Vehicle Air Conditioning) system must be certified under section 609 of the CAA and use approved refrigerant handling equipment.

Reusing Refrigerant: Refrigerant must be properly recycled or reclaimed before it can be reused, even if it is being returned to the vehicle from which it was removed.

EPA determines alternative refrigerants under its Significant New Alternatives Policy (SNAP) program. SNAP lists refrigerants as either "acceptable subject to use conditions" or "unacceptable."

In November 2016, the EPA updated its refrigerant management regulations by extending the sales restriction previously imposed on R-12 to other refrigerants including R-134a and 1234yf. This went into effect on Jan. 1, 2018 and applies to refrigerant containers two pounds and larger. Refrigerant sellers are responsible for determining that the buyer either is a certified technician or employs a certified technician. Section 609 credentials have always been and continue to be required when servicing MVACs for payment or barter.

In addition, the EPA included an exception for the DIY market to purchase small cans (less than two pounds) of MVAC refrigerant with self-sealing valves.

Sellers of refrigerant must maintain records indicating the name of the purchaser, date and the quantity sold. EPA also warns that "if someone other than the tech completes the transaction, the seller must keep the documentation provided that demonstrates the buyer employs at least one certified technician. Selling refrigerant to someone who is not a certified technician or the technician's employer could result in enforcement action against the vendor."

EPA is planning to issue a proposed rule to "revisit aspects of the 2016's rule extension of the refrigerant management regulations to substitutes."

With regard to new vehicles, the EPA originally planned to end the use of R-134a refrigerant in new cars by the 2021 model year. This has recently been challenged in court under the argument about whether EPA has the regulatory authority to end the use of R-134a refrigerant in new cars. New products with a lower Global Warming Potential (GWP), such as R-1234yf, are already in use. Although federal legislation is unlikely in the 115th Congress, we are likely to see legislation considered in the 116th Congress beginning in 2019.

Ignorance is never an acceptable excuse for non-compliance with regulations. Staying abreast of federal regulations affecting the automotive industry is often tedious, confusing and never-ending. Follow industry updates by joining industry associations, attending and fully participating in industry events, and building relationships with your industry peers. The knowledge gained is critical to the vehicle repairer's success and to the industry's credibility in the marketplace.

For more detailed information about current refrigerant regulations, go to https://www.epa.gov/mvac.

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

Delphi Technologies

delphiaftermarket.com

a shift to a new look

You may have noticed. We're shifting from red to blue – saying goodbye to the red oval, and hello to a common brand for both OE and Aftermarket. With this change, you can expect the same quality parts, tools, training and support you've come to know and love. From brakes to steering, air conditioning to ignition, engine management to fuel systems — whether it's diesel, gasoline, hybrid or electric. We're still the OE experts. We're still delivering quality you can trust. But now, we are Delphi Technologies.

ADAS is not a four-letter word, despite challenges

ADVANCED DRIVER ASSIST SYSTEMS REQUIRE BETTER EDUCATION AND UNDERSTANDING

CHRIS CHESNEY // Contributing Editor

Technology is being deployed rapidly in today's vehicles; capabilities such as sonar and radar have been prevalent for years, but with the introduction of forward-facing cameras and sensor technologies, the chance you'll see one in your service bay is high. Many of you have experienced sonar warning features that prevent you from bumping into the car in front of you, or the vehicle next to you when parking. These systems have become common place. Another common technology is the adaptive cruise control systems that use forward-facing short and long-range radar to keep a safe distance between you and the vehicles in front of you.

Then came the introduction of technologies like lane departure warning, autonomous park assist, and autonomous emergency braking. These technologies are being adopted at a rapid pace led by autonomous emergency braking, or AEB, which today numbers more than 18 million worldwide. It's interesting to note that the National Highway Transportation Safety Administration (NHTSA) was poised to mandate AEB, but was approached by the OEMs with a proposal of voluntary commitment by 20 manufacturers to implement AEB on all vehicles sold in North America by September of 2022. What does this mean for you? It means in order to be service ready for your customers, you must be able to service these systems properly before they arrive at your business.

This opportunity has presented itself to us many times before in the form of ABS, Stability Control, TPMS, etc. If you recall, these systems tended to be fairly robust and didn't cause too much stress for many years, giving us a chance to learn our way through them. But in the case of ADAS systems, we have a question of when to service or calibrate that must be answered. There is no doubt we as an industry can handle this technology just like we have with others in the past, however, this time we need to be better educated going in due to the passive nature of these systems. By passive I am referring to the fact that ADAS systems, while constantly monitoring and adjusting, are not reacting in a visible or noticeable way until there is a need to do so. This means if we have not adjusted or calibrated the technologies properly, there is a chance these systems will overreact or under-react to the situation at hand. Either of these conditions could result in an accident or harm to the motorist. While liability is in play here, the OEMs have invested tremendous capital to validate the technologies and create failure modes that keep motorist safe. However, this means we need to follow the processes they have designed when servicing and calibrating ADAS systems.

In order to understand how to calibrate ADAS systems, it is best to start with the basics. In most all cases, the first step in a calibration is to locate the centerline of the vehicle; this differs by OEM. Some use fixtures attached to alignment machines; others use a plumb bob and tape measure coupled with some simple trigonometry. Remember when the teacher told you to pay attention during math class? This is why.

Now is a good time to make a statement about following OE process. It is important to follow the processes spelled out by the OEM. During many calibration or service procedures, the OEM first describes how to find the centerline of the vehicle followed by the placement of a target used to calibrate the technology; i.e. camera or radar, followed by the initiation of the calibration via the use of a scan tool. Essentially, three critical steps that must be accomplished with accuracy, however, let's take a look at what the OEM is asking us to do.

When asked to find the centerline of the vehicle it is critical to understand why: sensors are attached to the vehicle, so they need to know which way the vehicle is pointed or traveling. Most calibrations are designed to use targets placed in a precise spot relative to the center line of the vehicle. But there are a couple caveats to consider. First is how the Steering Angle Sensor (SAS) relates to the centerline. It is critical, which means if you adjust the SAS during an alignment, you may need to calibrate ADAS sensors as well. Second, the critical part of this step is to find the centerline of the vehicle. If you look at how Honda or Toyota define this process, you can quickly see that it is simple trigonometry. Toyota has you hold the string of a plumb bob on the

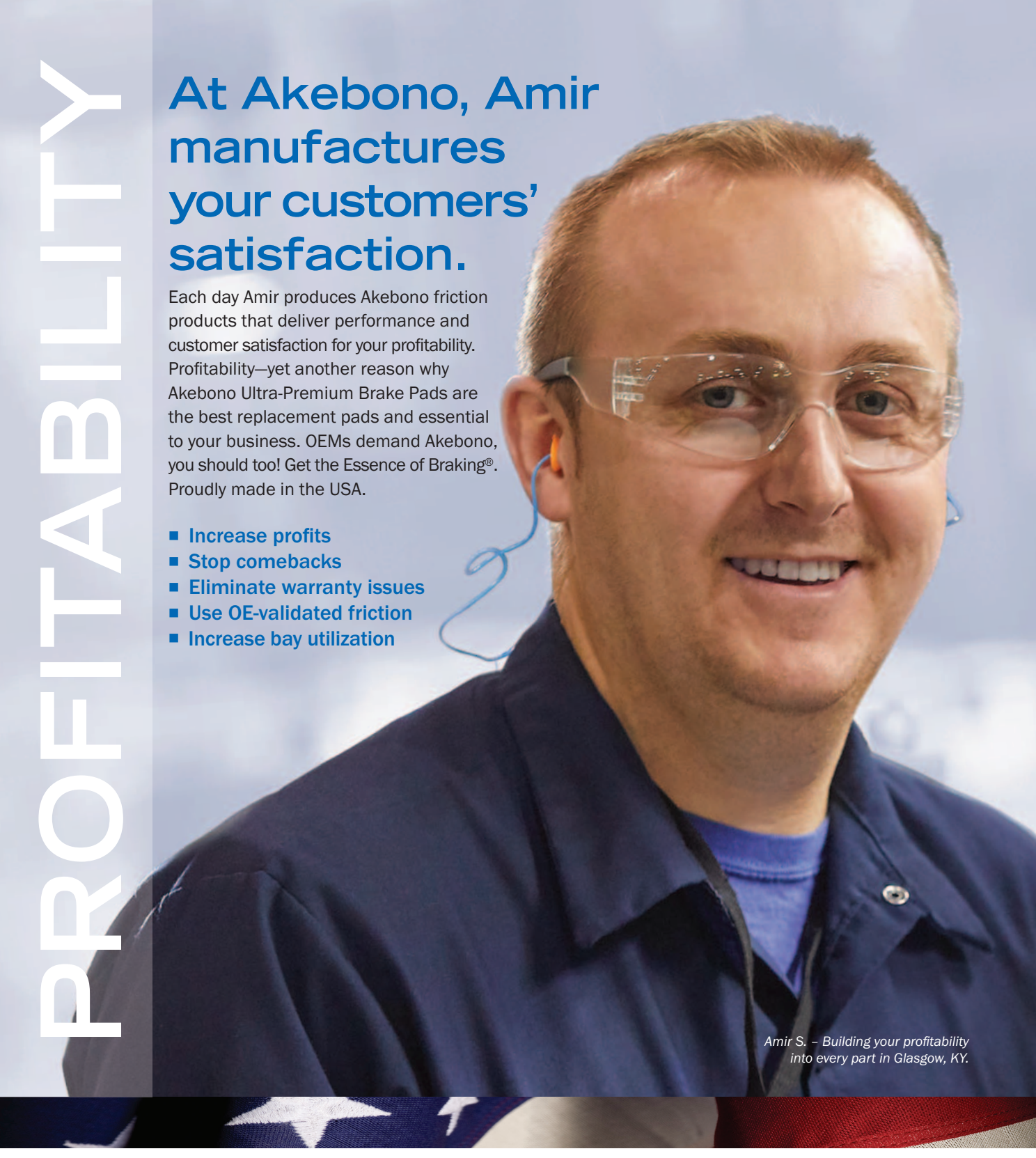
>> CONTINUES ON PAGE 40

PROFITABILITY

At Akebono, Amir manufactures your customers' satisfaction.

Each day Amir produces Akebono friction products that deliver performance and customer satisfaction for your profitability. Profitability—yet another reason why Akebono Ultra-Premium Brake Pads are the best replacement pads and essential to your business. OEMs demand Akebono, you should too! Get the Essence of Braking®. Proudly made in the USA.

- Increase profits
- Stop comebacks
- Eliminate warranty issues
- Use OE-validated friction
- Increase bay utilization



Amir S. – Building your profitability into every part in Glasgow, KY.

AKEBONO PROACT ULTRA-PREMIUM BRAKE PADS

AKEBONO EURO ULTRA-PREMIUM BRAKE PADS

AKEBONO PERFORMANCE ULTRA-PREMIUM BRAKE PADS

akebonobrakes.com

akebono BRAKE EXPERTS

FACTORY INSTALLED 350+ MODELS OEM BRAND OF CHOICE

ORIGINAL EQUIPMENT ADVANCED OEM TECHNOLOGY MANUFACTURER

MADE IN U. S. A.

COUNTDOWN TO
ATLANTA

MONTHS	WEEKS
10	03

MECHANICAL MOMENT

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

JEEP REAR HATCH OPEN WHEN SHIFTED INTO REVERSE

VEHICLE: 2014 Jeep Grand Cherokee, 4WD, 3.6L V6
MILEAGE: 38,602
PROBLEM: The power lift gate (hatch) will intermittently unlock and open when shifted into reverse.
DETAILS: First, the Tech-Assist consultant suggested using a scan tool to check the activation status in the power lift gate module to confirm if module did receive a signal (from the handle switch, interior switch or key fob). It was receiving a signal to open the lift gate from all sources.

Next, the consultant suggested checking the BCM trunk release PID data. It was switching from pressed to not pressed on its own. The next step was to unplug all the door switches. The BCM was still receiving a signal to open.
CONFIRMED REPAIR: The Tech-Assist consultant suggested opening the BCM for inspection. When he did, the tech found evidence of water intrusion and some corrosion on the circuit board. Replacing the BCM fixed this one.

This tech tip and others come from ALLDATA Tech-Assist, a diagnostics hotline of ASE-certified Master Techs. Learn more at: ALLDATA.com.

TRAINING EVENTS

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

OCTOBER 19-21
Management Success West
Sheraton Fairplex Hotel & Conference Center
Pomona, California

OCTOBER 28-29
National Alternative Fuel Training Consortium (NAFTC)
The Venetian Hotel
Las Vegas, Nevada

OCTOBER 30-NOVEMBER 1
AAPEX 2018
Sands Expo
Las Vegas, Nevada

OCTOBER 31-NOVEMBER 3
Automatic Transmission Rebuilders Association (ATRA)
Bally's Hotel & Casino
Las Vegas, Nevada

FEBRUARY 21-23
MACS 2019 Training Event & Trade Show
Anaheim Marriott
Anaheim, California

MARCH 30
TST 16th Annual Big Event
Westchester Marriott
Tarrytown, New York

YOUR SKILL. OUR PARTS.

MOOG® Hub Assemblies

- Roll Form Design ensures consistent and optimal preload
- Innovative, application-specific enhancements
- Increased load capacity for better durability
- Precision matched components deliver superior performance

Our commitment to quality parts is a promise we take seriously. With North America's broadest import and domestic parts availability, we have the parts you need that meet or exceed OE specifications.

Learn more at **AdvancePro.com**

MOOG CARQUEST BRAKES MONROE SHOCKS & STRUTS BWD | Advance Professional

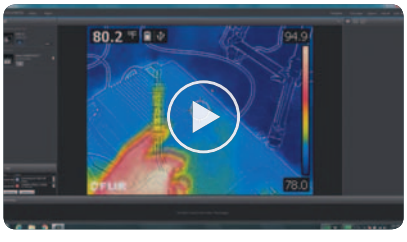
WATCH + LEARN

How to read a wiring diagram

MOTORAGE.COM/Diagram

How to keep young techs in the industry

MOTORAGE.COM/RetainTechs



Testing the heater circuit of an oxygen sensor

MOTORAGE.COM/Oxygen

Shop owner says he has best job in the world

MOTORAGE.COM/BestJob

>> CONTINUES FROM PAGE 36

center of the Toyota emblem on the hood or trunk to find the center of the front or rear, then snapping a chalk line between the two establishes the centerline. This is followed by measuring a prescribed distance from the front plumb bob point to find two center points where you use a string of a prescribed distance and a marker to scribe an arc. Where the two arcs intersect on either side of the centerline is the point you will place a target. There are several aftermarket target solutions that use lasers, tape measures and fixtures to do the same. Is one better than the other? No, as long as the result is placing the target in the proper position relative to the centerline of the vehicle.

Next you need targets; the OEM prescribes a specific target of a particular size, shape and pattern to be placed in the spot described above. The challenge is to find these targets; if you try to buy them from the OEM, there is a challenge in availability. Many manufacturers simply don't have them in stock. Or, the OEM provides them in their technical information system with printing instructions. This comes with a word of warning: READ THE PRINTING INSTRUCTIONS!! You can search YouTube for examples of someone not reading the instructions, placing the printed target in the wrong location and still getting the controller to accept the calibration. There are several aftermarket target solutions on the market that are exact replicas of the OEM target. They are robust and come with the fixtures needed to place them in the proper position. Some argue that you must use an OE target to be successful. The vehicle controller doesn't care as long is it is a target that is the same size, shape and pattern and it's placed in the proper position.

Finally, you will need to initiate the calibration. This is often accomplished by reading information displayed on the dash. Factory service information or the equivalent is a good source of this technique. However most require or can use a scan tool. It is critical to understand that the scan tool does not do the calibration of the sensor or technology; it is simply the messenger of the request you are sending to the onboard controller. This means that an aftermarket scan tool that implemented the requests it acquired from the OEM via either ETI or the OEM directly will work successfully. Of course, there are scan tools that won't implement properly, and the result will be no calibration.

At the end of the day, there are some unknowns regarding aftermarket tools and targets when calibrating ADAS technologies. The aftermarket needs to do a better job of providing information that gives shop owners and technicians confidence in the products, and the OEMs need to consider those situations where aftermarket tools, if implemented properly, will result in an accurate calibration by way of adding "or equivalent" to their position statements. Process is king, and as long as you find the centerline of the vehicle, place the target that is the right size, shape and pattern in the proper position and initiate the calibration properly, the system will operate as designed. After all, we currently install aftermarket brake pads and ABS accumulators, Steering Angle Sensors, and program immobilizer controllers and engine controllers using aftermarket scan tools. If we keep the fundamentals of the technologies in focus, we'll all be successful. MM

CHRIS CHESNEY is the Senior Director of Customer Training for Carquest Technical Institute (CTI) and Advance Professional.

chris.chesney@carquest.com

3C Intelligent Induction Cleaner™

Patent Pending

Heavy Carbon GUARANTEED Deposits Removed

1.6L Turbo Mini Cooper at 83,000 miles (cleaned in just 17 minutes)

For more images and videos visit: *atschemicals.com*

The tune-up for the modern GDI engine

GDI engines should be cleaned every 30,000 miles as routine maintenance.

- "At Independent Vehicle Service we have used all of the industry's big name induction cleaning chemicals over the years, however all of these chemicals have fallen short of our expectation. They just don't work. The 3C is the first carbon removal system that I have used that works well and I can confidently recommend to our customers."

  David Lang ASE certified Master Technician, with L1, L2, L3, 2017 Bosch ASE Master Mechanic of the year.

- "We had previously been performing walnut blasting to clean carbon buildup. Some walnut blasting operations were taking us as long as 9 hours, but with the ATS induction machine (in most cases) you are done in less than half an hour, with equally good results. I highly recommend the 3C Intelligent Induction Cleaner. It works just as advertised. This is just another way to save your customer money while making your shop more efficient and profitable."

  Andreas Wittler Owner Hans Wittler's Automotive

- "We have used most major brands carbon cleaning chemicals with disappointing results. The 3C induction cleaning machine is the first cleaning process I have used that actually works. I highly recommend this system."

  Eric Hartley European Motor Cars

ATS AUTOMOTIVE Test Solutions

automotivetestsolutions.com **800.572.6112**

Available at WORLDPAC Wholesale Distributor of Original Equipment Automotive Parts · CARQUEST · NAPA AUTO PARTS · Precision Tec Diagnostics COMPLETE DIAGNOSTIC & TRAINING SOLUTIONS

SCOPING OUT THE CAUSES OF NVH

DO YOU RELY ON A "SEAT-OF-THE-PANTS" APPROACH WHEN TROUBLESHOOTING NOISE, VIBRATION AND HARSHNESS (NVH) COMPLAINTS? TRY USING YOUR SCOPE INSTEAD!

ALBIN MOORE // Contributing Editor

The world of NVH (noise, vibration, harshness) diagnostics can be rather interesting. Over the years, many different pieces of equipment have been used to point the technician in the right direction when tackling noise and vibration complaints.

Before I go too far on the subject, we need to understand the causes of NVH that cause our customers to bring their vehicles in for diagnosis. When it comes to a vibration, the only difference between the slamming of a door (which creates a noise and a vibration in the vehicle) and a vibration that will make the dashboard rattle, is the frequency of the vibration and the amplitude (harshness) of the vibration. Keeping these two things in mind can make finding the problem a lot easier.

Applying technology to NVH

Over the years, I have used several different types of tooling to find the causes of NVH — reed tachometers, the Chassis Ear®, stethoscopes and the Pico NVH kit, for example. Each of these tools has their place and should be used as the need arises. NVH problem analysis starts out much as any other problem analysis by gathering a lot of information over a wide area. This might start with a test drive and listening and observing the operation of the vehicle while it is being driven around corners, over bumps and on smooth roads, all while trying to duplicate the concerns of the customers. We can call this "getting a direction" so the vibration or noise can then be pinpointed with other tooling or testing.

I think most all of us have had our fair share of wheel bearings that would talk as the vehicle is driven. Many times it is easy to use a stethoscope or even grab hold of the coil spring and turn the wheel to both hear and feel the vibration that is caused by the rough wheel bearing. But what about a wheel bearing on a vehicle with torsion bar or leaf spring suspension?

THE VEHICLE IS POWERED WITH THE 2.4L 4 CYLINDER ENGINE. This vehicle is equipped with an automatic transmission with 4-wheel drive powertrain. The odometer shows 61,000 miles.

ALBIN MOORE USING HIS HANDS and a stethoscope to find a rough wheel bearing.

This adds to the difficulty of finding the problem. There is no one simple way to accomplish the task.

When it comes to vibrations in the drivetrain (engine, transmission, driveline and differential), these vibrations can all be synchronized with engine RPM or tire RPM. It all boils down to the frequency of the vibration.

Over the years, I have had vibrations that gave me a run for my money. I remember one on a Mercedes-Benz E320 that

PHOTOS: ALBIN MOORE

COME SEE US AT SEMA SHOW

October 30 - November 2, 2018

Westgate Booth #16415 & Silver Lot 1 Booth #61007

BendPak

QUICKJACK™

AUTOSTACKER™

COOL BOSS™

GRANDPRIX™

DON'T MISS OUT ON TRADE SHOW DEALS!

www.quickjack.com/SEMA2018

QUICKJACK™

NO SUCH THING AS "TOO TALL"

XPR-10AXLS

Model shown XPR-10XLS

MRP $3,860

*FREE SHIPPING

Super-Tall Rise

BP 5-2-1 YEAR WARRANTY

For technicians challenged to work under a lift all day, common injuries stem from poor working posture and improperly fitted equipment. BendPak's **NEW 10,000-lb. capacity XPR-10AXLS** and **XPR-10XLS** two-post lifts feature over **80 inches of lifting height** to absolutely tower above other lifts. Make all jobs easier and support the long-term health of taller techs. Plus, get the best warranty and after-sale support that only comes with BendPak.

1-800-253-2363 ▪ bendpak.com

*Free shipping on BendPak products to the 48 contiguous states.

BP BendPak®

It's the QUALITY you demand
ADVANCED TECHNOLOGY guaranteed to last

High Alumina Ceramic Insulator, Uniquely Formulated for Spark Plug Application

Nickel-Plated Shell

Excellent Durability

Iridium Enhanced Finewire Center Electrode

More Focused Ignition for Better Overall Ignitability*

Iridium Enhanced Platinum Alloy Pad

Proprietary, Platinum Sidewire Technology

THE SMART CHOICE FOR EVERY MODEL.

Autolite's Iridium XP Spark Plug is the most recent example of our commitment to quality and innovation. Balancing a tested blend of iridium, platinum and tungsten, Autolite's Iridium XP plugs precisely focus spark energy at the optimum ignition point to deliver the high power, long life and exceptional value demanded by vehicle owners. Revolutionary technology from the trusted industry leader.

*Compared to 0.8mm finewire, multi-electrode design and standard plugs

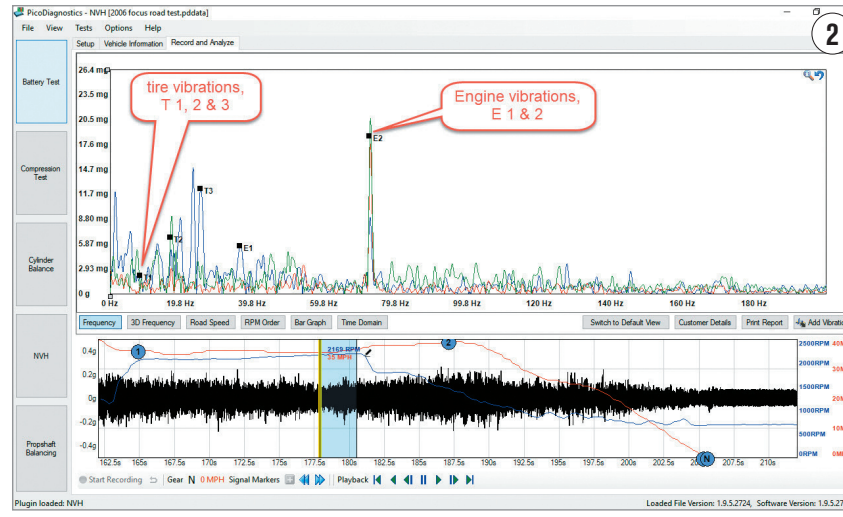
Check out the Iridium XP plug at **autolite.com**

Autolite® SPARK PLUGS

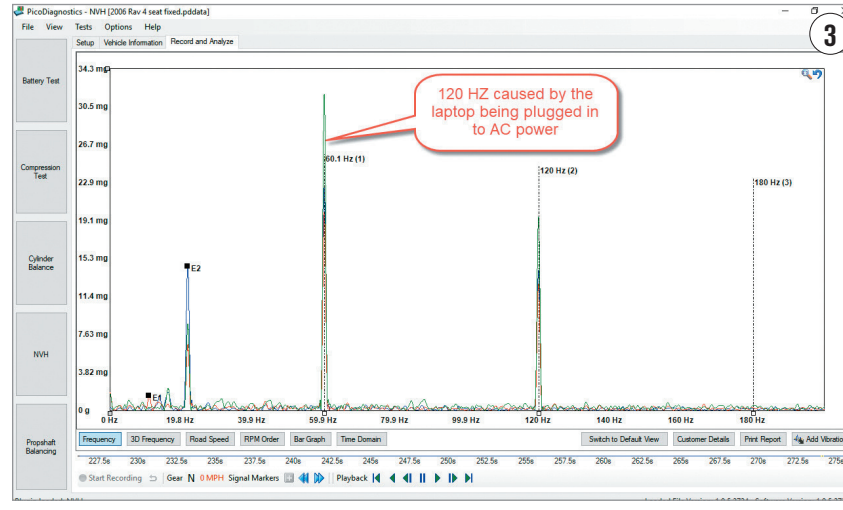
came in for a rear wheel bearing noise. I found the problem with the right engine mount. The mount had deteriorated, which let the engine lean over to the right, which let the exhaust pipe bump on the frame, which then transferred the noise down to the right rear wheel bearing. Stopping the wheel would make the noise go away. Vibrations can be transmitted throughout the vehicle easily, which can make the problem of finding the root cause of the NVH hard at times.

For those of us who have done NVH work for a while, I think I can safely say, "There is no one part that vibrates the same way or makes the same noise when it fails." Take for instance a wheel bearing; I have heard them squeak, growl, moan or not even make a noise when they fail. Having a tool to give a good direction to NVH is indeed a cool tool to have.

The tool I am currently using is the Pico NVH tool, which uses either one or two accelerometers that are hooked to interface boxes, which are then hooked to a Pico 4-channel labscope. The tool also needs to have an RPM signal, either from data from the vehicle Diagnostic Link Connector (DLC) or from a digital RPM pickup from the engine crankshaft. By far, the easiest is to use either the Pico cable that is designed for this purpose or you can also use a J2534 box to hook between your laptop and the vehicle DLC. By hooking to the DLC, you not only get RPM data, but you also get vehicle speed data. Both pieces of data can be very helpful when it comes to pinpointing vibrations.



DATA CAPTURE FROM A KNOWN GOOD VEHICLE. Before you use a labscope to analyze a problem, you need to use it on a known good car. That way, you know what is good and can find the bad waveforms easily.



SCOPE CAPTURE OF A GHOST VIBRATION. Notice the frequency of the vibration is 60 HZ? This problem is caused by the laptop being plugged in. If perchance the vehicle did have a 60 HZ vibration, it would change with either engine speed or vehicle speed. Learn what is good — then you know what is not good.

The basics of vehicle vibrations

A few basics on the tool can be seen in Figure 2. Listed on the scope screen are plots T1, T2 and T3. These are vibrations caused by the tires. T1 is a first-order vibration from a tire (one occurring every rotation of the tire, such as an out-of-round tire). T2 (second order) and T3 (third order) vibrations are a vibration that is two or three times the speed of the tire. Changing the vehicle speed will cause these vibrations to come and go. By using these variations, you can pinpoint issues with tire balance and out-of-round tires or anything that could be related, such as an out-of-balance brake drum.

To the right of T1, T2 and T3 is E1 and E2. These are engine vibrations. Since this is a front-wheel drive vehicle (Ford Focus), there are no driveline vibrations listed. The E1 and E2 (first order and second order engine vibration) vibrations are normal for a four-cylinder engine. However, be sure to pay attention to the amplitude of the vibrations.

The E2 vibration on a 4-cylinder is a vibration two times engine RPM, which is the frequency of the firing events of the pistons. A 6-cylinder engine would show an E3 vibration, and a V8 engine would show an E4 vibration, so pay close attention to the amplitude of those vibrations.

BOSCH
Invented for life

AVAILABLE NOW

Go-to diagnostic tools

The best scan tools for the vehicles you repair

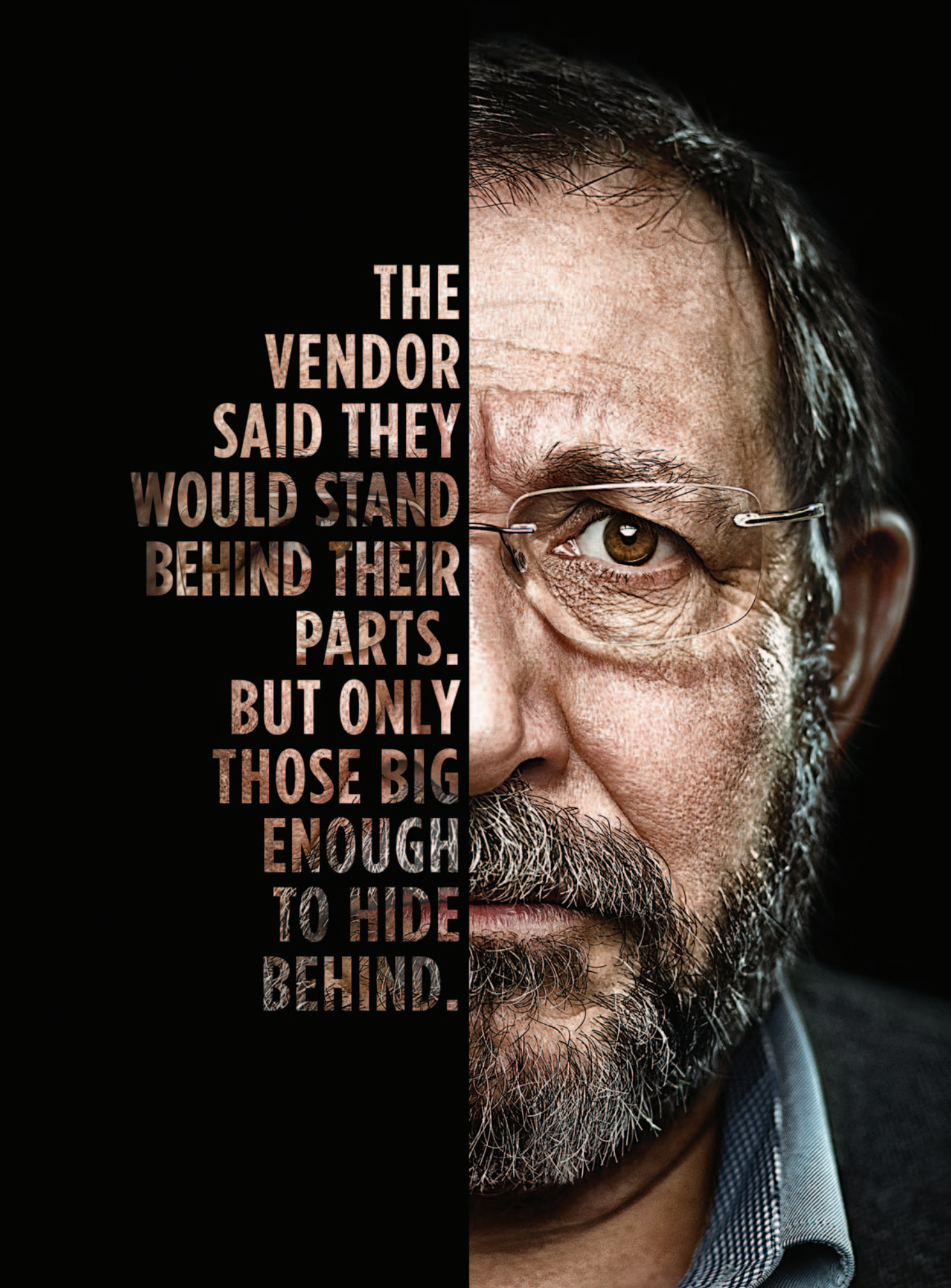
Ask your tool dealer

ADS325 ADS625

Introducing the new Bosch ADS 325 and ADS 625 professional diagnostic tools

- The only diagnostic tools made for technicians, by technicians, ensuring the coverage you need most with best ease of use and all 10 modes of global OBD II
- Module and system coverage including ABS, Airbag, traction control, HVAC, instrument cluster, security and more
- On-tool and online repair information: confirmed fixes, key reprogramming, technical service bulletins and maintenance procedures including brake, battery, TPMS, tune-up specs, component locations
- Easy to use and consistent across all vehicles
- Thousands of bidirectional tests and data PIDS from vehicle modules including steering angle resets, idle air volume, throttle body relearn and more
- The ADS series is compatible with borescopes, battery testers, NVH analyzers and more to enhance your diagnostic ability as you need

Ask your tool dealer about Bosch Diagnostics or visit boschdiagnostics.com


THE VENDOR SAID THEY WOULD STAND BEHIND THEIR PARTS. BUT ONLY THOSE BIG ENOUGH TO HIDE BEHIND.

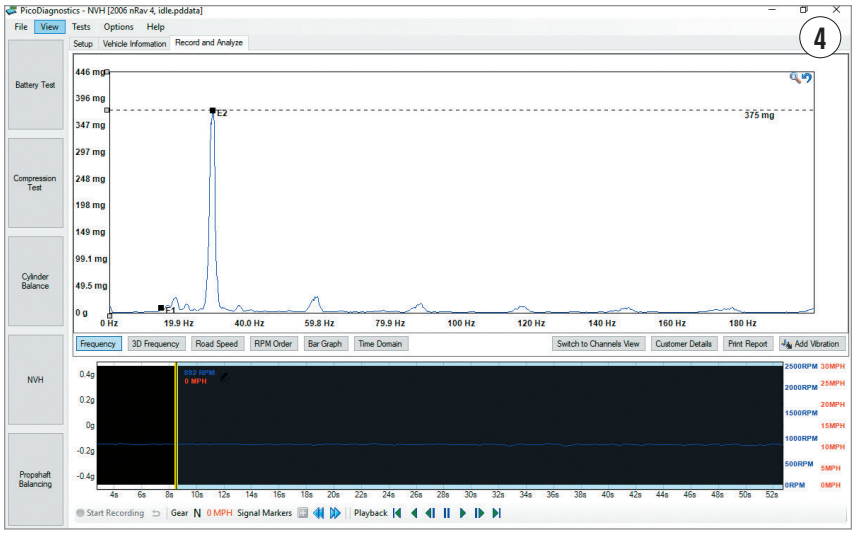
OMNICRAFT™ GETS IT. FORD BACKS IT.

Premium Omnicraft parts come with a limited warranty* that includes labor and has no commercial exceptions. Trust Omnicraft for your non-Ford vehicle repairs.
OmnicraftAutoParts.com

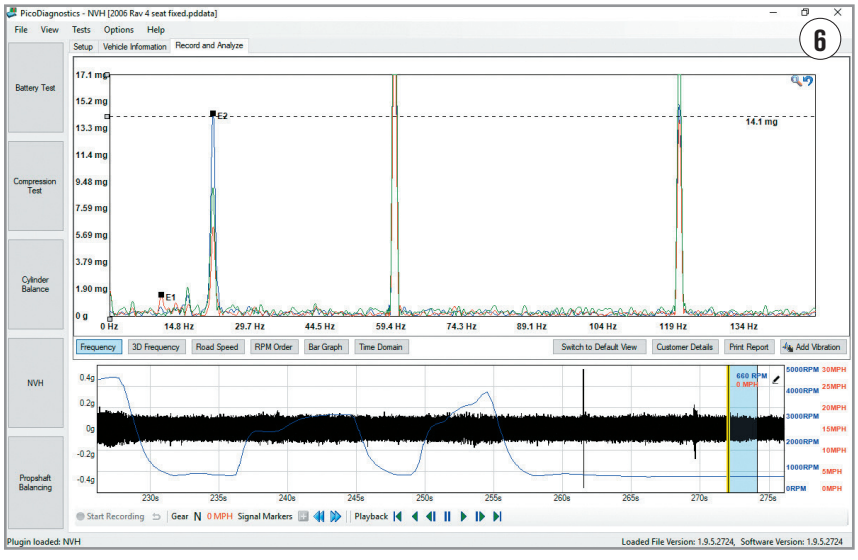
Omnicraft™

Backed by Ford Motor Company

*Limited labor costs. See seller for limited-warranty details. Omnicraft™ is a trademark of Ford Motor Company.



TOYOTA RAV 4 IDLING. This vibration is so harsh that it makes the dashboard rattle.



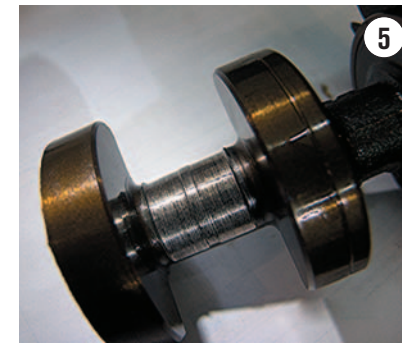
WAVEFORM OF THE ENGINE FIXED. The engine runs smooth, and no vibrations can be felt in either the steering wheel, or any place in the passenger compartment.

Most vehicles will not exhibit a vibration that can be felt in the steering wheel.

Before we leave the basics of the waveforms, I want to speak to the problem of ghost vibrations in the waveforms. Figure 3 is a classic example. Notice the vibration of 60 Hz and 120 Hz. These seeming vibrations in the waveform will not change with engine speed. The cause of the waveform is that the laptop charger is plugged in and the screen is displaying the frequency of the A/C current that the laptop is running on. The fix is to just unplug the laptop and run it on battery. Here again, learn what is good in a waveform.

The problem vehicle of the day

The vehicle is a 2006 Toyota Rav4. It has been in my shop a few times for some maintenance. The first time it was in, I noticed an engine vibration when I backed the vehicle out of the shop. The vehicle owner wasn't much concerned and the vibration had been there for quite some time. Two months later,



WORN BALANCE SHAFT JOURNAL

the vehicle was back with a complaint of "the engine sounds like a chainsaw when it idles." When I started the engine, sure enough, it sounded a lot like a chainsaw, and the vibration I had noticed before was even worse.

My first step in this vibration analysis was to hook up my NVH tool to see if I could get a quick direction. Since this was an engine vibration at idle, there was no need to drive the vehicle. All the diagnostic work was done in the shop bay. I start all my NVH diagnostic routines by sticking the accelerometer to the inside driver's seat rail. With the engine idling, I captured the waveform found in Figure 4; it shows an E2 vibration of 375 MG (Milli-G), which is a measurement of acceleration. This vibration is strong enough to be felt in the steering wheel and to make things rattle in the dash. If you compare this vibration of 375 MG to the 20 MG vibration found in Figure 2, you can get the vibration into perspective. The Ford Focus engine is not all that smooth at idle.

The vibration in the Rav 4, along with the noise from the engine, is not normal at all. One of the benefits of using the NVH waveforms on a problem like this is to get a direction and a possible pointer on the next place to go and test. It is easier to spend a few minutes looking at a waveform than it is to start taking an engine or transmission apart in hopes that you will find the problem.

Since this is an E2 vibration, what

could be the cause? It is normal for a 4-cylinder to have an E2 vibration since this fits the frequency of the combustion events, but this vibration is a little strong. In fact, it's more than a little strong — it is very strong.

Clues to the problem surface

So far I have two clues to the problem: the E2 vibration and the noise. Using a stethoscope on the engine, the noise is loudest down in the lower part of the center of the engine and in the center of the engine oil pan. Knowing this, we can rule out anything related to a crankshaft vibration or a piece of piston being broken off causing a vibration from one light piston. It narrows the problem down to something rotating two times for every crankshaft rotation. From my experience with 4-cylinder engines, many of them have a balance shaft that sits under the crankshaft. These balance shafts turn either two or three times the speed of the crankshaft. By removing the engine oil pan, the balance shafts can be accessed for inspection.

With the engine oil pan removed and the lower balance shaft housing removed, the balance shafts will drop out without any problems. With the first balance shaft out, I found the bearings on one of the balance shafts were badly worn as you can see in Figure 5. This badly worn bearing was causing both the noise and the bad vibration in the vehicle.

The repair needed was a set of new balance shafts and new bearings. With the new parts installed, the "after-the-repair" test shown in Figure 6 confirmed the problem was fixed.

By using the NVH tool, service information and experience, I was able to know where the problem was located before I started taking the engine apart. The time spent finding out where the problem was before surgery started on the engine was a great investment, which made finding the problem quick and easy.

Many times the real truth about the problem comes out after the problem is fixed. I was told by the vehicle owner that this vibration problem was present after the vehicle had been taken in for warranty repairs for oil consumption. The engine had gotten a set of new pistons and when the vehicle was picked up after the repairs, the vibration was present. When I took the engine apart, I found the balance shafts were not in proper time with the crankshaft. This built-in vibration had taken its toll over time on the balance shaft bearings.

ALBIN MOORE spent 21 years in logging before opening a shop in 1992 that specializes in drivability problem analysis. He is an ASE CMAT L1 technician with 40 years of analyzing and fixing mechanical and electrical issues.
bwrench@yahoo.com

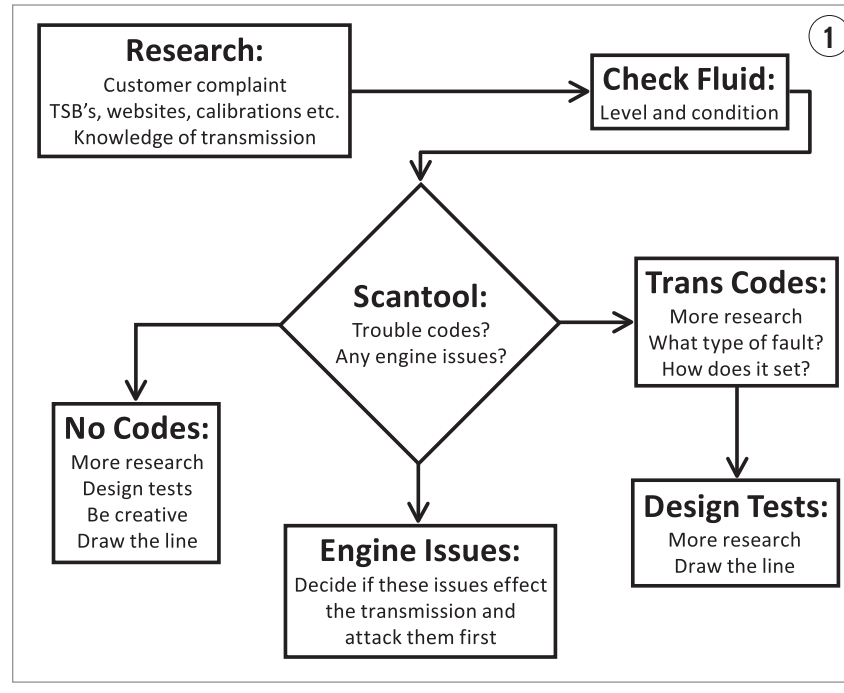
TRANSMISSION DIAGNOSTICS FOR NON-TRANS TECHS

SOLVE MORE TRANSMISSION CONCERNS IN-HOUSE WITH THESE DIAGNOSTIC TIPS

SCOTT SHOTTON // Contributing Editor

Years ago, while I was working for a particular shop, we used to view Volkswagens like vampires. We would hold our hands up and use our index fingers to make a cross to repel the evil beings and send them down the road to another shop. After a while I attended some training, purchased a very reasonably priced scan tool that works well on VW/Audi products and dove in. Persistence led me to realize "these are just cars after all!" My point here is you have to have the right attitude. Once we decide to get over the fear of the unknown and start working towards a goal, we usually attain said goal. Now the shop still works on VWs and Audis to this day. There's no need to push those cars out the door.

Transmission diagnostics are no different. I realize that transmission rebuilding is a specialty by itself and many shops do not perform these tasks in-house. However, with the proliferation of computer-controlled transmissions over the last three decades, there is no reason a competent drivability diagnostic technician can't apply his or her skills to transmission diagnosis.



A BASIC FLOWCHART to lead you down a logical transmission diagnostic path.

Don't ship the car to the transmission shop right off the bat. Pull up your boot straps, adjust your attitude and give it a shot. You might be surprised how many transmission issues can be resolved without a major transmission overhaul.

Draw a line

The basic theory is to "draw a line" between an electrical issue and a hydraulic/mechanical issue. If the failure ends up being electrical (wiring, a solenoid or a module, for example), then the repair can usually be performed in-house. If all of the electrical components test good, then a hydraulic/mechanical issue would be the cause of the transmission issue. At this point, your individual shop can decide whether the problem will be dealt with in-

PHOTOS: SCOTT SHOTTON

THE POWER IS YOURS

Elite™ Series BY BendPak

MSRP $3,010

VMX-10120V-603
10 HP / 35 CFM

MSRP $2,425

VMX-7580V-601
7.5 HP / 26 CFM

MSRP $2,095

TS-580V-601
5 HP / 17 CFM

BP 5-2-1 YEAR WARRANTY

- ☑ Unquestionably quiet
- ☑ Rugged cast-iron pump
- ☑ ASME Certified tank
- ☑ Forced air aftercooler
- ☑ Reliable disc valves

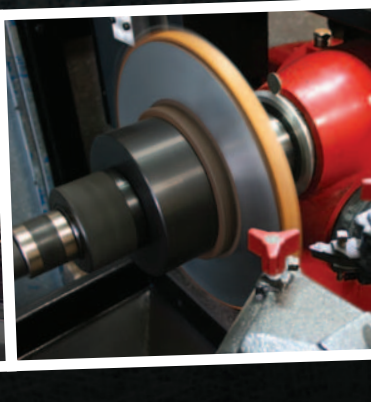
BendPak® eliminates one-size-fits-all air power with **three incredible compressors**. Single and three-phase Elite™ Series models are available in 5, 7.5 or 10 HP and 80 or 120 gallon tanks. Each compressor features very little running time and houses an oversized, UL Approved motor that provides **True Horsepower**. No exaggerations. The ASME Certified air tank is sure to keep up with your demands, while 100% cast iron pump blocks feature truly massive pistons for **extremely quiet**, low-RPM operation. This exclusive design extends each unit's lifespan far beyond that of other compressors. Only BendPak offers this much **choice** with this much glorious, quiet-running **power**.

1-800-253-2363 ▪ www.bendpak.com

BP BendPak®

WHEEL SERVICE DONE RIGHT

When you want the job done right, choose Ranger. Advanced engineering, breakthrough technology and the highest standards deliver shop-tested performance you can depend on. That's why we have the confidence to offer a full 24-month parts warranty along with 12 months of on-site labor and free shipping. That's better than **any** warranty offered by **any** of our rivals. Choose Ranger and enjoy industry-leading performance backed by an assurance warranty that is clear, easy to understand and comes with the best support possible for your business. Call **1-800-253-2363** or visit **bendpak.com/wheel-service.**



1-800-253-2363 • bendpak.com/wheel-service

Ranger

house, a remanufactured unit will be installed or the vehicle will be sent to a transmission shop for a rebuild.

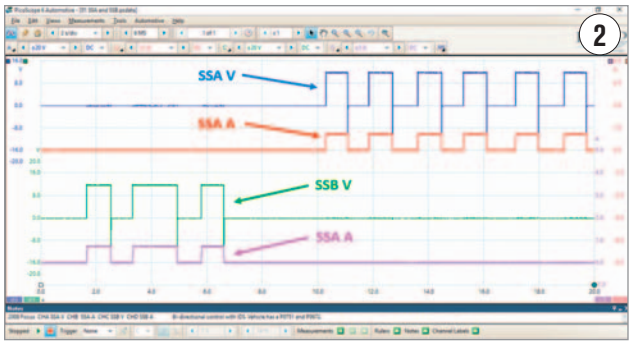
As with any diagnosis, a basic knowledge of the system and logical procedure should be followed to avoid going down the proverbial rabbit hole. Figure 1 is a rough flowchart that should lead you down the correct path on most applications. The first step is to do a little research on the basics of how the transmission works, paying attention specifically to areas related to the particular transmission complaint. Technical Service Bulletins (TSBs), reflashes, solenoid apply charts and code setting criteria are some of the areas to focus on here. Second, the fluid level should be checked. Feel free to mix up steps 1 and 2. Step 3, if it hasn't been done already, is to connect a scan tool and gather codes and any other pertinent data. From there, we need to make a decision on where to go next.

Engine issues must be resolved first. If the engine is not operating correctly it needs to be fixed before we can move forward. Remember, engine operation can impact transmission operation; rarely does transmission operation impact the operation of the engine. Once we have covered the initial steps, our path will depend on what data we have obtained to this point. Sometimes, our task may be as simple as scoping the operation of a shift solenoid, while other times we may need to be more creative with our testing techniques.

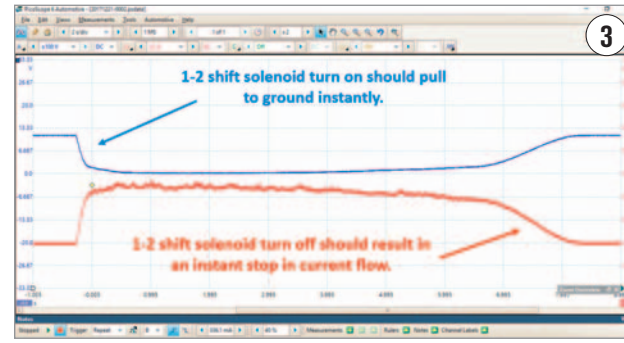
Putting the plan into action

Let's explore a few broken cars to illustrate the process. The first car will be a 2008 Ford Focus. It has already had its transmission rebuilt, and an aftermarket remanufactured valve body has been installed to attempt to resolve an MIL illumination and shifting issue. The PCM has stored DTCs P0751 – SSA Performance or Stuck Off and P0972 – SSA Control Circuit Range/Performance. During the research phase, it is determined that neither of these codes are set by a circuit fault for SSA (Shift Solenoid A). They have been set due to a performance issue with the shift associated with SSA. It can also be noted that there are no engine-related DTCs and the engine is operating correctly.

Research found a TSB that discussed the possibility of a worn servo rod bore that can be repaired by installing a bushing to correct the bore wear and subsequent fluid pressure loss. Could this bushing have been missed during the transmission rebuild? Our task now will be to determine if SSA is performing correctly using the same



A SCOPE CAPTURE is taken while exercising two shift solenoids to compare a known good to a questionable one. It's exactly the same as fuel injectors.



THE SOLENOID DRIVER in the PCM is not turning on and off quickly enough.

testing we apply to fuel injectors. After all, shift solenoids and fuel injectors are both just solenoids, correct?

The shift solenoid resistance is obtained from service information and, in this case, SSA and SSB should both be between 10.9 and 26.2 ohms. We will scope both SSA and SSB so we can compare a known good solenoid (SSB) to our suspect solenoid (SSA.) The wiring diagrams are consulted and it is determined that both solenoids are power-side switched. The easiest place to access the wiring is right at the PCM, which is located next to the battery, so our connections will be made there. Figure 2 shows the scope capture obtained while cycling the solenoids on and off with the Ford IDS scan tool. SSB was cycled on and off first to establish a baseline followed by the cycling of SSA. The scope connections are Channel A (Blue) is connected to SSA voltage on the switched side, Channel B (Red) is a current probe measuring the amperage through SSA, Channel C (Green) is connected to SSB voltage on the switched side and Channel D (Purple) is a current probe measuring the amperage through SSB.

Almost everything in this capture mirrors one taken of a fuel injector. The main difference is the voltage captures appear to be upside down. This is because the shift solenoids in this application are not ground-side switched like most fuel injectors; they are controlled by switching power on and off. Regardless of this difference, both solenoid drivers in the PCM can be seen switching on and off cleanly. We can also see that both shift solenoids are building magnetic fields because they both have inductive kicks when the PCM driver shuts off. Both solenoid current captures show about a 750 milliamp current draw, which by using basic Ohms law confirms that both solenoids are in an acceptable resistance range. An extra bonus without doing any serious analysis — both the good SSB and the suspect SSA look exactly the same.

At this point it is fair to say that electrically (wiring, solenoid and PCM), everything seems to be functioning correctly. Additionally, very light "clicks" can be heard coming from the transmission while performing this test, which confirms the solenoids are mechanically moving. Actually, the Ford diagnostic chart suggests jumping power and ground to the transmission connector and listening for a click. We used the scan tool but the same result was obtained. Can we now "Draw the Line?" There has to be an internal hydraulic/mechanical issue causing the MIL illumination and shifting issue. Time to send it back to the transmission shop to see what they may have overlooked.

AUTEL MAXISYS

WORK SMARTER NOT HARDER

DIAGNOSTIC INTELLIGENCE

NEW

POWERFUL HARDWARE

- 1.3GHZ + 1.7GHZ Hexacore Processor
- 64G SSD Memory/32G Micro SD Card
- 8M Camera / 2 USB Ports

NEW

SMARTER SOFTWARE

4.4.2

- Bi-Directional with Advanced Coding
- Data PIDs from Vehicle Modules
- Advanced Service/Reset Diesel Emissions
- Key Programming/ADAS Identification

MAXIFIX & MAXICLOUD

Database of Repairs, Diagnostic Tips & Procedures

DATA LOGGING

Live Troubleshooting with Autel Tech Support Team

Compatible with the MP408 Oscilloscope & MaxiVideo Digital Inspection Scopes

MS908S

MS908SP

PRE-SCAN & POST-SCAN
COLLISION REPAIR READY SOFTWARE PACKAGE

PURCHASE INCLUDES:

- Tablet Tool
- Complete Connector Kit
- Durable Carry Case
- 1-Year Software Updates
- 1-Year Warranty

WATCH NOW
AUTEL.COM
MAXITPMS.COM

AUTEL TRAINING ACADEMY

YouTube TRAINING VIDEOS

HOW-TO-USE
@AutelTools

AUTEL TECH SUPPORT INDUSTRY LEADER (855) 288-3587
maxitpms.com

AUTEL LIVE CHAT TECH SUPPORT
autel.com
Register and update tools for latest coverage

Follow Us @AutelTools

AUTEL®

Testing a GMC and a Nissan

Our second vehicle, a 2012 GMC Canyon, is a perfect example of how the injector scoping techniques we are familiar with apply to transmission shift solenoids. The shop involved followed a diagnostic chart that had them use a test light to check and see if the solenoid control in the PCM was functioning. When the solenoid was commanded on, the test lamp illuminated. The solenoid was then replaced and the late shift issue still existed. Scoping the solenoid operation revealed the real cause of the issue. Figure 3 shows the 1-2 shift solenoid voltage on channel A (Blue) and the 1-2 shift solenoid current on Channel B (Red.)

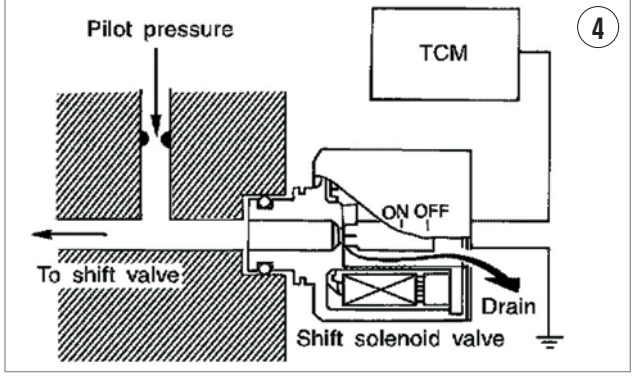
The scope capture shows that the shift solenoid driver in the PCM is taking a long time to pull the control wire to ground, causing a slow/late solenoid opening. The PCM driver is also taking a long time to turn off, causing another slow solenoid switching event. In addition, the slow current release is not allowing the magnetic field in the solenoid to collapse quickly and is the reason there is no inductive kick in the voltage capture. It should be noted that this "slow" solenoid driver would have illuminated a test lamp and led to an inaccurate diagnosis. Time to draw the line. A new PCM was installed, programmed and the shifting issue was resolved.

The third vehicle we will explore is a 2004 Nissan Maxima that has had the transmission rebuilt and now has a late 1-2 shift much like our previous example. The shop contacted me to perform a TCM initialization, which should be done after a major repair. The initialization completed and the late shift remained. Next, the shop asked me to perform a TCM update. The calibration in the TCM was outdated, so I programmed the TCM with the latest calibration from Nissan. Again, the late shift complaint remained. The next step is to continue our flowchart (Figure 1.)

Since our first few steps have been completed and no DTCs are present, it is time to be creative. Research on this particular transmission, using the solenoid apply chart (Figure 4), confirms that shift solenoid A switches from ON to OFF in order to obtain our questionable 1-2 shift. When shift solenoid A turns OFF, it vents pilot pressure and allows a shift valve in the valve body to move, which actually accomplishes the shift.

The task now is to determine if the solenoid is operating correctly or if there is a hydraulic issue in the valve body. Scoping the solenoid while commanding it ON and OFF will be the first step and is easily obtained because the TCM is located in the passenger's side kick panel. The wiring diagram confirms that the solenoid is power side switched, so our voltage capture will appear upside down just like the capture from the Focus (Fig ure 2.)

Shift solenoid valve	Gear position				
	D1 , 21 , 11	D2 , 22 , 12	D3	D4 (O/D)	N-P
A	ON (Closed)	OFF (Open)	OFF (Open)	ON (Closed)	ON (Closed)
B	ON (Closed)	ON (Closed)	OFF (Open)	OFF (Open)	ON (Closed)



A 2004 NISSAN MAXIMA solenoid apply chart and a visual of the solenoid valve.

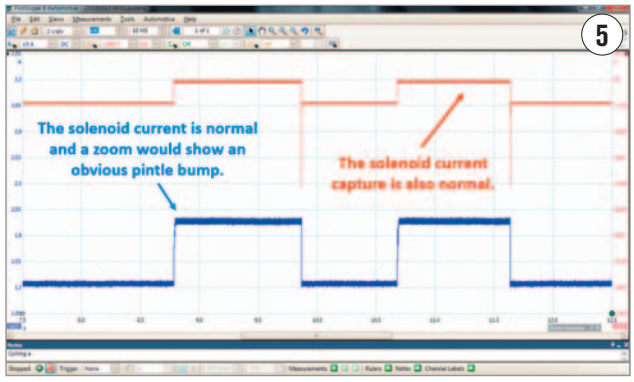
DEALING WITH TRANSMISSION CONCERNS

PETE MEIER // Technical Editor

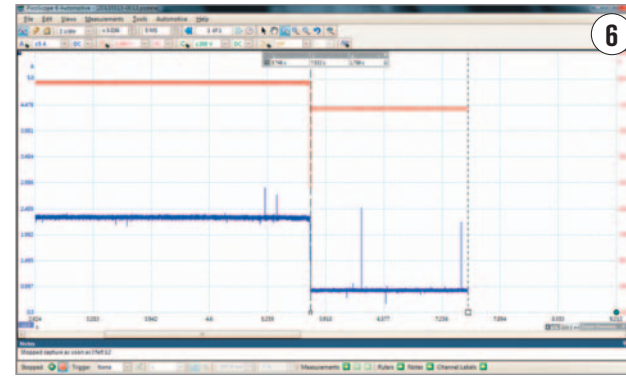
Many of the same factors can cause both engine and transmission performance complaints. And some drivability problems can mimic transmission problems! Learn what to do before you even start troubleshooting the concern, how to check transmission performance with your scan tool, and what you absolutely need to do after you've made any major changes in the transmission or it's related systems. Visit *MotorAge.com/Jul18Trainer.*

In Figure 5, channel A (Blue) is connected to shift solenoid A current, and channel B (Red) is connected to shift solenoid A voltage. The solenoid is then cycled ON and OFF. Both the voltage and current captures confirm proper electrical operation of the TCM, wiring and solenoid. In addition, a pintle bump can be seen if we were to zoom in on the beginning of the current capture, which confirms the solenoid is mechanically opening and closing.

At this point we have one more thing to confirm: Is the shifting issue due to an incorrect command from the TCM or an issue with the valve in the valve body? To accomplish this, we will have to be a little bit creative. When using a Picoscope the space bar will freeze the capture. What if we were to drive the vehicle with our scope still connected and observe when the shift command happens? Then, could we compare this information to when the shift actually occurs?



SCOPING SHIFT SOLENOID A confirms both electrical and mechanical operation of the solenoid.



THE TIME MEASURED BETWEEN the command for the solenoid to turn off and the time of the actual shift was excessive.

That is exactly what we will try.

In the next scope capture, Figure 6, our scope is connected in the same manner as our last capture. The vehicle has been driven until the 1-2 shift is felt and the scope is stopped immediately. The scope's time cursors are then used to measure the time between the shift command and the shift feel. If the time difference were to be extremely short, then a late shift command might be suspected. In this case, it took almost two seconds for the physical shift to occur after the solenoid had changed state. This confirms that there is a hydraulic issue inside the transmission. Can we draw the line? Our failing Maxima had a shift valve that was binding in its bore. A new Nissan valve body, although more expensive than a remanufactured unit, was installed and the shifting issue was resolved.

Time to draw a few lines of your own

In all three of our case study vehicles we loosely followed the flow chart (Figure 1) and, with knowledge we already possess and a little creativity, we were able to determine if the faults were electrical or hydraulic/mechanical in nature. It has been my experience, not a recorded statistic, that the electrical versus hydraulic/mechanical fault ratio is about 50/50. Even if your shop does not perform mechanical repairs on transmissions, this would mean you would be able to keep about half of the transmission repairs, and associated profits, in your building.

Because of the importance of the research required for some of these diagnoses, I would be remiss if I were not to mention some additional resources to find the information we may need. We are probably all familiar with service information sources such as ALLDATA, Mitchell, Shop Key, etc. and professional websites such as International Automotive Technicians Network (iATN) and Identifix, so I will not go into any of those. However, there are additional resources that are specifically geared (pun intended) to transmissions.

Transmission associations like the Automatic Transmission Rebuilders Association (ATRA) and the Automatic Transmission Service Group (ATSG) have their own websites and publications. Some of these are free resources while others may require memberships. Many of these groups and associations offer training around the country that can be beneficial even if you are not a rebuilder. In addition, they often make service and training manuals available for purchase or they can sometimes be found in downloadable versions on-line. There are also companies that specialize in transmission parts, Sonnax just to name one, that can also be a valuable resource because they offer updated products to solve common issues. Websites for companies like these usually have valuable information that could aid in your diagnosis of a particular transmission. The last resource I would like to mention is a good local transmission rebuilder. Having someone that is sharp on the internals of a transmission can often be the right person to call and bounce a few ideas off of before going too deep in a diagnosis.

To summarize, basic knowledge of transmissions, techniques we already use for other diagnoses, some research and a logical diagnostic approach will get us a long way. Adjusting our attitudes towards automatic transmissions willn also give us a jump start on our transmission diagnostics. The "fear" of a transmission will slowly fade, the work will remain in your shop and you will benefit from the additional profit and customer confidence.

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

CHANGES IN AUTOMATIC TRANSMISSION FLUID

TRANSMISSIONS HAVE EVOLVED INTO HIGH TECH ENGINEERING MARVELS — AND SO HAS THE FLUID THAT THEY DEPEND ON TO OPERATE AS INTENDED BY THE OEMS.

JOHN D. KELLY // Contributing Editor

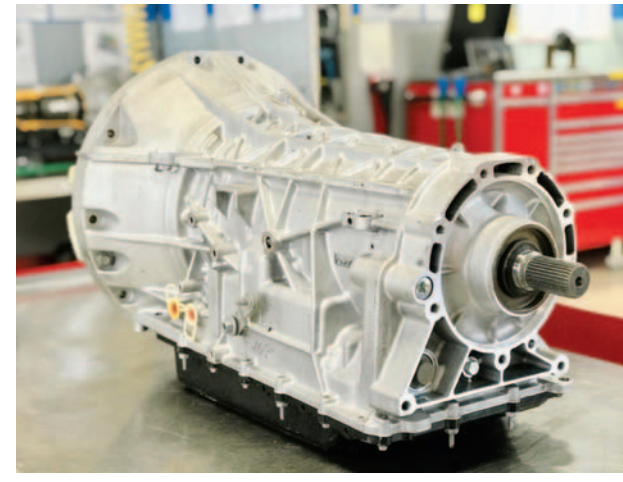
Earlier this year Ford donated a brand new 10R80 10-speed automatic transmission from a 2017 Ford F-150 to our school for training purposes. I was very excited because this is one of the newest transmission technologies available. As I positioned it on my workbench, I looked across the shop at another transmission with incredible technology, the 1940 General Motors Hydra-Matic 4-speed, the world's first mass-produced automatic transmission.

Both of these amazing transmissions, as well as the hundreds of others that have come along in the past 78 years, were designed to use an Automatic Transmission Fluid (ATF) that had been customized for that very transmission. Without the specified ATF, these transmissions cannot perform as designed. This article will focus on the evolution of ATF and the reasons why using the right fluid can make a big difference. I know that some of you do not believe that the factory-specified fluid is the best choice for your transmission, but if you will continue reading, you may change your mind by the end of this article.

Warning — Historical content!

To understand the evolution of ATF, it is helpful to have a basic understanding of the development of the automatic transmission. Prior to 1940, manually shifted transmissions were the only option for the majority of automobiles and trucks available. Prior to 1928, none of those transmissions contained synchronizers. This means that every shift could take up to 10 seconds to complete because the driver had to use a difficult process called Double Clutching to avoid gear clash.

A young engineer named Earl A. Thompson designed and patented the first synchronized manual transmission in 1922. Cadillac purchased Thompson's patents and, with Thompson's help, offered a refined version of it as the Synchro-Mesh Transmission in 1928 Cadillacs. This invention was only the first step towards Thompson's goal of designing a fully automated transmission.



2017 FORD F-150 10R80 10-SPEED AUTOMATIC TRANSMISSION

1939-1951 MOPAR FLUID DRIVE FLUID

1938-1939: Strange beginnings — motor oil

By 1934, Thompson's group had developed a 4-speed transmission called the Automatic Safety Transmission (AST). It was given that name because clutch operation was reduced to one-third of that required by a conventional transmission. The AST used the same seasonal grade of motor oil as the engine for lubrication and hydraulic functions.

In the 1930s, crude oil was refined into a Group I base oil by a process called solvent refining. Motor oil was created by combining chemical detergents (additives) with the base oil to prevent sludge and varnish buildup.

PHOTOS: JOHN D. KELLY

Move Forward with Victor Reinz® Gaskets.

aapex
ahead of the curve
Sands Expo Oct 30 - Nov 1, 2018
Dana Booth **#2838**

SEMA SHOW
Las Vegas Convention Center
Oct 30 - Nov 2, 2018
Dana Booth **#35117**

"★★★★★ - Very satisfied!"

Move Forward with the global leader in OE gasket design and manufacturing.

Move Forward with coverage for domestic brands and the rapidly growing foreign nameplate market.

Move Forward with the gasket company that supports aftermarket distribution.

For OE quality gaskets and sealing solutions, contact your Victor Reinz® sales representative today! Call **1.800.621.8084** or visit us on the web.

VICTOR REINZ®

DANA

VictorReinz.us or for our e-catalog, DanaAftermarket.com
VictorReinz.us/MoveForward

1939-1941: Specialty transmission fluids are developed

For the 1939 model year, Chrysler offered the "Fluid Drive." This car had a three-speed manual transmission connected to a conventional clutch. The clutch was connected to the engine through a sealed fluid coupling. Depressing the clutch pedal was not needed unless the driver desired a different transmission gear. The fluid coupling was partially filled (80 percent) with a special Mopar Fluid Drive Fluid. The transmission gearbox used regular S.A.E. 80-160 gear oil.

The world's first mass-produced fully automatic transmission, the Hydra-Matic Drive, was released for 1940 model year Oldsmobiles. This was the first transmission that combined several new and existing technologies (planetary gears, bands, servos, governor, throttle valve, valve body and fluid coupling) into one fully automatic package.

The Hydra-Matic Drive used a specialized lubricant called GM Transmission Fluid No. 1. By using the term "fluid" rather than "oil" they hoped to discourage the previously accepted practice of using S.A.E 20 engine oil. The only source of this new transmission fluid was at Oldsmobile dealerships. In 1941, Cadillac also used the Hydra-Matic Drive.

TWO EXAMPLES OF GM HYDRA-MATIC FLUID 1940-1949

FIVE EXAMPLES OF TYPE A FLUID 1949-1957

Oldsmobile and Cadillac recommended the fluid be checked every 1,000 miles and changed every 5,000 miles. The Hydra-Matic drive was a huge success with more than 13 million transmissions being produced over the next 16 years.

The Hydra-Matic Drive fluid was created by combining several chemical additives with the Group I base oil. These additives helped to prevent oxidation, corrosion, foaming, sludge and varnish buildup, and clutch chatter. They also helped maintain viscosity, chemical stability and oil cleanliness.

1942–1945: World War II – A need for reliable lubrication for severe conditions

On December 7, 1941, the Japanese bombed Pearl Harbor and drew the United States into World War II. As a result, the U.S. Military ordered all car manufacturers to stop production of automobiles and to start building war machinery. During the war, each Army M-5 and M-24 Tank used two modified Hydra-Matic Drive transmissions powered by Cadillac V-8 engines. The relatively new Hydra-Matic Drive and its special fluid were now being used under very rough conditions. These conditions helped GM make improvements in the transmission.

1946-1948: Post-war experimentation and growing pains

After the war, Buick, Chevrolet and Chrysler were experiment-

THE MAKINGS OF A BETTER FILTER.

VISIT US AT AAPEX BOOTH #1432

PRECISION ENGINEERING AND MANUFACTURING

ADVANCED RESEARCH AND DEVELOPMENT

RIGOROUS TESTING

OE QUALITY DESIGN

AN AMERICAN BRAND SINCE 1923™

WE INVENTED THE OIL FILTER BUT WE DIDN'T STOP THERE.

Vehicles have evolved dramatically over the years and Purolator has advanced right along with them. Developed and manufactured by the world's leading filtration supplier, PurolatorTECH™ is the new standard in OE quality oil, air and cabin air filters.

NOTHING GETS BY US.®

pureoil.com

PUROLATOR TECH™

ing with different configurations of fluid drives and torque converters. They were interested in developing a less expensive and smoother shifting transmission than the Hydra-Matic. In 1948 Buick offered a new 2-speed transmission with a torque converter called the Dynaflow. The Dynaflow's torque converter created so much heat that it impacted the life of the existing fluid. A better fluid was needed.

1949-1958: Mass marketed fluids

By 1949, it had become obvious that a single source (dealership only) transmission fluid supply system was a mistake, as repair shops worldwide were substituting S.A.E 20 motor oil in place of the recommended transmission fluid. To be successful, the Hydra-Matic transmission fluid would need to be available at every service station and gas station.

In 1949, GM released the Type "A" fluid standard. This was an improved fluid with a longer service interval of 15,000 miles. GM used the Armour Research Foundation for "Armour Qualification" (AQ) fluid tests. Passing the qualification test would allow any independent oil company to produce, distribute, and sell GM approved Type A transmission fluid.

SEVEN EXAMPLES OF TYPE A SUFFIX A FLUID 1957-1967

Fluids that passed the AQ tests were assigned an (AQ-ATF-xxx) qualification number. This number had to be marked on the fluid can. By 1955, 482 AQ licenses were granted with 229 marketers nationwide (mostly service stations) and several in other countries. Almost every automatic transmission produced by any vehicle manufacturer used the GM Type-A transmission fluids from 1949-1958. Chrysler, Dodge and Desoto were an exception with their fluid drives.

During the 1950s, GM released five-new transmissions that used unique multi-element torque converters. These torque converters caused so much heat and fluid oxidation that the GM Type A fluid specification had to be revised in 1951 and again in 1957.

During the same time period, Ford released their first three new automatic transmissions. Chrysler released their first two automatic transmissions. These torque converters got very hot. Cooling fans and air ducting was added to cool them. There was a need for an improved transmission fluid that could withstand higher heat for longer periods of time.

In 1957, GM released the "Type A Suffix A" standard. Fluids that passed the new AQ tests were assigned a new (AQ-ATF-xxxA) qualification number.

Some fluid makers produced counterfeit qualification numbers like WL-CO-ATF-334 Suffix A with the apparent intent of tricking people into purchasing their unapproved and less expensive fluids. The WARCO can in the photo above is one early example. Counterfeit fluid makes up about 50 percent of the fluid market today in 2018.

1959-1976: The Big 3 diverge

Up until this date, Group I base oils have typically had a viscosity index (VI) of 80-120. In the 1960s a new refining process

Expect More. Expect TYC.

Don’t Lose Your Cool

TYC’s Transmission Oil Coolers and Charge Air Coolers are designed to be application-specific (non-universal) for drop-in fit and include additional hoses or shrouds (where applicable), adding convenience and value.

For more information about TYC™ replacement automotive parts, consult your local TYC™ parts distributor or look up parts online at www.TYCUSA.com

ISO-9001:2000 CERTIFIED QS9000

called Hydrotreating improves Group I base oil quality, giving it a VI closer to 120 (higher is better). In 1971 an improved refining process called Hydrocracking produced a Group II base oil (a better quality base oil).

In 1959, Ford developed and released their own fluid standards: Types A and B. Type D was released in 1961, Type F in 1967, and Type-CJ in 1974. Ford also released several new 3-speed transmissions: The C-4 and C-6 in 1964 and the C-3 in 1974.

Chrysler continued using the Type A Suffix A fluid and released two new 3-speed transmissions: The A904 in 1960 and the A727 in 1962. In 1964, Chrysler released their own fluid standard MS-3256 followed by MS-4228 in 1966. Chrysler released two new 3-speed transmissions in 1968: The A998 and A999.

GM revised the Type A Suffix A fluid specification two more times in 1959 and 1960. GM also releases six new transmissions including the 2-speed aluminum Powerglide in 1962 and the 3-speed TH400 in 1964. (The Powerglide is very hard on transmission fluids because of high torque converter fluid temperatures and oxidation).

In 1967, GM released the new Dexron (B) fluid specification This improved fluid had a longer service interval of 25,000 miles. GM also releases three more 3-speed transmissions. This is followed by the Dexron-II (C) Fluid Specification in 1973.

1977-1990: Fuel economy, overdrive and the Torque Converter Clutch

As a result of the 1973 OPEC Oil Embargo and fuel shortages, the U.S. government created the Corporate Average Fuel Economy (CAFE) regulations in 1975. The regulations were to be fully implemented by the 1978 model year. The automotive industry responded by changing to three typically unused transmission technologies: 1) A 4th gear (overdrive); 2) A Torque Converter Clutch (TCC); and 3) Front Wheel Drive (FWD).

The introduction of the TCC led to customer complaints of a shudder while driving. All vehicle manufacturers made changes to their ATF specifications and the controls of their TCC to try to alleviate the problem. Chrysler released the ATF +2 fluid specification in 1980. Ford released the M2166-H fluid specification in 1981 and the Mercon fluid Specification in 1987.

Toyota, who had been producing automatic transmissions since the 2-Speed Toyoglide in 1963, continued using various GM ATF specifications until 1988. The Type T Fluid Specification was released in 1988, followed by Type T-II in 1993, Type T-IV in 1996, and the WS fluid in 2002.

In 1989 The first Group IV Base oil fully synthetic polyalphaolefins (PAO) ATF was released by Mobil.

IN 1959 FORD STARTED RELEASING THEIR OWN FLUID SPECIFICATIONS

IN 1966 CHRYSLER STARTED RELEASING THEIR OWN FLUID SPECIFICATIONS

EIGHT GENERATIONS OF THE DEXRON FLUID 1967-2017

1991-1995: Electronic controls and improved fluids

In the 1990s, Electronic controls of the transmission phased out the old hydraulic/mechanically controlled system. Chrysler and Toyota were first to market with electronic controlled transmission systems in 1988; Ford followed in 1989 and GM in 1991.

Electronic control of shift pattern (when does it shift), shift timing (how long it takes to shift), shift quality (shift feel), line pressure and TCC apply and release rates were all affected by cold temperature performance of the ATF flowing through solenoids GM Revised their Dexron fluid specification two times: Dexron-II (D) and Dexron-II (E) in 1992 with improved cold temperature performance.

In 1993, Chevron patented a process called ISODEWAXING that produced Group III base oils. Group III base oils have a Vis-

www.liqui-moly.us

LIQUI MOLY

MOTOR OILS & ADDITIVES

Enlight your engine

with molecular friction control

Visit us at AAPEX and Sema Show!

MOLYGEN

Reduction of fuel consumption
up to 15% lower friction coefficient*

Fluorescent green color
with molecular friction control

Always best performance
high thermal and pressure stability

Longer engine life
up to 30% less wear*

*Result of Linear-Oscillation (SRV®) test 2016: Molygen New Generation 5W-30 vs. standard motor oil with same viscosity.

For further information or technical support please call 1-888-MOLYOIL (665-9645)

cosity Index (VI) of 120-141 (Very close to that of Group IV synthetic base oils).

In 1995, GM released the new Dexron-III (F) fluid specification This was an improved fluid with better compatibility with newer clutch friction materials, seals, etc. and it had better oxidation stability, which gave it a longer service interval of 50,000 miles.

1996-2007: Variable Capacity Converter Clutch

In 1994-1995, some early OBD-II phase-in vehicles experienced a P0300 DTC (Random Misfire). Engineers determined that road forces being transferred through the TCC were affecting the normal rotational fluctuations of the crankshaft and tricked the ECM into thinking there was a cylinder misfire.

The solution was to create a new kind of TCC that would normally slip around 35 rpm. GM called it the Variable Capacity Converter Clutch (VCCC); other manufacturers had their own names. Some VCCC systems had a shudder or vibration during normal operation. Engineers tried several computer calibration changes, but a revised fluid was also needed to address the issue.

Ford released the new Mercon V Fluid Specification in 1996, GM released the Dexron-III (G) Fluid Specification in 1998, and Chrysler released the MS-9602 Change C Fluid Specification in 1999.

In 1999 Ford and DaimlerChrysler offered a 5-speed automatic transmission, GM followed in 2000. In 2001, DaimlerChrysler revised their fluid specifications to ATF +3 and then ATF +4 in 2003. GM revised their Dexron-III H fluid specification in 2003.

2008-2016: Low viscosity fluids

In a joint venture, Ford and GM collaborated on the development of a new 6-speed FWD transaxle (6T70/6F50) and an RWD transmission (6L80/6R140). Both companies would share the designs and build their own transmissions. The design of these transmissions required a new fluid.

In 2005, Ford released the Mercon Low Viscosity (LV) fluid and GM released the Dexron VI specification. Both of these fluids were comprised of PAO Group IV base oils or blends. This resulted in a fluid change interval of 100,000 miles.

IN 1993 TOYOTA STARTED RELEASING THEIR OWN FLUID SPECIFICATIONS

Toyota and DaimlerChrysler also offered 6-speed transaxles but kept their existing fluid specifications. These 6-speed transmissions were built to help meet the upcoming 2008 Tier-2 Emissions Regulations.

Important Note: In 2011, GM inactivated the Dexron III (H) fluid specification. In 2016, GM releases the Dexron-III (K) Fluid Specification for manual transmissions and power steering systems only. All ATF additives were removed. Do not use it as ATF!

With increasing CAFE regulations, smaller engines with very narrow torque bands were being put in cars with low volume oil capacity 6-, 7-, 8-, and 9-speed transmissions. Lexus, GM and ZF all offer 8-speed transmissions, ZF offers a 9-speed FWD transaxle. Another fluid change is needed.

In July of 2013, GM released the Dexron-HP (LV) Fluid Specification. In 2014, Ford released the Mercon Ultra Low Viscosity (ULV) Fluid Specification. The GM Dexron-VI Fluid Specification is revised again. ZF releases their LIFEGUARDFLUID 8 fluid specification.

In 2015, a Group III+ [a Gas-to-Liquid (GTL) base oil] is released that has a viscosity index of 144 — same as that of some Group IV base oils. In 2017, GM revises the Dexron-HP (LV) Fluid Specification to include Group III+ base oil.

2017-2019: Ultra low viscosity fluids

By January 2017, full compliance with Tier-3 Emissions Regulations was required. As you may know, Ford and GM collaborated again on the development of a new 10-speed rear wheel drive transmission (10R80/10L90) and a 9-speed front wheel drive transaxle (9T50). The ULV fluids developed in 2014 the required for the 10-speed models.

Conclusion

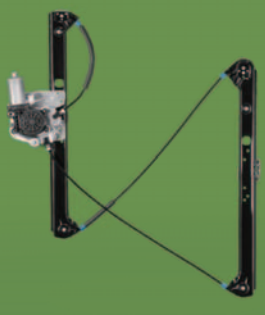
As you have read, almost every change in transmission technology over the past 78 years required a specialized fluid to go with it. Counterfeit fluids, misleading labels and low prices are all very confusing to the general public. There is not enough room in this article to cover all of the specification details for each fluid. I have done the research, and I will only use the factory fluids in my own vehicles. I encourage you to do the same. Best wishes!

JOHN D. KELLY is a professor of automotive technology at Weber State University in Ogden, Utah, and a former technician. He specializes in automatic and manual drivetrain and NVH diagnosis and hybrid and electric vehicle technology.
Jkelly1@weber.edu

Expect More. Expect TYC.

Window of Opportunity

Open your window to opportunity. TYC's Window Regulators are OE-comparable, providing unsurpassed interchangeability and convenience in repairs. With premium build quality and strong motors, they provide undeniable value, leading to satisfied customers and repeat business.



For more information about TYC™ replacement automotive parts, consult your local TYC™ parts distributor or look up parts online at www.TYCUSA.com

ISO-9001:2000 CERTIFIED QS9000

EVEN PARTIALLY RESTRICTED FILTERS can cause big drivability problems.

THE HIGH COST OF DIESEL MAINTENANCE

DIESEL VEHICLES MAY NOT BE CHEAP TO LOOK AFTER ANYMORE, BUT REGULAR MAINTENANCE IS STILL THE BEST WAY TO KEEP THEM RUNNING WELL. HERE'S HOW TO EXPLAIN THIS NEW REALITY TO YOUR CUSTOMER AND MAYBE HELP LESSEN THE FINANCIAL PAIN INVOLVED.

VANESSA ATTWELL // Contributing Editor

Not terribly long ago, diesel vehicles were cheaper to run and maintain than their gasoline-powered equivalents — but that's not always true anymore.

Thanks to the rising costs of (decent) diesel fuel and the high cost of (decent) diesel-specific replacement parts and fluids, modern diesel vehicles can actually end up being quite a bit more expensive to maintain than similar gasoline-powered vehicles. Ouch! And that's without factoring in the costs of mistakes like putting diesel emission fluid (DEF) into the wrong tank or taking the internet's advice and putting crazy stuff into the fuel. Just the cost of regular maintenance alone can be financially painful.

And the fact is, not spending the money to look after a diesel vehicle properly will almost certainly be much more expensive than paying for the high cost of diesel maintenance in the first place — but that's not something most customers want to hear and usually not something that's pleasant to explain.

In reality, it may take a few different approaches to explain the importance of regular maintenance to your diesel customer and to convince them that it's a worthwhile expense.

Because it needs to be done.

However, if your customer gets upset or outraged at how much quality maintenance work on diesel vehicles costs, here are a few lessons, from ex-

PHOTOS: VANESSA ATTWELL


Solera
IDENTIFIX
DIRECT-HIT
REPAIR MORE VEHICLES FASTER
Access the largest source of OE Repair Information and Real World Fixes
SEE IT AT AAPEX
BOOTH #2858
OR LEARN MORE NOW:
IDENTIFIX.COM/FIXED
877-721-4943

perience, that may help convince them that it's easier and cheaper to pay now rather than pay later. Because one way or another, they will indeed pay — it's just how much and when.

Surprising reasons why maintenance is so critical

Along with the obvious reasons for properly and responsibly maintaining a diesel vehicle, such as keeping the vehicle running reliably and efficiently and keeping the air we breathe nice and clean, there are a few other reasons to take good care of these units that may not seem obvious to your customer at first and may help convince them that paying for maintenance is a wise investment.

For example, for some reason it seems to take especially long for special-order or back-ordered parts to arrive for diesel vehicles in particular, which means breaking down is best avoided if at all possible because it may take way longer than expected for the correct parts to arrive (the wrong parts are usually readily available — go figure).

I remember recently waiting over six months for a diesel exhaust system (with the emission reduction system included) to arrive for a newer Ford 4x4 F-550 truck and no amount of begging or pleading could get the parts to arrive any sooner. And worse, even though the exhaust system needed replacement because it was damaged when the customer ran over a rock (in other words, it was completely the customer's fault), the customer wasn't happy at all losing the truck for that long. It was tough to explain, repeatedly, that we were doing our best and we wanted the vehicle fixed and running just as much as they did (even more, actually).

In other words, the reality for modern diesel vehicles is that if they break down they may be waiting for parts much longer than their gasoline counterparts would, so preventing problems before they occur is wise.

SCROLLING THROUGH THE INFORMATION SETTINGS on this Ford F-550 shows the diesel emission system monitors – helpful indeed.

Additionally, many diesel vehicles are used as work trucks with specialty equipment or tools installed on them; renting a similar vehicle when their truck breaks down just isn't possible. So if the truck can't run, neither can the customer's business, which makes keeping the unit on the road absolutely critical and provides quite an incentive to maintain the vehicle despite the high costs involved in doing so.

And finally, many of those diesel work trucks are branded with corporate names and logos and if they're smoking, leaking, overly smelly or just generally misbehaving (or on a tow hook) there's a good chance someone will put photos or videos of the offending unit on the internet and embarrass the company — not good at all. So even though it's not cheap to maintain a diesel vehicle, it really is worth the costs involved.

However, if your customer is still reluctant to pay the high cost of diesel maintenance, even after explaining these things, here are a few additional reasons to explain why they need to maintain their vehicles as well as how

Expect More. Expect TYC.

Fuel Your Business With TYC

Meticulously designed & tested, with coverage spanning the most popular applications, TYC fuel pumps and modules provide exceptional value to help you grow your business. Make TYC your first choice when ordering your next fuel pump!

For more information about TYC™ replacement automotive parts, consult your local TYC™ parts distributor or look up parts online at www.TYCUSA.com

ISO-9001:2000 CERTIFIED QS9000

you can help convince them that it's very much worth it.

Small details make a big difference

It may be worth pointing out to your customer that diesel vehicles are notoriously hard to start when the weather gets cold and therefore it's worth inspecting the things that tend to cause no-start conditions and replace them before the cold weather arrives if they're due for replacement.

In particular, on diesel vehicles, it's worth inspecting batteries for weaknesses and inspecting block heater cords for high resistance. A battery measuring as little as .2 of a volt below manufacturer's specification (not just reading almost "12-volts," but the actual specification) can and has resulted in a scary-sounding banging noise when attempting to start a Ford F-550 truck. (Charging the battery got that vehicle to start without issue and replacing the battery fixed the problem completely — caused by a battery undercharged by .2 of a volt!) So it's well worth quickly performing a battery test and making sure the component is up to the challenge in the cold months ahead.

It's also worth quickly checking the block heater to ensure it's operating normally. I've lost track of how many winter no-starts get towed in and are fixed by charging up the battery and then inspecting the block heater cord to verify high resistance affecting operation, and then finally replacing the faulty cord. It's become winter routine.

And really, the cost of replacing either of these items before they fail is much cheaper than paying the cost of a tow or service call, and then diagnosing and repairing the no-start. Plus, catching the problem in advance means the customer gets to choose a more convenient time to be without the vehicle, rather than hope the upcoming and inevitable no-start happens when they're not doing much, their kids aren't in the vehicle, the shop is still open, and parts and a technician are available right away to get them going — and there isn't a long wait for a tow truck to show up.

EVEN A SLIGHT VARIATION FROM MANUFACTURER SPECIFICATIONS can result in drivability problems – just because the battery measures "approximately 12.0 volts at the terminals" definitely doesn't mean it's OK.

MAINTAINING A MODERN DIESEL VEHICLE can be very costly and it needs to be done. Here's why your customers need to pay for high-quality maintenance work.

Pointing out to the customer that a component is out of specification and should be replaced before it fails and strands the vehicle somewhere usually helps convince a customer to pay the cost of maintenance.

But if not, here are a few more lessons that might help.

Frequent filters

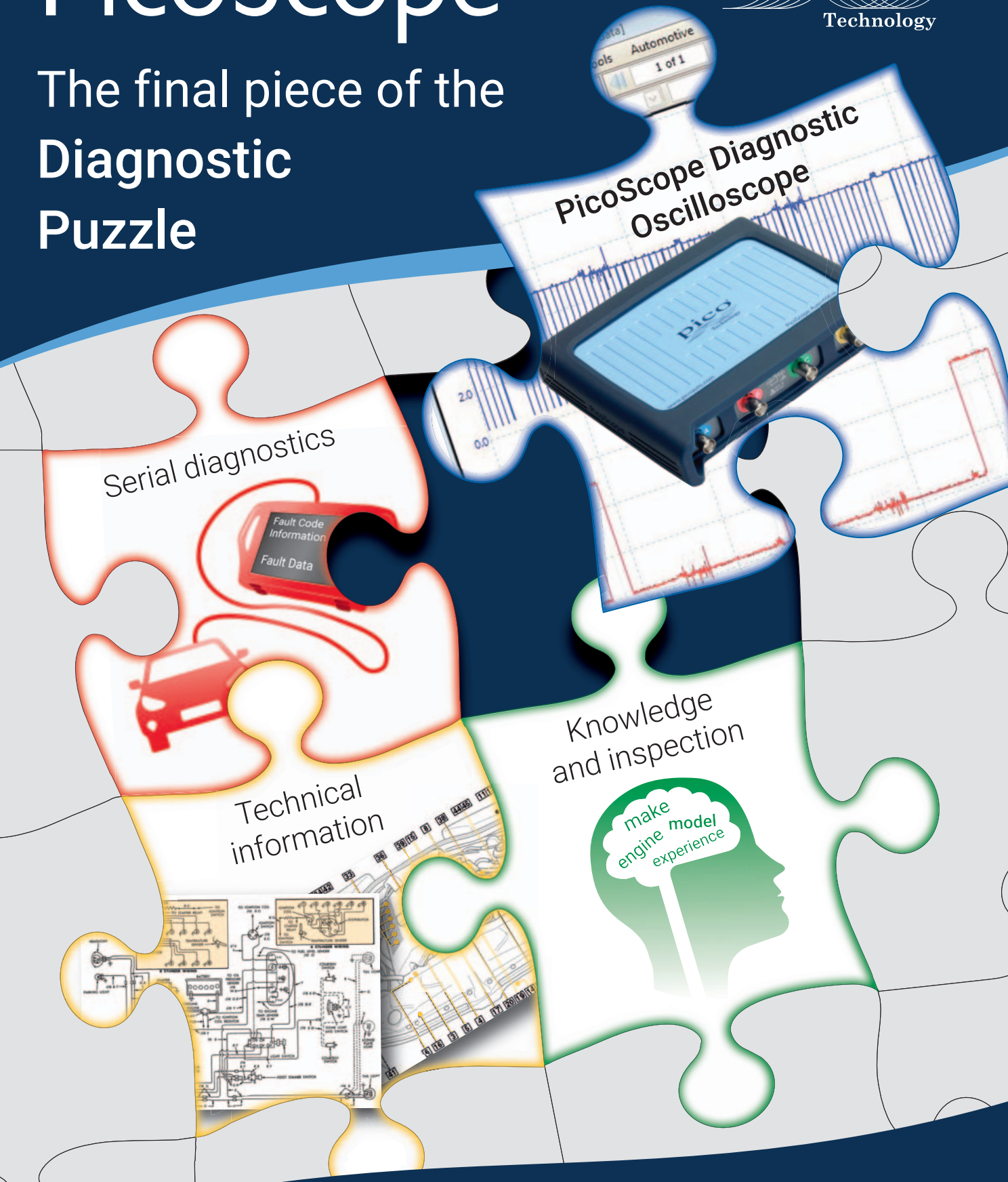
Many customers are still surprised at how often filters need to be changed on a modern diesel vehicle, how even a seemingly slightly restricted air filter can (and has) caused big drivability problems — and also how much quality filters cost.

Not replacing the air filter on an inspection to save the customer money can result in a no-start — or worse if

PicoScope®

pico® Technology

The final piece of the **Diagnostic Puzzle**



www.picoauto.com/A173

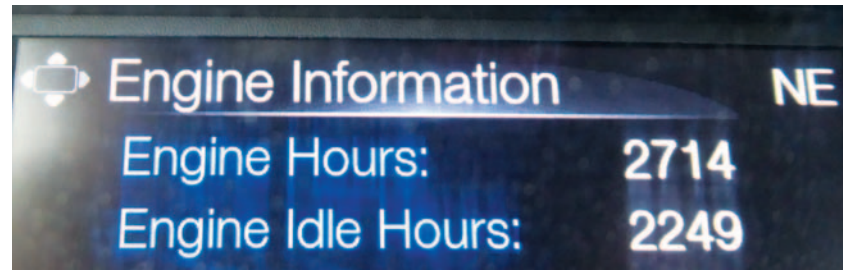
the restricted filter gets sucked into the intake and chewed by the components along the way. One advisor I worked with keeps a filter that actually caused drivability problems to show customers how little it takes to cause problems; show and tell works well with her customers. She also has a cheap brand of filter cut open to show the difference in quality inside the filter and persuades her customers to use quality parts. She says using the props really helps make the sale.

And while it's also important to replace the fuel filter, because not replacing the fuel filter can also have severe consequences, it's tough to keep a restricted fuel filter at hand because they're often a messy, smelly hazard — but it's very possible to show the size of the passages involved and relate the pressures involved to something commonly understood.

Fuel injectors and turbos also suffer when the vehicle isn't maintained properly (or spends too much time idling) but they're both incredibly expensive and there's usually a core charge on them, so keeping failed ones around isn't usually possible or practical — but taking pictures of them can help. Showing customers photos of failed components can help convey what happens when maintenance is neglected — and so too can showing copies of previous invoices for repairing the problems on similar vehicles (with the names and identifying details blacked out, of course).

In other words, whenever it's possible, using real examples to show customers can often help the customer understand why maintenance is so important and what happens when it's neglected.

But yes, some people don't learn. And in that case, it may take the reality of having the vehicle break down or fail to restart to convince them to spend money on maintenance, which is too bad because this situation can so often be prevented.



MOST OF THIS FORD F-550'S OPERATING HOURS have been spent idling – common for working diesel vehicles and very hard on their emission systems.

DEF lessons

Many customers are still surprised to learn that they need to top up the DEF often and regularly, because most vehicles will lose power and they all eventually won't restart if the DEF runs out (the Environmental Protection Agency requires this strict consequence — no DEF, no driving).

So in addition to the typical components that need to be replaced regularly, modern diesel vehicles also have that emission control system that needs to be maintained, because the vehicles simply won't drive if they don't.

There's plenty of warning before this happens, but one advisor at a dealership I worked with says that's still far and away the number one problem her diesel customers come in for: empty DEF containers and subsequent low power conditions. No matter what it says in the owners' manual, mileage will vary and some units require DEF top ups more often than others, which many people learn the hard way. And depending on the vehicle, the DEF system may need to be filled up completely, right to the top (not just topped up a tiny bit) before it starts again.

To be fair, there are times when it's not the customer's fault that the unit ran out of fluid quickly, such as when the DEF freezes and blocks the flow of fluid, or when the pump or components are damaged by debris. But whatever the cause, the resulting low power or no re-start is always annoying and inconvenient. And the fact remains that a significant number of breakdowns and repairs can be prevented with simple maintenance.

So yes, keeping the DEF topped up is expensive, but the alternative is much worse. It's unfortunately one of the high costs of maintaining a modern diesel vehicle.

DPF filters

Unfortunately, many customers are also shocked when they find out the cost of keeping their vehicle's diesel particulate filter (DPF) clean, which often involves removing the filter and cleaning it manually (with mixed success) or replacing the extremely expensive part altogether. And it's a fairly common problem.

It's easy to tell when these filters go bad — the vehicle loses power and often won't move at all, usually at an extremely inconvenient time. Or, in some cases, the filter's monitor just says so.

And while DPF delete kits do exist and people do install them despite the associated risks, liability and potential fines (and also damage to the environment), from experience most customers do grudgingly pay to have their clogged or restricted filters cleaned or replaced to keep their vehicles running.

One dealer tech I know tries to soften the blow by explaining the cost of a new

filter and also explaining the limited success rate involved with removing and cleaning the existing one to the customer and lets the customer make the choice whether to buy new or pay to remove the filter for a thorough cleaning. Unfortunately though, he's found customers tend to resent it if the cleaning is unsuccessful and the whole process usually just delays the inevitable cost of replacing them, so it's often wise to just pay to fix it the first time. It is what it is.

And since it's tough to keep a DPF close at hand to show customers (although some places do, or have cutaways), it helps to take photos of ones that have previously clogged to help customers who need convincing. Most manufacturers also have excellent images and explanations on their websites that may help explain and illustrate what's going on. Again, using real-world examples to help the customer understand can be very effective.

It's not something your customer may want to hear, but the DPF filter needs maintenance, it's every expensive — and unfortunately that's just the way it is. Hey, the bright side is that it's nice to be able to breathe.

Conclusion

True, most diesel vehicles are fuel efficient, which can be a significant savings over a gasoline vehicle, but the fact is that newer diesel vehicles need costly maintenance to keep them running, they tend to take longer than expected to repair when they do break down and they're programmed to stop operating when their emission systems are neglected.

And despite all that, people still love them.

In many parts of the country a loaded 4x4 diesel truck with leather guts and a crew cab is considered to be a fancier, showier daily vehicle than a gasoline-powered luxury car. And plenty of folks won't tow a boat or trailer with anything but a diesel truck.

And with that said, the reality is that it takes a whole lot of money to keep a modern diesel truck running well and on the road, and those costs simply can't be (responsibly) avoided. True, maintaining diesel vehicles is expensive, but not maintaining them is much worse. And that's the new reality of owning a diesel-powered vehicle — so enjoy the drive.

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

WHEN YOU DON'T KNOW WHAT YOU DON'T KNOW

STAYING CURRENT AND GETTING THE TRAINING YOU KNOW YOU NEED IS NO LONGER AN OPTION. IT'S A NECESSITY.

PETE MEIER // Technical Editor

PHOTO: GENERAL MOTORS

GM'S CEO MARY BARRA believes that we'll see more change in our industry in the next few years than we've seen in the last few decades.

I believe the auto industry will change more in the next 5 to 10 years than it has in the last 50," said Mary Barra, Chairman and CEO of General Motors.

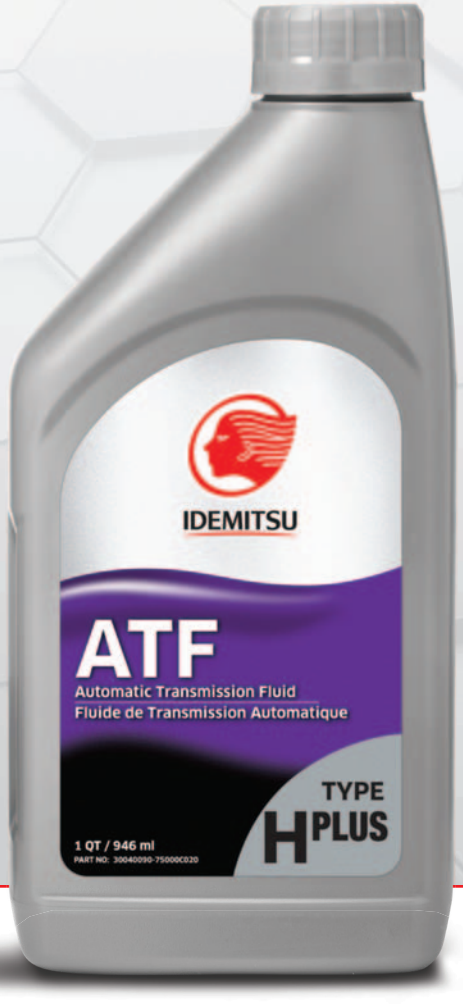
I first picked up a wrench for pay when I was 15 years old. Many of you know that I started my wrenching career back in the days when you had your car serviced at the same shop you purchased your gas from. At that time, the first few national auto service chains (Sears and J.C. Penney) were just being born, opening huge service centers in the same shopping malls that hosted their retail stores. And it was the end of an era, as the Feds and the California Air Resource Board began enacting regulations governing vehicle emissions, giving birth to the catalytic converter and unleaded fuel and suffocating the muscle cars that we loved so dearly.

All told, I've been in or around the automotive industry for the last 45 years, so the comments made by Barra really got me to thinking. In that time, I've seen the industry evolve in some remarkable ways. I was there when electronic ignition was first introduced, when the first onboard engine controllers were developed, and witnessed the move from carbureted engines to throttle body injection, then to multiport injection and now, gasoline direct injection (GDI).

I remember the days when you adjusted point gap and used a strobe light to line up the timing marks, rotating the distributor ever so slightly. Now, few cars even have timing marks and only the computer can make adjustments to the timing. Overhead cams were just coming to the market, at first from the Asian invasion of small, fuel efficient cars Americans were buying as fast as they arrived on U.S. shores due, in large part, to the oil embargo that OPEC was holding over our heads.

Now we have multiple cams that adjust continuously to maximize engine efficiency across the load/rpm band and today, there is even a production car that can vary compression ratio "on the fly" to further improve efficiency. The smaller powerplants of today, many turbocharged, are producing more power per liter than ever before, getting more

WE'VE ADDED 1 MORE TO OUR ALL-STAR LINEUP



INTRODUCING H PLUS, PRECISELY FORMULATED FOR VEHICLES WITH DW-1® SPECIFICATIONS

New H Plus automatic transmission fluid (ATF) is a breakthrough product from Idemitsu. Working directly with leading Asian OEMs, Idemitsu has exclusively developed formulations to match specific transmission application needs for maximizing performance and fuel economy. Don't risk your transmission with a multi-vehicle ATF, choose Idemitsu H Plus ATF for transmissions requiring Z-1® or DW-1® fluids.

FOR MORE INFORMATION:
IdemitsuLubricants.com

IDEMITSU
Lubricant solutions since 1911.

fuel economy than ever before and lasting longer than ever before.

And, if many industry experts are correct, by the time I hit the 50-year mark, autonomous vehicles will be almost commonplace — most likely starting in our major cities as ride-share platforms. And by the time my new grandson is old enough to drive, he won't have to. He'll be able to summon his electric "taxi," using an app on his phone, and he'll be able to stream live entertainment to a screen in the cabin as the BEV takes him safely wherever he wants to go.

What is the impact on our industry today?

If the changes we've witnessed in the last 50 years will be surpassed in the next 10, what is the impact on our everyday business now? I think there are several we need to be acutely aware of.

To be honest, the one that scares me the most is knowing that, in the aftermarket repair sector, we don't know what we don't know. Have you as a technician or shop owner stopped to consider the processes you have in place and how they mate up with the newer vehicles you are servicing? You may be aware of the Advanced Driver-Assistance Systems (ADAS) many newer vehicles come equipped with, and may even understand that when performing repairs on these systems, some form of recalibration or initialization will be needed to complete that repair. But are you aware of the impact even routine services can have on these systems?

For example, performing a routine alignment can alter how the forward-facing cameras or radar systems "see" the road. Altering steering wheel position without addressing the steering wheel position sensor could provide misinformation to these systems that could result in the system malfunctioning when needed, causing injury rather than preventing it.

PHOTO: FORD MOTOR CO.

THE 2016 FORD F-150 has over 150 million lines of computer code – necessary for the numerous electronic systems today's modern vehicles utilize.

PHOTO: LOCKHEED

THE F-22 RAPTOR is the most advanced aircraft in the world and uses a tenth of the computer code required by a modern automobile.

Are you, as a technician or shop owner, prepared for the inevitable liability risks these new systems can present to you and your business? Standing before a judge and claiming you didn't know is not going to be a workable defense. In this case, the only good defense is a good offense — and that means that getting and staying trained is no longer the option it once was. If you, or your shop, insists on continuing to repair vehicles "the way we've always done it," you're going to be shelling out millions of dollars in judgements and getting less sleep at night, knowing that your failure to bring yourself current caused someone serious injury. Or you'll be turning away more and more work because you don't have the knowledge, tooling or skills to perform it.

A message for the masses

Now, understand that I'm addressing the nearly 750,000 men and women who are turning wrenches on cars in the U.S. If you're one of the few who regularly attend training, you'll be in a position to grow your business exponentially and get paid for the skills and knowledge you've invested in. If you're one of the many who hunger for training but you aren't getting the support of the shop or its owner, you're in a unique position to be able to move to one that does. And if you are considering entering the field, I think you are entering at one of the most exciting times we've ever experienced.

ELECTRIC BRAKE FORCE METER

WITH DYNAMIC LOAD SIMULATION AND CIRCUIT TESTING

Tests Truck-Side Brake Controller Output and All Tow-Lighting Functions Without a Trailer

MADE AND ASSEMBLED GLOBAL COMPONENTS

#9107A

- Brake Force Meter displays real-time, brake controller output gain and timing
- Quickly troubleshoots electrical circuits and ground condition
- For use with integrated and aftermarket brake controllers

Multiple Patents Pending

REINVENTING THE WHEEL

3-in-1 Diamond Grinding Wheels

1 Grind 2 Cut 3 Undercut

- Access hard-to-reach areas
- Outperform standard grinding wheels; maintains diameter, lasts a minimum of 2,000% (20X) longer and cuts faster

#8120 ***#8151*** ***#8150***

DIAGNOSTICS

#9101 RANGER MUTT®

MADE IN USA

Portable, Water-Resistant Trailer Tester for Lights and Electric Brakes

- Short circuit protection
- Turn signal simulation and power verification LED

#8016 FUSE SAVER® MASTER KIT

MADE AND ASSEMBLED GLOBAL COMPONENTS

Chase Down Short Circuits Without Blowing Fuses!

- Allows a technician to move around a vehicle shake testing wires while looking for the short
- Includes: 5 Color-Coded, Resetting Breaker Handles (5-30A), Dual-Sided Fuse Box Main Connector, BuzzAlert™, Fuse Box Adapter Kit

#9038A RELAY BYPASS SWITCH KIT WITH AMP LOOP

MADE AND ASSEMBLED GLOBAL COMPONENTS

Allows Circuit Byass and Current Testing for 12V DC Relays

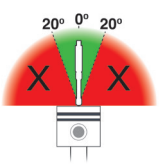
- Control relay circuit independent of “key-on/key-off” systems

#7891 ENGINE CALIBRATION AND SET-UP KIT

Eliminate Mistakes When Setting Up Mechanical Engine Timing Sequences, Chains, Balance Shafts, Belts and Distributor Installations

MADE IN USA

DO NOT use on an engine that has an acute spark plug angle relative to the flat top of the piston or you may bend the TDC shaft



Patented

CONTACT CARE

#8040 DIAMOND-TIP ELECTRICAL TERMINAL CLEANERS

For Electrical Flat (Spade) Type Pin Connectors

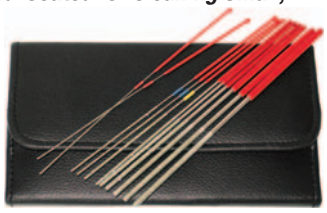
- Highly durable with mild abrasive coating
- Pivoting-handle design for added versatility

Patented

#8042 DIAMOND MICRO ROUND FILES

Super-Hard, Flexible and Diamond-Coated for Cleaning Small, Round, Female Electrical Pins

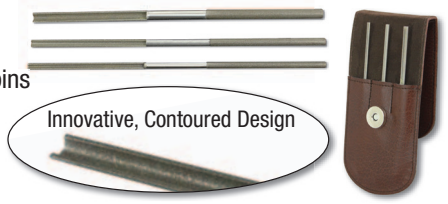
- Strong but felxible
- Diameter sizes range from .030" to .120" and 5" long



#8043 MICRO MALE ELECTRICAL PIN CLEANERS

Cleans Deutsch, Cannon, Bullet and Other Round Electrical Pins

- Durable diamond coating
- Will not damage pins



#8086 LIGHT SOCKET BRUSH KIT

Tufted End Is Specially Designed To Clean The Entire Light Socket in One Operation

MADE IN USA

- For 1156/1157 type light bulb sockets and 5/8"-3/4" bores

SATISFACTION GUARANTEED • 24-HOUR REPAIR/REPLACE • SATISFACTION GUARANTEED • 24-HOUR REPAIR/REPLACE

SATISFACTION GUARANTEED • 24-HOUR REPAIR/REPLACE • SATISFACTION GUARANTEED • 24-HOUR REPAIR/REPLACE

We are at a pivotal point in our industry's history, with the technology advancing and the number of qualified technicians who can repair them dwindling. Even routine repairs, from A to Z, will require more and more technical expertise to perform. Consider that today, you can't even replace a battery on many cars without letting the car know you did so! And if you don't, the new battery will likely not last long. Anyone remember when we thought it was a good idea to replace a failed battery with one with more cranking power? On many of today's platforms, that can cause a variety of issues with the onboard electronics.

And that's what a modern car is, right? They are no longer just cars — they are rolling computer networks. Recently, a nationally renowned speaker and industry advocate used this example:

"A modern pacemaker needs 80,000 lines of computer code to work properly and keep the patient alive, the F-22 Raptor, arguably the most advanced fighter aircraft in the world, has 1.7 million lines of code. The new Boeing 787 Dreamliner has over 6.5 million lines of code for its avionics package and onboard support systems.

And the 2016 Ford F-150? Over 150 million lines of code…"

And what about the next generation of techs?

Recently, I saw a post on one of the many Facebook groups aimed at "professional" technicians. They boast a membership of nearly 45,000. One member asked the group how best to learn the business and the comments, for the most part, praised "on the job" experience as THE way to go. And to be honest, that's how I learned when I first started.

But I'll also be the first to admit that much of what I learned from the "experienced" guy was wrong, or didn't match the needs of the technology of the day. That is increasingly true, and there is no way anyone can enter this field and learn under the eyes of a mentor alone. I support the initiatives that NASTF is taking in working on an educational model that, as Carquest's Chris Chesney states, "takes our educational format from one of objective-based learning to one of competency-based learning." The sooner we can let a student practice what they are taught, the better. As it is today, even the best programs in the country struggle with the ability of the students to retain all the information that's been hammered into them over a traditional two-year program. It's better to graduate a capable apprentice than a semi-skilled "master" technician with limited experience.

That is, if we can attract the talent we need to our industry in the first place. The technician shortage is real, and it's a global issue — one we are in tough competition with, with every trade represented in a modern technical college facing the same dilemma. Here in Tampa, for example, over 6,000 tradespeople are needed to start the new light rail project that will ultimately connect Tampa and Orlando. 6,000 positions with no one to fill them.

What is the answer? Smarter people than I have offered their observations, but it isn't hard to see that some factors are obvious; compensation, adequate benefits, working conditions, image of the industry among the students and their parents (pushing for college as the only "real" sign of success), are just a few that immediately come to mind.

For the short term, I can only encourage the shop owners out there reading this to get involved with their communities and their local school system. Take part in the job fairs offered, even at the middle school level. Join the automotive program's Industry Advisory Council. Support organizations that are taking point on these challenges: NASTF, the ASE Education Foundation, and others. And when you hire that new tech, fresh out of school, truly mentor him or her. And while you're at it, bring your existing staff up to speed. Insist on a culture of continued learning in your business — or find yourself falling behind even further.

If Barra is right (and I am confident she is), the next decade is going to be an exciting and challenging one for all of us. Considering the talented people I've had the opportunity to meet, it's a challenge that I am confident we will rise to.

PHOTO: CHEVRON-TEXACO

NOT THE STATION I WORKED at while in high school, but you get the idea. "You can trust your car to the man who wears the star…"

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

Next Generation Diagnostics

The first full diagnostics platform completely re-invented ***for mobile***

POWER

Gesture-based user interface allowing for more complex interactions

SPEED

WIFI for greater distance and faster throughout

COVERAGE

Highest scoring scan tool in the 2017 CCC collision scan tool shootout

REPORTING

Pre- and Post-scan to XML, text message, email, and PDF

- 58 car makers
- Full DTC output (including freeze frame, event data, odometer, fault frequency, number of ignition cycles, etc.)
- Bi-directional controls and system tests (including Power Balance, Crank Learn, etc.)
- Reset adaptations and calibrations (including SAS, Yaw Rate, Zero Calibrations, and DPF Relearns, etc.)
- Annual update costs 50 -450

Coming for Android Q1 2018

480-827-TOOL (8665) **www.autoenginuity.com**

BASIC INSTINCT

5 LESSONS TO HELP TECHNICIANS TAKE ON THE CHALLENGE OF COMPLEX VEHICLE REPAIRS

BRANDON STECKLER // Contributing Editor

With the proper training, the correct tooling and a thorough understanding of how our opponent (the subject vehicle) "ticks," the odds are high that the fault can be identified, the root cause pinpointed and the vehicle repaired in a reasonable amount of time. That is, of course, if we can identify what the customer is concerned with.

Lesson #1 — The three-legged stool

I want to take a moment to bring up a very valuable lesson I learned years ago from AutoNerdz founder Tom Roberts. Tom is a valuable contributor to the automotive industry and is known for his diagnostic and scope expertise. He once described the ability of a technician to perform his/her duties as being perched

PHOTOS: BRANDON STECKLER

Kia.com

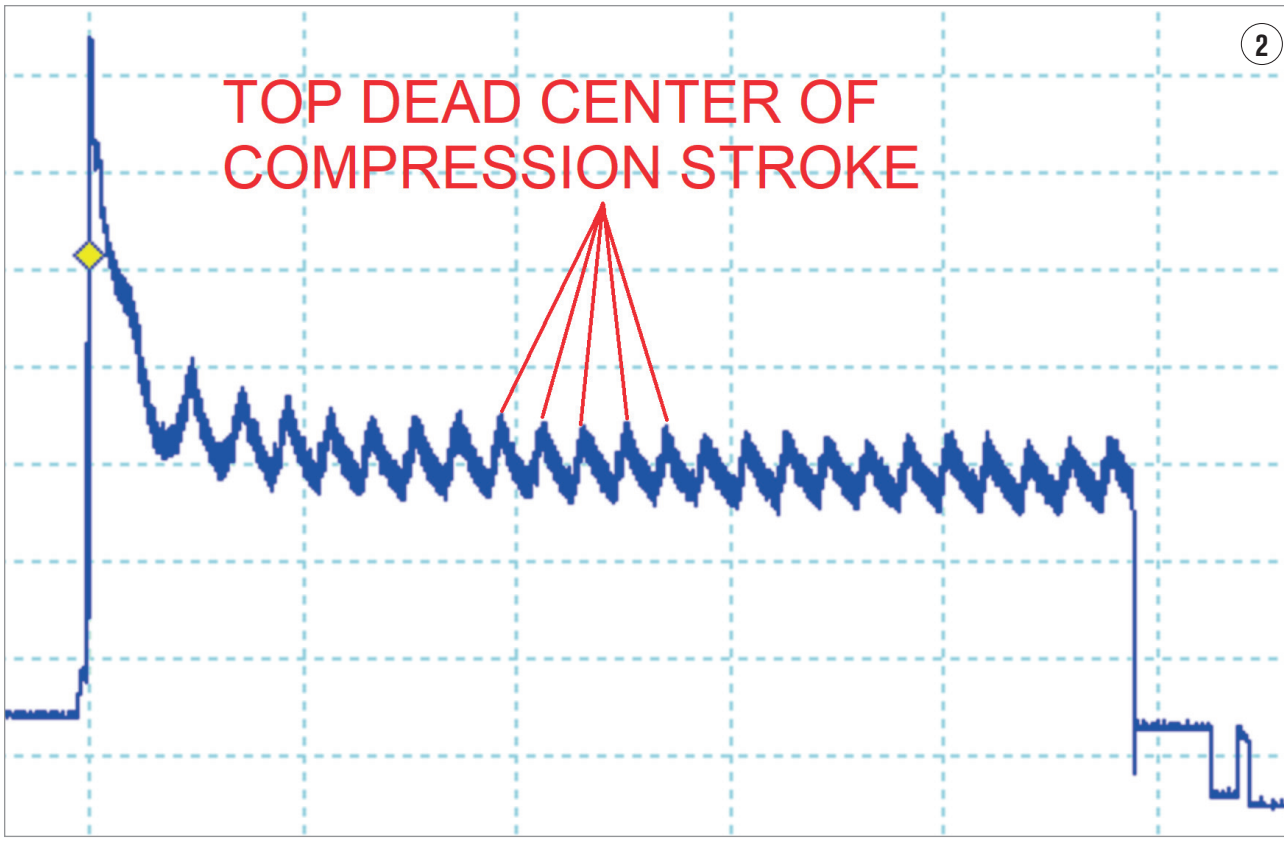
If it's not in the right box, it's not genuine.

KIA

Genuine Parts

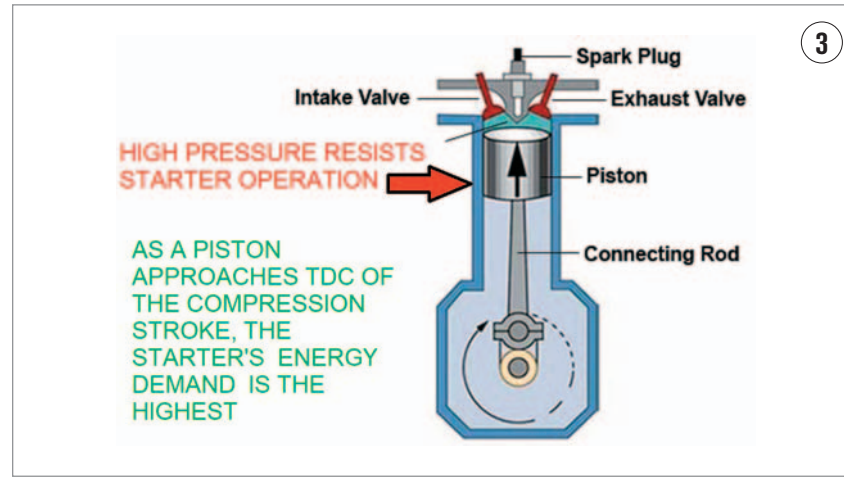
From starters to alternators, oil filters to spark plugs, there is no substitute for genuine. The only way to assure that you are getting Genuine Kia parts, backed by the Kia Warranty, is to order them from your local Authorized Kia Dealer. Contact your local Kia dealer for assistance and delivery of the parts you need.

*Genuine Kia replacement parts (except battery) sold by Authorized Kia Dealer under warranty are covered for the greater of (1) the duration of the New Vehicle Limited Warranty or (2) the first 12 months from the date of installation or 12,000 miles, whichever comes first. Labor charges not included when not installed by an Authorized Kia Dealer. Warranty is limited. See Kia's Replacement Parts and Accessories Limited Warranty for further details.



upon a three-legged stool. The three legs represent a technician's competency, capable tooling and adequate information.

I believe Tom used the analogy because, just like a three-legged stool missing a leg, a technician who lacks one of the three items would soon find himself or herself toppling over in a crash landing. We must fortify ourselves from those three angles to be consistent and successful diagnosticians and technicians.



Lesson #2 — The 85/15 rule

There is another valuable lesson that I was taught years ago. About 85 percent of every action that occurs on an automobile occurs on all of them because it must. It is a matter of physics. For example, we can energize a fuel injector by completing the path to ground, by providing a voltage source or even by providing both a voltage source and ground path. The point is that the injector must open to allow a cylinder to be fueled properly. The 85 percent is that very fact — the 15 percent is how the manufacturer designed that function to be carried out. This very lesson is the basis for this topic of discussion.

The initial encounter

The vehicle in question is from a very loyal fleet account of ours (Figure 1). It seems their 2013 GMC Sierra Diesel 6.6L (LML) with 186K on the odometer has been experiencing a loss of coolant level for some time now. I was issued the vehicle for evaluation along with some basic routine maintenance. The vehicle was well maintained and in fine shape. I noticed the degas bottle exhibiting a very

Motor Age TRAINING CONNECT

WE SUPPORT PROFESSIONAL CERTIFICATION THROUGH THE National Insitute For AUTOMOTIVE SERVICE EXCELLENCE

INTERACTIVE VIDEO TRAINING TO HELP YOU PASS THE ASE

GET YOUR FREE TRIAL

Connect.MotorAgeTraining.com

PUT THE POWER OF TRAINING IN YOUR HANDS

AVAILABLE 24/7
TRAIN ON YOUR SCHEDULE

- Guided Module-Based Training
- New Videos Added Bi-Weekly

OVER 350 VIDEOS IN THESE SUBJECT AREAS

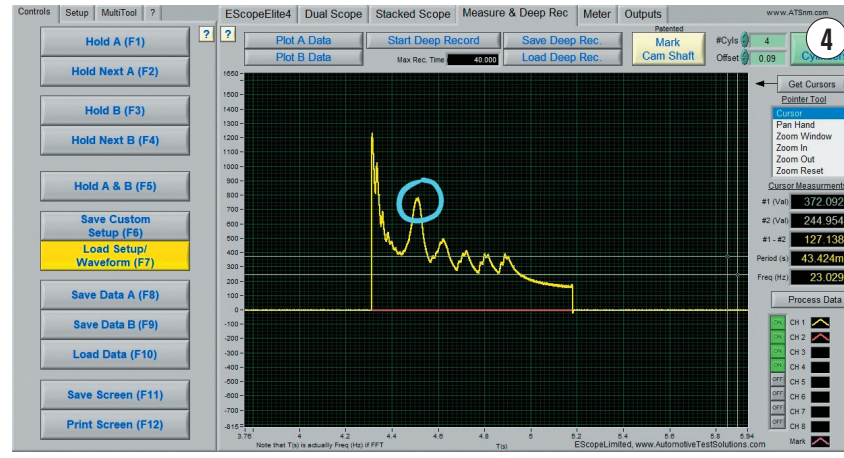
AUTOMOTIVE ELECTRICAL	73
ENGINE PERFORMANCE	118
ENGINE MECHANICAL	16
DRIVELINE SYSTEMS	10
STEERING & SUSPENSION	16
BRAKES & VEHICLE DYNAMICS	15
HVAC SYSTEMS	12
VEHICLE SERVICING	6
TOOLS & EQUIPMENT	57
TECHNICAL INFORMATION	29

low level of coolant and in the engine compartment the unmistakable, sweet smell of hot antifreeze lingered over the hot powerplant. A visual inspection of the hoses was carried out and the leak was easily pinpointed to the lower radiator hose. I received authorization from the fleet manager to complete the repair, and the vehicle was ready for pick-up later that same afternoon.

It was about 3 p.m. when the driver of the truck returned to the shop to retrieve the vehicle. He was excited to get his truck back but left me with some concern when I met him in the parking lot. It seems the driver had failed to mention upon drop-off that he was experiencing some difficulty starting the engine from time to time. I certainly noted no such symptom each time I started the truck and I asked him if he could demonstrate the erratic behavior for me. The driver attempted to duplicate the strange concern but to no avail. The truck's engine repeatedly started without hesitation or struggle. I reassured him with visual confirmation of the battery's condition, as I had left (on the passenger seat of the truck), a print out of the starting/charging system test we perform as a courtesy during routine maintenance. Satisfied, he took the vehicle and assured me that he would return if the symptom were to present itself again.

Lesson #3 — The interviewing process

Sure as can be, the following Monday, the driver returned to the shop with his truck and a complaint of the hard-start concern. This time I asked him to spend a few minutes with me so that I might ask him a few questions regarding the nature of this erratic fault. In my experience, it's always been a fantastic idea to interview my customers on the nature of the faults and for good reason. Just think of how often an intermittent fault arises. We call it intermittent, but the



THE TRAINER: WHAT IS YOUR DIAGNOSTIC PROCESS IN THE SHOP?

PETE MEIER //
Technical Editor

Dealing with a customer concern of an illuminated Check Engine light is one that many of us cut our diagnostic teeth on, so we'll take what we've learned so far and move on one more step – learning a diagnostic process that will help lead us to the cause of the DTC and from there, to its successful repair.

When I worked fulltime in the bays, I paid attention to the process many of my fellow techs seemed to be using when faced with a "MIL on" concern. Step 1 – connect a scan tool and read the DTC(s) stored in the Engine Control Module (ECM). Step 2 – clear the code(s) before removing the scan tool from the vehicle. Step 3 – select the replacement parts based on the ones referenced in the DTC (an oxygen sensor for all oxygen sensor codes, a MAF sensor for all MAF sensor related codes, and so on). Step 4 – install said part and return the car to the customer. Step 5 – see if the customer came back with the same code (if not, the repair was successful. If so, refer customer to the dealer).

No, I'm not kidding. I knew several techs that worked just that way! Needless to say, this approach is not the best way to tackle the problem. So, log on, sit back and come watch as I take you through a more logical process you can apply to any diagnostic situation!

Learn what to do before you even start troubleshooting the concern, how to check transmission performance with your scan tool, and what you absolutely need to do after you've made any major changes in the transmission or it's related systems. Watch this edition of The Trainer at *MotorAge.com/apr17trainer.*

fact usually is that once we figure out how to force the fault to reveal itself we can almost do so at will. Intelligent questions regarding failure criteria include asking about weather and ambient conditions present at the time of the fault, whether the vehicle had experienced a hot or cold soak prior to the fault, the frequency of the fault and overall driving habits.

These can really help narrow the failure down and eliminate a lot of wasted time and energy. After speaking with Ron, the driver of the GMC, it has been determined that the symptom is only exhibited if the truck sits all day after a drive to operating temperature. I asked Ron to then describe the symptom to me. What does he mean by hard start? He responded by telling me, "The engine seems to stutter while its cranking over, like perhaps the starter is failing." That description brought a thought to the forefront of my mind and I didn't like what I was seeing. His description of the starter operation led me to believe that the engine became difficult to turn at some point in the 720-degree engine cycle. I do want to reiterate that the truck was very well taken care of and was relatively young, especially for a diesel powerplant. The thought of a potential mechanical failure didn't sit well with me, but the clues I have before me will lead me down that path for initial testing.

Lesson #4 — Returning to my roots

As mentioned earlier, the 85/15 rule regards mastering the function and operation of all that apply to the 85 percent.

Being intimately familiar with engine operation, engine management systems as well as their components and their functionality, give us the ability to apply testing techniques to monitor their functionality. Because these devices apply to every year/make/model on the road, it's only beneficial to invest the time to master them. Which brings me to my next point.

Lesson #5 — Test known-good vehicles

I'm not a diesel tech, and though I've worked with them successfully, I don't currently possess the experience necessary to be comfortable with them. They require me to remain extra focused, as they don't present to me as second-nature like they do to more experienced and properly trained diesel technicians. What is neat about the approach to this diagnosis is that I don't need to be a diesel tech! I know DC motors and what to expect to see on a lab scope to determine whether they're operating properly or not. I've learned years ago to carry out testing techniques on known-good vehicles. Being comfortable with what "GOOD" looks like means "BAD" sticks out like the proverbial sore thumb.

Because of the fault description Ron provided me, as well as the way the fault presented itself, it led me to believe that the engine was the cause, becoming difficult to turn somewhere in the 720-degree engine cycle. I was going to capture the fault using a lab scope and a high current amp probe while operating the vehicle under the same failure criteria Ron had described earlier.

If you refer to Figure 2, you can see a capture of starter current, while cranking a known-good vehicle. This trace first exhibits an in-rush current. This is the tall peak you see to the left of the capture. What this represents is a momentary high rate of current flow. This occurs because the starter uses a lot of energy to get the engine moving. Once the engine begins to rotate, the energy required to keep it rotating has diminished. Next you will notice the repetitive peaks. They represent the Top Dead-Center (TDC) locations of each piston's compression stroke, in turn. The waveform presents in this fashion because

STATEMENT OF OWNERSHIP MANAGEMENT, AND CIRCULATION

(Requester Publications Only) (Required by 39 USC 3685)

1. **Publication Title:** Motor Age
2. **Publication Number:** 1520-9385
3. **Filing Date:** 9/30/18
4. **Issue Frequency:** Monthly
5. **Number of Issues Published Annually:** 12
6. **Annual Subscription Price (if any):** $70.00
7. **Complete Mailing Address of Known Office of Publication:** 131 West First Street, Duluth, St. Louis County, Minnesota 55802-2065
   Contact Person: Tracy White
   Telephone: 218-740-7204
8. **Complete Mailing Address of Headquarters or General Business Office of Publisher:** 2 Penn Plaza, 15th Floor, New York, NY 10121
9. **Full Names and Complete Mailing Addresses of**
   Publisher: Terri McMenamin, 25115 Country Club Blvd, North Olmsted, OH 44070
   Group Content Director: Mike Willins, 25115 Country Club Blvd, North Olmsted, OH 44070
   Content Channel Director: Krista McNamara, 25115 Country Club Blvd, North Olmsted, OH 44070
10. **This publication is owned by:** Advanstar Communications Inc., 2 Penn Plaza, 15th Floor, New York, NY 10121. The sole shareholder of Advanstar Communications Inc. is: Rocket Holdings, Inc., 1983 Marcus Ave., Suite 205, Lake Success, NY 11042.
11. **Known Bondholders, Mortgages, and Other Security Holders Owning or Holding 1 Percent or More of Total Amounts of Bonds, Mortgages, or Other Securities. If none, check box.** → ☑ **None**
12. **Does Not Apply**
13. **Publication Title:** Motor Age
14. **Issue Date for Circulation Data Below:** August 2018
15. **Extent and Nature of Circulation**

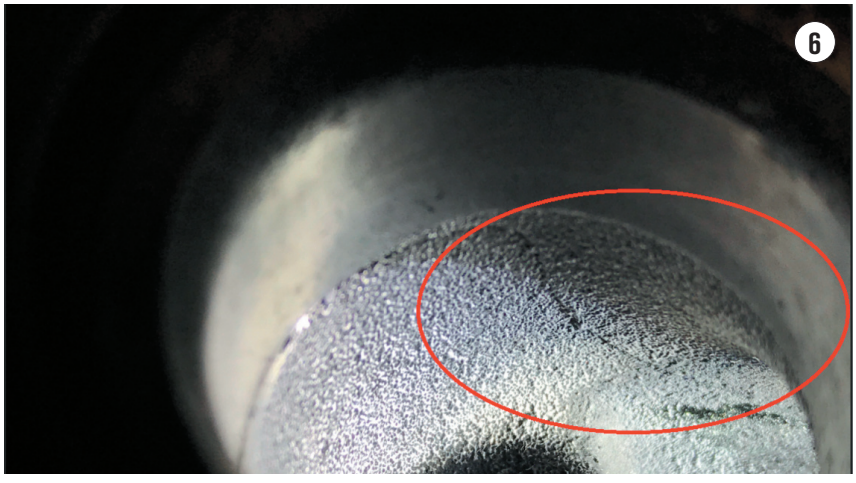
	Average No. Copies Each Issue During Preceding 12 Months	No. Copies of Single Issue Published Nearest to Filing Date
A. Total Number of Copies	110,689	104,790
B. Legitimate Paid and/or Requested Distribution		
1. Outside County Paid/Requested Mail Subscriptions Stated on PS Form 3541	96,452	83,126
2. In-County Paid/Requested Mail Subscriptions Stated on PS Form 3541	0	0
3. Sales Through Dealers and Carriers, Street Vendors, Counter Sales, and Other Paid or Requested Distribution Outside USPS	126	123
4. Requested Copies Distributed by Other Mail Classes Through the USPS	0	0
C. Total Paid and /or Requested Circulation (Sum of 15b (1), (2), (3), and (4))	96,578	83,249
D. Non-requested Distribution		
1. Outside County Non-requested Copies Stated on PS Form 3541	13,647	21,173
2. In-County Non-requested Copies Stated on PS Form 3541	0	0
3. Non-requested Copies Distributed Through the USPS by Other Classes of Mail	0	0
4. Non-requested Copies Distributed Outside the Mail	399	271
E. Total Non-requested Distribution (Sum of 15d (1), (2), (3) and (4))	14,046	21,444
F. Total Distribution (Sum of 15c and e)	110,624	104,693
G. Copies not Distributed	65	97
H. Total (Sum of 15f and g)	110,689	104,790
I. Percent Paid and/or Requested Circulation	87.30%	79.52%

16. **Electronic Copy Circulation**
    ***If you are not claiming electronic copies, skip to line 17**
    a. Requested and Paid Electronic Copies
    b. Total Requested and Paid Print Copies (Line 15C) **+ Requested/Paid Electronic Copies**
    c. Total Requested Copy Distribution (Line 15F) **+ Requested/Paid Electronic Copies**
    d. Percent Paid and/or Requested Circulation (Both Print & Electronic Copies)

    ☑ **I certify that 50% of all my distributed copies** (electronic and print) **are legitimate requests or paid copies.**

17. **Publication of Statement of Ownership for a Requester Publication is required and will be printed in the October issue of this publication.**
    Name and Title of Editor, Publisher, Business Manager, or Owner:
    Kristina Bildeaux, Senior Audience Development Strategy Director
    Signature:

Date: 09/30/18
I certify that the statements made by me above are correct and complete.



the starter consumes more energy trying to compress the contents of the cylinder then it does simply rotating the crankshaft (Figure 3).

Flushing out the fault

The GMC was taken on a road test around town for about 20 miles to get the big 6.6L up to operating temperature, just as Ron described. The vehicle was then parked for the rest of the afternoon and was prepped to capture the fault, red-handed, first thing the following morning. I placed a 600A-rated current clamp around the heavy cable feeding the starter motor. Although it may not have been totally necessary, I chose this test location to eliminate other devices that will serve as "noise" in my starter current capture. Devices like fuel supply pump and glow plugs may impede upon my capture and hide what I'm trying to see.

I connected my current probe to my lab scope and zeroed the probe out. I turned the key and awaited the extinguishing of the glow-plug indicator. I then cranked the engine over and found the description Ron provided to be totally valid. On top of that, my lab scope reflected the fault as a momentary event of high current draw, indicating a high starter effort was required. Unfortunately, the capture was inadvertently erased and I had to repeat the prep-process with only a couple of hours allotted for me to capture the fault for this article. If you see Figure 4, you can see the second peak from the left is not like the known-good example displayed. It represents the starter momentarily struggling before it continued to rotate.

Because this only occurs upon the initial cranking of the engine, it's an indicator that the engine is likely trying to compress a liquid in one of the cylinders (fuel, coolant) rather than a mechanical fault internal to the engine, as this would likely be more prevalent. I will point out that there is no visible smoke once the engine is started.

Who's the culprit?

I always let the results of my easy tests drive me to more pinpointed tests. This way, every move I make is justified. Every subsequent test will yield an answer. There is no shooting from the hip, so to speak. I also always curtail my testing around the configuration of the subject vehicle. In most cases, I would like to prove (as easily as possible) which cylinder is at fault. In this case, I already know that the fault is going to be time consuming to repair, and I must see what fluid is filling one of the eight cylinders. This piece of information will determine what the repair will be and how far the vehicle will have to be disassembled for repair.

I chose to remove all eight glow plugs. They are very easy to remove and because they plug directly into the combustion chambers, the removal will yield me the information I seek. The engine was once again ran hot and put away for the evening. The glow plugs were removed and the engine was cranked over. If you refer to Figure 5, you can see a still-capture of a short video. It is showing cylinder #6 expelling coolant from the glow plug port as the piston ascended towards TDC.

Pinpointing the root cause

After gaining permission to begin disassembly of the 6.6L, it was noted throughout the disassembly process that no other components outside of the combustion chamber were wet with coolant. This further corroborated the thought that the fault lay internal to the combustion chamber of the suspect cylinder or at least common to only the suspect cylinder. The cylinder head for bank #2 was removed for inspection and a crack in the coolant jacket within one of the #6 intake valve ports was found to be the root-cause of the "hard-start" concern (Figure 6). The takeaway from all this is that a solid foundation of basic testing techniques is what it took to gain a diagnostic direction. One doesn't have to be a "specialist" of any particular make or model to be successful in performing the diagnosis — but having a solid foundation, capable tools and adequate information is key to keeping your diagnostic balance on the three-legged stool!

BRANDON STECKLER is a working technician at Lykon Automotive in Bristol, Pa. He has worked in the field for over 18 years and holds ASE certifications A1-A9, X1, L1, L2 and L3 and C1.
theboywonder13@comcast.net

Raybestos provides all-weather protection against the elements

Winters can be harsh and especially damaging to the brake system. Rust is a growing concern and is due in part to the increasing amounts of chemicals used on the roadways for snow and ice removal, which in turn, can erode brake components. Raybestos® has invested in research, development and testing to provide top quality products that not only inhibit rust, but also increase durability and extend product life, making them ideal for vehicles in all-weather conditions.

Raybestos RPT Rust Prevention Technology™ coated rotors use a propriety finishing technology to evenly coat each rotor's entire surface, including the cooling vanes. The full Grey Fusion 4.0™ coating helps resist corrosion and significantly delays rust-induced performance issues. Open-wheel designs on modern vehicles leave brake parts, particularly rotors, more exposed to the elements. If a rotor is uncoated, corrosion and red rust begin to form immediately.

RPT Rust Prevention Technology plated brake calipers are premium quality, remanufactured calipers that function and fit like OE. A proprietary zinc electroplating process inhibits rust and provides all-weather protection against the elements. RPT calipers are friction ready and engineered for safe, leak-free operation. The plated brake calipers maintain their high-quality appearance and deliver continued functionality throughout their extended service life.

Strict testing criteria guarantees RPT calipers provide trouble-free installation and optimal performance in demanding driving conditions such as rain, salt and snow. They undergo a rigorous remanufacturing process to ensure they not only meet or exceed OE standards, but that they also adhere to global industry standards including SAE J1603, QC/T 592-2013, ASTM B117 and JASO C448. All recovered components are thoroughly cleaned, checked for wear and straightness, and zinc electroplated. The seals, boots, bleeder screws and O-rings are replaced with new materials.

Raybestos Opti-Cal™ premium new brake calipers are made from 100 percent new components, and unlike traditional calipers, requires no core return. Engineered to rigorous specifications and manufactured to meet or exceed OE performance, each caliper ensures safe, reliable and leak-free operation, combined with time-saving and trouble-free installation.

Opti-Cal is considered the optimum caliper for good reason. The all-new caliper body, bracket and components used in the manufacturing process, no core return and meticulous quality testing, all work to ensure that Opti-Cal calipers are engineered to perfection. Each caliper body and bracket is machined to precision. Aluminum or zinc plated housings and zinc plated brackets deliver superior corrosion prevention. The zinc finish provides all-weather protection, prevents rust and maintains a pristine appearance. All-new components, including pistons, lubricated guide pins and pad mounting hardware ensure that the caliper will fit and function correctly.

Opti-Cal calipers undergo significant levels of extreme testing to ensure adherence to global industry standards such as SAE J1603, JASO C448, QC/T 592-2013 and ASTM B117. The calipers undergo temperature durability testing, leak-free pressure testing, functionality testing and environment exposure testing to guarantee trouble-free operation, proper braking function and the best possible performance to meet today's rigorous driving demands.

For more information, contact a Raybestos sales representative or visit www.raybestos.com.

REPAIR DATA

Since 1918, Mitchell 1 has been the industry standard for quality repair data to the motor vehicle industry. From repair information with real-world fixes to shop management software and marketing services, auto and truck repair businesses rely on Mitchell 1's integrated solutions to achieve end-to-end process efficiency and improve productivity and profitability.

WWW.MITCHELL1.COM

FILTRATION PRODUCTS

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

WWW.PUREOIL.COM.

BRAKE PADS

Akebono Pro-ACT®, EURO® and Performance® Ultra-Premium Ceramic Brake Pads provide consistent, smooth stopping power across a wide range of driving conditions, including panic stops. The carefully selected materials found in Akebono application-specific friction formulations are designed to help minimize and virtually eliminate unwanted brake dust. Akebono is proud to manufacture its aftermarket ceramic brake pads in the USA.

WWW.AKEBONOBRAKES.COM

SCAN TOOL

New for 2018, a next-generation professional full-function, full-coverage scan tool. The new TORQUE includes an exciting new user interface making the TORQUE the easiest to use professional scan tool in the industry. The Torque features a unique intelligent VIN acquisition and decoding feature allowing vehicle access in seconds. The TORQUE is based on the new open Android™ 7.1" with Google Play.

WWW.LAUNCHTECHUSA.COM

INDUCTION CLEANER

ATS Chemicals 3C Intelligent Induction Cleaner is specifically designed to remove heavy carbon deposits from the gasoline based internal combustion engine. The 3C system quickly attaches to an induction port on the engine. The 3C microprocessor then delivers a customized measured amount of carbon removing chemical in timed intervals into the induction system thus removing heavy carbon deposits from the induction system and combustion chambers.

WWW.AUTOMOTIVETESTSOLUTIONS.COM

TECHNICAL TRAINING

WORLDPAC Training Institute (WTI) offers carline-specific advanced technical training, business management solutions and exclusive Smart Groups designed explicitly for independent repair shop professionals. Always developed and taught by experienced instructors, WTI training keeps you ahead of the learning curve to ensure your business remains competitive and profitable. View the complete class listing at the below website.

WWW.WORLDPAC.COM/TRAINING

FUEL PUMPS

Carquest Fuel Pumps, available exclusively from Advance Professional and Carquest, are performance-tested premium fuel pumps that ensure long life through quiet and precise operation. Designed with upgrades to meet or exceed OE specifications, Carquest Fuel Pumps use a superior carbon commutator and turbine technology to improve durability, enhance performance and reduce vibration noise. For more information on quality Carquest parts, call your local Advance Auto Parts or Carquest delivery location.

WWW.CARQUEST.COM

HEADLAMPS

NAPA NIGHTVISION™ Headlamps work on over 99 percent of the vehicles in operation since 1958 and provide whiter, brighter light for improved depth perception and contrast. So, when you go with NAPA NIGHTVISION™ Brilliant capsules, you'll get industry-leading brightness that'll outperform any OE parts. Plus, each comes with a three-year warranty, which means you can buy with confidence.

WWW.NAPAONLINE.COM

DYE KIT

The TP-8692 UV Multi-Colored Fluid Dye Kit has a complete set of dyes that fluoresce brightly when exposed to ultraviolet light. The kit includes three dyes for oil-based fluids: white dye, yellow dye and blue dye. The kit has a green fluorescent dye for conventional coolant. Quickly isolate and identify multiple leaks in all vehicle systems with color-coded dyes.

WWW.TRACERPRODUCTS.COM

OXYGEN SENSORS

NTK

THE SENSOR SPECIALIST™

From the world's largest OE oxygen sensor manufacturer comes a full line of premium technical sensors for the aftermarket, featuring more than 6,800 SKUs. Engineered for optimum performance, our new sensors meet exacting OE requirements and are designed for reliability. Visit us at AAPEX Booth #1832 to see our new sensors for yourself.

WWW.NGKSPARKPLUGS.COM/SENSORSPECIALIST

DIAGNOSTICS SCAN TOOL

Snap-on® APOLLO D8™ saves time by guiding technicians directly to the fix and eliminating guesswork. With Intelligent Diagnostics accessible in this versatile platform, the information needed to diagnose vehicles and diagnostic trouble codes is located on one convenient card, making the diagnostic process simpler than ever before. It also offers SureTrack® expert information, TSBs, "Smart Data" and functional tests and resets.

WWW.SNAPON.COM

SPINDLE ADAPTER

OTC has announced the new 5091 Heavy Duty Spindle Adapter, now available in North America. The low-lift transmission jack adapter holds the spindle assembly securely in place during king pin service, eliminating the need to completely disassemble the brakes and reducing the spindle weight while handling. For maximum convenience during service, the spindle assembly can be raised to a comfortable working height while replacing king pin bearings or bushings.

WWW.OTCTOOLS.COM

AD INDEX

AD INDEX

PRODUCTS

TRAINING

WHAT IS YOUR PRE-DIAGNOSTIC ROUTINE?

IT'S IMPORTANT TO RESOLVE YOUR CUSTOMER'S CONCERN. IT IS ALSO IMPORTANT TO HEAD OFF ANY THAT MAY LIE AHEAD!

PETE MEIER // Technical Editor

What is your normal routine when a customer arrives with a specific concern, like an MIL (Malfunction Indicator Lamp) illumination? Do you grab your code reader and go directly after the Diagnostic Trouble Code(s) that caused the light to come on? And do you end your process when you've corrected (or think you've corrected) the cause of the DTCs? If so, you may find yourself on the wrong side of a comeback!

Certainly, we want to resolve the concerns that our customer brought to us. But he or she is only bringing the concerns they are aware of to our attention. It is up to us to also address any concerns that are lying in wait. This could be overlooked maintenance needs or DTCs that are pending and haven't matured to turn on the MIL. In addition, inspecting the vehicle to discover these concerns is also going to provide you with potentially vital information that could assist you in repairing the current complaint. Finally, a final check of the vehicle after the repairs are made will not only verify the repairs but flush out any potential issues the original DTCs may have prevented you from seeing on the vehicle's initial arrival.

In this edition of the Trainer, sponsored by Snap-on, I will show you my pre-diagnostic routine and post-repair follow-up. Adding a similar routine to your repair process will cut down your comebacks, improve your customer satisfaction rate and add to your bottom line!

SPONSORED BY

Snap-on

GET THE PRODEMAND ADVANTAGE

ProDemand® wraps the industry's leading OEM & real-world repair information in a user-friendly interface that works the way you do. You're always a click away from the information you need for the most efficient diagnosis and repair.

From start to finish, advantages at every step of the repair process:

- ☑ **Start the Job Right**
  Plate-to-VIN vehicle identification, the latest TSBs & shortcuts to key specifications
- ☑ **Diagnose the Issue**
  Real-world diagnostic insights based on over a billion actual repairs
- ☑ **Complete the Repair**
  1Search™ Plus delivers the exact information you need in a tech-friendly workflow

Learn how you can get 1 month free!
Call us 800-896-3126 | Visit us: mitchell1.com
Or find your local Mitchell 1 sales rep: mitchellrep.com
repair information | shop management | shop marketing

Mitchell1®
In your shop, at your side

VISIT US AT AAPEX BOOTH 438

speed DIAL®

The **First to Market**
OE eCatalog from WORLDPAC

20th ANNIVERSARY

WORLDPAC 20 year ANNIVERSARY speed DIAL

Use speedDIAL® anytime, anywhere, for wholesale access to OE and quality aftermarket import and domestic automotive replacement parts.

- Over 40 Import and Domestic Car Lines
- Multiple Same-Day Delivery and Overnight Shipping Options
- OE-Style Exploded Diagrams
- Fully Optimized for Tablets
- Vast Selection of More than 900,000 Parts
- 24/24 Standard Parts Warranty
- VIN Scanner

Celebrating 20 years of supplying quality brands our customers know and trust.

ACDelco · TEXTAR BRAKE TECHNOLOGY · BERU · AISIN · GEBA · BEHR HELLA SERVICE · Zimmermann · MAHLE ORIGINAL · MAVAL · GOETZE · Arnott Air Suspension Products · BANDO · NPN · DELPHI · REDLINE ENGINE MANAGEMENT · MOPAR · IDEMITSU · AE · ajusa · PENTOSIN · Continental · rein AUTOMOTIVE · Ford Motorcraft · akebono BRAKE EXPERTS · MOTUL · VDO · KYB World Class Shocks & Struts · ISG · GRAF · SCHAEFFLER · LUK · INA · FAG · RUVILLE · CARDONE · BOSCH · LIQUI MOLY · CORTECO · MANN FILTER · NGK SPARK PLUGS · NTK OXYGEN SENSORS · ENEOS · ADVICS · BILSTEIN · BRAKE DISC ROTORS mountain · ebi bilstein · MITSUBOSHI · WBR · SACHS · LEMFÖRDER · TRW · distributed by ZF Services, LLC STABILUS · ZF · Valeo · Gates · NISSIN · WORLD SOURCEONE · DENSO first time fit · EXEDY EXEDY Globalparts Corporation · ATE · Nissens · PILENGA Brake Disc Division · GLYCO · RED LINE SYNTHETIC OIL · bosal · METRIX · FERODO · SB SANGSIN BRAKE · CSF The Cooling Experts · PRENCO · DORMAN NEW SINCE 1918 · FEQ AXLES

worldpac.com/sd20 | worldpac.ca/sd20

WORLDPAC
Wholesale Distributor of OE Parts for Import and Domestic Vehicles