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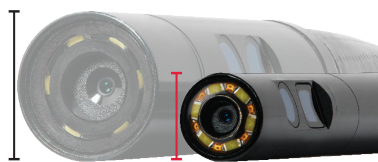
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PAVING THE ROAD

FOR

EV MAINTENANCE

AND

GENERAL SERVICE

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OUT OF SIGHT, OUT OF MIND? NOT ANYMORE

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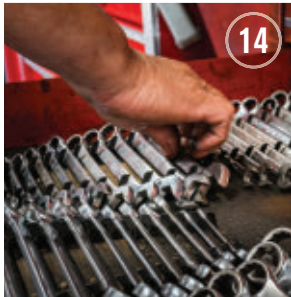
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TOP 10 PRODUCTS OF AUGUST 2023



From long-reach hose-grip pliers and a flare nut wrench set to athletic-level cushioning work shoes, check out the most clicked-on products. See what other technicians, shop owners, and mobile tool distributors were clicking on last month. Here are the top 10 most clicked-on products that were added to VehicleServicePros.com in August.



WEB EXCLUSIVES

ASA: INDUSTRY RIGHT-TO-REPAIR AGREEMENT STRENGTHENED BY SUPPORT FROM TESLA AND RIVIAN

The agreement will now cover nearly 100 percent of auto makes. The Right-to-Repair and vehicle data access agreement reached in July 2023 between the Automotive Service Association (ASA), the Alliance for Automotive Innovation (AAI), and the Society of Collision Repair Specialists (SCRS) is gaining industry support. It was revealed to the public at the end of August that electric vehicle manufacturers Tesla and Rivian endorse the agreement. OEMs see the agreement as providing confidence to customers that independent repair shops will be able to service their vehicles, should that be their choice.



Scan the QR code to read this article in its entirety.

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SEMA SHOW MOVES NEW PRODUCTS SHOWCASE TO NORTH HALL

➔ The 2023 New Products Showcase is set to feature thousands of the hottest products in the automotive aftermarket.

This year, the world's largest display of new automotive aftermarket products, as SEMA Show claims, will be relocating to the North Hall of the Las Vegas Convention Center (LVCC), according to a recent press release.

The 2023 SEMA Show New Products Showcase is accessible exclusively to SEMA Showgoers during the Oct. 31 to Nov. 3 trade show.

"The New Products Showcase is the most comprehensive collection of

what is coming next in the automotive industry, providing attendees a virtual glimpse into the future of the market," said SEMA Vice President of Events Tom Gattuso. "It is where SEMA Show attendees can also envision how to utilize the latest products and services in their own businesses by learning details about the products, including the exhibitor's booth number, so they connect directly with the manufacturer on the Show floor. Exhibitors can maximize their ROI by participating in the New Products Showcase, which results in increased brand exposure and more visitors to their booths." *TZ*

"THE NEW PRODUCTS SHOWCASE IS THE MOST COMPREHENSIVE COLLECTION OF WHAT IS COMING NEXT IN THE INDUSTRY, PROVIDING ATTENDEES A VIRTUAL GLIMPSE INTO THE FUTURE OF THE MARKET." – TOM GATTUSO, SEMA VICE PRESIDENT OF EVENTS



CAR CARE SCHOLARSHIPS AWARDED TO 10 STUDENTS

➔ Federated Auto Parts has awarded Car Care scholarships to 10 exceptional students: Taylor Butler, Kylie Caverly, Keith Cecil, Christian Fisher, Leigh Hicks, Jacob Miller, Michael Phelps, Kathleen Raab, Bailey Thede, and Hannah Winn.

Federated Auto Parts has awarded 10 Car Care scholarships to students for the 2023-24 academic year.

Awardees included employees or children of Federated Car Care Center members. Scholarships are funded by Fisher Auto Parts and administered by the University of the Aftermarket Foundation in memory of the late Art Fisher, founder of Federated Auto Parts.

"Throughout our history, Federated has been dedicated to providing educational opportunities for students," said Sue Godschalk, president of Federated Auto Parts. "It is with great pleasure that we present the Federated Car Care scholarships to this remarkable group of young individuals. Beyond their impressive academic achievements, these students have also showcased exceptional leadership within their communities. We extend our heartfelt congratulations to them and offer our best wishes as they embark on the upcoming school year."

To be considered, applicants had to meet the criteria outlined in the Federated section of the Automotive Aftermarket Scholarship Central website and name Federated in the sponsor section of their completed application.

Scholarship recipients: Taylor Butler, Kylie Caverly, Keith Cecil, Christian Fisher, Leigh Hicks, Jacob Miller, Michael Phelps, Kathleen Raab, Bailey Thede, and Hannah Winn. *TZ*



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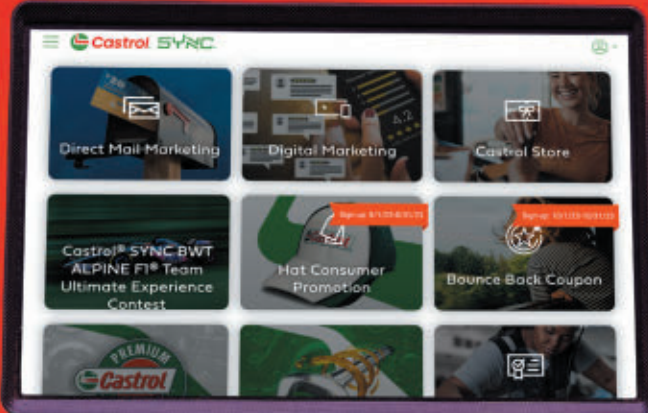
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HUNTER ENGINEERING EXPANDS SUPPLY CAPABILITIES IN MISSOURI AND MISSISSIPPI

Company continues to efficiently serve customers despite supply chain challenges

➔ For the last several years, supply chain and logistical difficulties have created well-known havoc in the automotive industry. Such challenges haven't stopped Hunter Engineering from producing and delivering the innovative, durable equipment its distributors and customers have long come to expect.

Over the past 12 months, Hunter has made a number of significant changes at



its St. Louis headquarters and production plants in Mississippi to ease supply strains and keep products moving.

Last year, Hunter opened a new distribution center in Madison, Mississippi, between its plants in Durant and Raymond, Mississippi. The 106,000-square-foot, 37-bay facility was designed to open more production room at the existing plants, while also dramatically speeding up shipping times.

Finished products are now stocked and consolidated in Madison before delivery to customers in an efficient, single shipment. The new center soon

set a new company record by shipping more than 30 racks in a single day.

Earlier this year, Hunter restructured its St. Louis service center to streamline procedures and make the most efficient use of space.

Employing a new automated pack-out line, the packing team completely rearranged operations for an improved flow. The receiving team was able to process critical inbound parts two days faster, sending them into the field sooner and with less effort.

Additionally, moving teams to other parts of the building allowed for the removal of walls, creating more space for warehousing and other uses.

Other improvements to ensure consistent service have been occurring throughout the company.

The manufacturing of bench lathe parts, previously performed by a third party, has been brought in-house for more quality control and reduced customer lead times.

In Durant, a new tube-cutting laser enabled all RX leg and cross-member cutting to be performed onsite. An additional massive 10K Trumpf laser was installed to keep pace with demand.

In the Raymond metal fabrication

plant, additional press brakes, robotic welding cells and a panel former were brought online. New assembly operation cells were added to build the new Ultimate ADAS™ system and the popular Maverick® tire changer.

The Hunter electronics plant in Raymond commissioned a second full Panasonic pick-and-place line and state-of-the-art automated inspection technology, allowing Hunter to build boards with the latest high-speed technology for an even greater quality advantage. The wire and cable department also received new cable processing technology to improve quality and add capacity.

The equipment and continuous improvement efforts from Hunter Excellence Teams yielded significantly increased throughput to keep pace with growth.

"Hunter has always prided itself on not only producing innovative equipment but making sure it's always kept in constant use by our customers," said Mike Redfean, Hunter vice president, manufacturing. "We're very proud that we've been able to maintain our usual standard of performance despite numerous supply chain obstacles." 

ALLSYSTEMSMAX CLOSING DOWN

The Oregon-based software company announced its closure and the retirement of CEO Steve Miller.


Shop management software company AllSystemsMax will close its doors and CEO Steve Miller will retire, according to a press release.

The Oregon-based company said it will conclude operations at the end of 2023. AllSystemsMax provided few de-

tails behind the closure and spent much of its press release diverting customers to another software provider, Tekmetric.

From the press release: "As AllSystemsMax LLC concludes this chapter, Miller and his team extend their deepest gratitude to those who have been a part



of the company's journey. AllSystemsMax LLC remains humbled by the opportunity to serve shop owners across the nation and is excited to witness the continued success of its customers under the guidance of Tekmetric." 

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Monetizing tire services in your auto repair shop:

10 STRATEGIES FOR SUCCESS

BY BRIAN HUNNICUTT // Contributing Editor

Running an auto repair shop can be a lucrative venture, especially when you tap into various avenues for revenue generation. One of the most consistent and profitable areas to explore is tire services. Tires are essential to every vehicle, and their maintenance and replacement needs provide a prime opportunity for monetization. This article will explore practical strategies for monetizing tire services in your auto repair shop.

1 Offer a comprehensive range of tire services

To successfully monetize tire services, it's crucial to provide a comprehensive range of offerings that cater to different customer needs. These services can include tire sales, tire installation, tire rotation, wheel alignment, tire repair, and tire storage. By providing a one-stop shop for everything related to tires, you position your auto repair shop as a reliable destination for customers' tire needs.

2 High-quality products and brands

Investing in high-quality tire products and reputable brands is essential for both customer satisfaction and building a strong business reputation. Partnering with well-known tire manufacturers ensures that you're offering reliable and durable products to your customers. Remember, customers are willing to pay a premium for quality, which can significantly impact your shop's bottom line.

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TIRES ARE ESSENTIAL to every vehicle, and their maintenance and replacement needs provide a prime opportunity for monetization.



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3 Implement competitive pricing strategies

While quality is vital, pricing also plays a pivotal role in monetizing tire services. Research your local market and competitors to determine reasonable and competitive pricing for your tire offerings. Consider bundling services, such as offering discounted tire installation when purchasing a complete set of tires. Striking the right balance between quality and affordability can attract a wide range of customers.

4 Upselling and cross-selling

Upselling and cross-selling are effective techniques to increase the value of each customer transaction. When a customer comes in for a tire service, train your staff to suggest related services or products. For instance, if a customer is getting their tires replaced, your team can recommend a wheel alignment to ensure the longevity of the new tires. Similarly, offering tire maintenance products like tire shine or tire protectant can increase your average transaction value.

5 Loyalty programs and discounts

Implementing loyalty programs or offering discounts to repeat customers can foster long-term relationships and encourage customer retention. Consider creating a point-based system where customers earn points for each tire service they use. Then, allow them to redeem points for future services or discounts, incentivizing customers to choose your shop over competitors.

6 Online presence and e-commerce

In today's digital age, having a strong online presence is crucial for business success. Create a user-friendly website where customers can browse your tire offerings, schedule appointments, and even purchase

online. E-commerce integration allows customers to buy tires directly from your website, expanding your reach beyond walk-in customers.

7 Educational workshops and content

Educating your customers about the importance of proper tire maintenance and the advantages of premium tires can position your shop as a trusted authority. Consider hosting workshops or creating informative content on your website/blog. Topics could include tire care tips, the impact of tires on fuel efficiency, and the differences between various tire types. By showcasing your expertise, you build trust and credibility with your audience.

8 Fleet services

Don't overlook the potential of offering tire services to local businesses with vehicle fleets. Establishing partnerships with businesses that rely on multiple vehicles can provide a steady stream of work. Fleet services can include regular tire maintenance, replacements, and emergency repairs. Offering discounted rates for bulk services can make your shop an attractive choice for fleet managers.

9 Seasonal promotions


Tire needs vary based on season. Capitalize on this by offering seasonal promotions. For example, offer deals on snow tires and winterizing packages before the winter season. During the summer, promote tire maintenance services that ensure optimal performance during road trips. These promotions attract customers and encourage them to plan their tire-related services in advance.

10 Exceptional customer service

Outstanding customer service is a cornerstone of any successful business. Train your staff

to provide exceptional service from the moment a customer walks in until the job is complete. Friendly and knowledgeable staff who can answer customer queries, recommend appropriate tire options, and explain the benefits of different services can significantly impact customer satisfaction and loyalty.

Monetizing tire services in your auto repair shop requires a strategic approach encompassing a range of offerings, high-quality products, competitive pricing, and excellent customer service. By implementing these strategies and continuously adapting to your customers' needs, you can establish a thriving business that stands out in the competitive auto repair industry. Remember, satisfied customers are more likely to return and refer others, creating a growth cycle for your shop.

Auto repair shops are busy and complex businesses that require proper management of various resources, including inventory. Therefore, a proper checklist for all your operations, such as ATI's Leader's Operations Checklist, is essential for auto repair shops to provide quality services to their customers while ensuring they are profitable. To receive your copy, go to www.ationlinetraining.com/2023-10 for a limited time. 



BRIAN HUNNICUTT, CEC, PFP, has been in the automotive industry since 1978 and is an executive coach for the Automotive

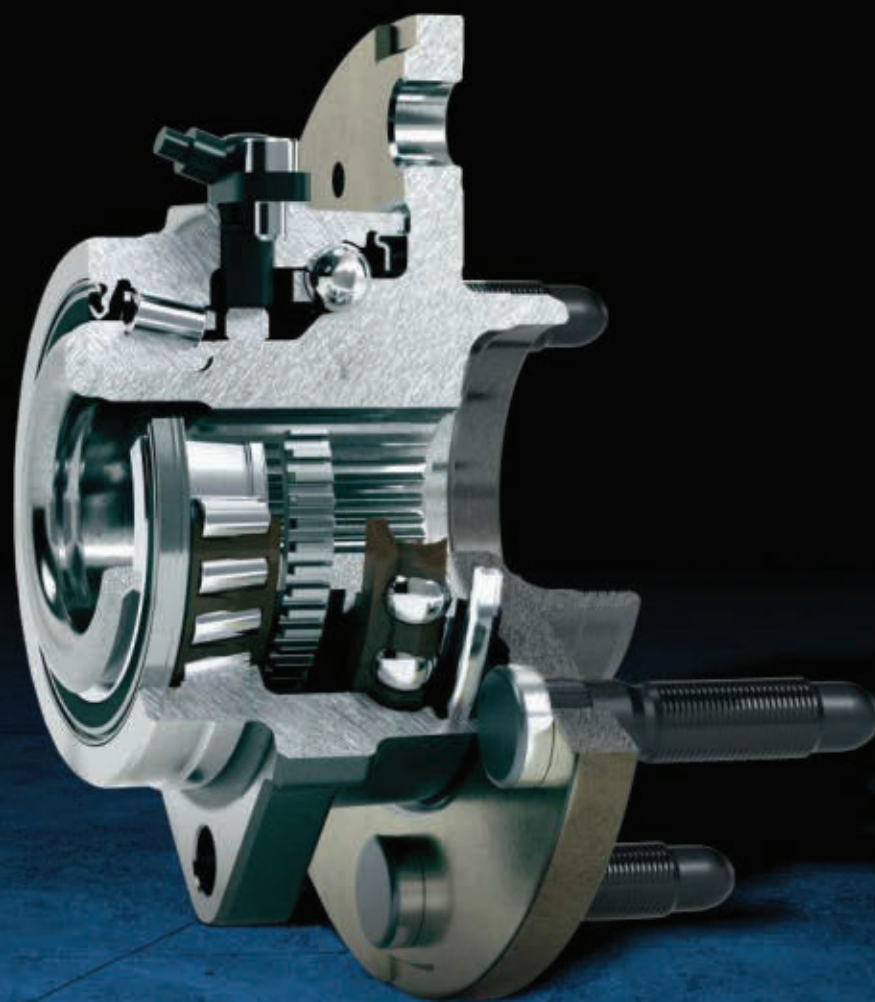
Training Institute (ATI). Often called in as a troubleshooter, Hunnicutt is an innovative thinker with a history of reviving failing stores, consistently breaking sales records and exceeding expectations. He helps auto shop owners effectively apply successful, practical methods and systems, rather than theoretical techniques. ATI's 34 full-time, certified coaches have helped ATI's members earn over \$2.5 billion in return on their coaching investment since ATI was founded.

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The electric classroom

Troy Lachance of White Mountains Community College gets students ready for EV repair success.

BY KACEY FREDERICK // Contributing Editor

As shops grapple with vehicles changing and becoming more electric, finding technicians who are equipped to work on EVs becomes essential in a pool of talent that is already limited. Troy Lachance, an instructor in the automotive program at White Mountains Community College in Berlin, New Hampshire, talked about what technicians entering the workforce need to know and what is needed in the industry from the next generation.

An unexpected calling

Lachance graduated in 1993 from the program he currently teaches and then went on to work as a full-time world-class General Motors technician until 2013.

Lachance never intended to become a teacher, but in 2011, he was approached by a former teacher who encouraged him to apply for a vacant position at the school.

"I just happen to get a visit from him one day saying, 'Hey, one of the other instructors is retiring. I think you've got a good personality and would be a good fit,'" Lachance recounts. "And I applied for the job and the rest is history. So you just never know where life is going to take you right?"

Since then, Lachance has run his own repair shop from his home and pushed for the automotive program at WMCC to create classes dedicated to electric vehicles.

Preparing for an electric future

The school offers students a 15-week EV course in the tradi-

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tional automotive program or a one-year accelerated electric vehicle program, which Lachance had a part in helping create.

There's much that students need to learn before they are able to build an EV successfully, but the biggest point Lachance hammers home for them is attention to safety.

"It's no different than a lineman working out on the pole, you know, (on) your street corner, there's a lot of safety protocol that has to happen," Lachance says.

Lachance goes over essential topics related to EVs with his class: different drive systems that hybrids and EVs have, battery technology, inverters, converters and charging technology—Lachance says that the students get a look at nearly everything related to EVs.

Students listen to lessons as well as perform hands-on work. In the one-year EV program, students actually have the chance to build an EV in the class shop, which is a great opportunity for students to work on something new without potentially endangering a driver.

EVs, shmee-vees

Lachance encounters many students that aren't interested in learning about EVs. Regardless of anyone's feelings on the existence of EVs, technicians will have to know how to deal with them as they grow in popularity.

"You don't have to like EVs," Lachance states. "I'm neutral. But you'd be silly if you didn't recognize the increased popularity and the fact that you can make a bunch of money fixing them."

With most manufacturers having an electric or hybrid option now, technicians who are qualified to work on EVs become an asset to any shop.

"The EV techs are short, there's not many of them out there. So you can work wherever you want—more or less name your price, as long as you are, you know, asking reasonable wages—you'll be in high demand," Lachance says.

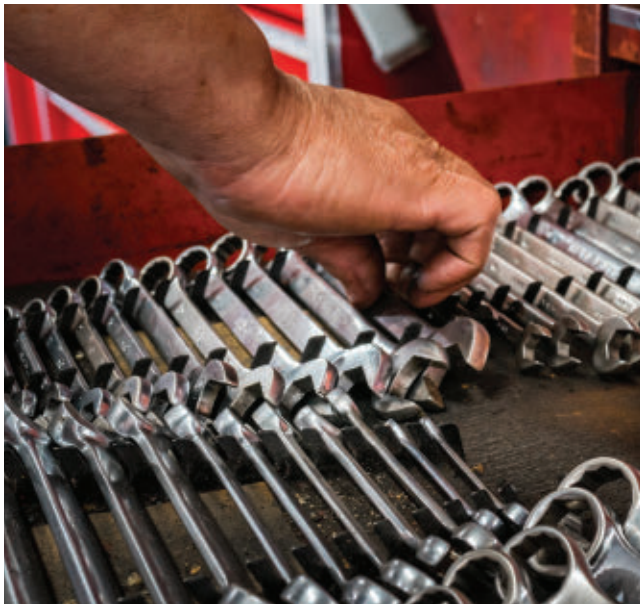
Cultivating a capable crew

Shops looking to attract talent that can work with this emerging technology must show that they can have a fulfilling career. If students see that they can make a comfortable living working in the industry, the industry will draw in intuitive minds.

“We need intelligent, intellectual people to work on vehicles,” he asserts. “Younger people need to understand that there’s a lot that emulates what they already know, right? Whether it’s video games and computers and cell phones ... there’s a lot of modern electronics and computerized components that require the interest and expertise of the younger generation.”

Technicians that are aware of and willing to adapt to the changes in the coming years, such as battery technology changing and improving, will be able to help support a shop navigating incoming changes.

Regardless of the direction the industry and the future of EVs go, Lachance’s goal is to prepare his students to have the best opportunities and to keep drivers safe with the work they do.



Though he doubts many proposed EV transition goals will be met, EVs are nonetheless established in the industry and will only become more prominent.

As shops look for talent to build their teams, they need to be sure their technicians can handle what is becoming an established market in the industry by investing time and resources into preparing their staff for the work they will see in the shop in the coming years. *ZZ*



KACEY FREDERICK is an assistant editor for Endeavor Business Media's Vehicle Repair Group. Frederick covers innovations and trends in the automotive industry.

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PHOTO COURTESY OF DEREK MOHART

Derek Mohart claims the title of **2023 BEST YOUNG TECH**

Mohart stood out for his can-do attitude, penchant for problem-solving, and ability to quickly find ways to improve clunky work processes.

BY EMILY MARKHAM // Contributing Editor



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Derek Mohart has spent his entire life around cars. Growing up, he notes, his dad owned a variety of different vehicles, from a 1932 Hudson Essex to an '88 Chevy Crew Cab with an 8' bed, and everything in between. He spent a lot of time as a kid helping his dad with those vehicles. However, when it came time to head off to college, Mohart never dreamed of going to school to become a technician.

"I went to [The University of Missouri] for pre-med in biochemistry," he says. "I was planning to be a radiologist."

With this career path, he was planning to follow his mom into the medical field, but after a year full of science and math classes, Mohart found he was losing interest. Over the summer, he went home and started working on his truck and fell in love with doing upgrades and putting aftermarket parts on it. That's when his passion for the automotive industry really started to grow.

This passion has taken Mohart far in his journey as a technician. With his can-do attitude, penchant for problem-solving, and ability to quickly find ways to improve clunky or outdated processes, it's no wonder Chris Chesney, VP Training & Organizational Development for Repairify, nominated Mohart for this year's Motor Age and PTEN Best Young Tech Award.

The award is designed to honor technicians aged 35 or younger who are moving the service repair industry forward, excel in their current role, and are passionate about their work.

Finding a place in the industry

Mohart, age 28, has had an interesting career pathway thus far. After graduating from Ranken Technical College with a degree in High Performance Racing Technology, he worked a job diagnosing and rebuilding transmissions as well as doing custom engine work. From there, he began work as a subcontractor for Anheuser-Busch where he performed maintenance, repairs, and diagnostics on the Cummins compressed natural gas (CNG) engines. During that time, he also received his Class A CDL. A little further down the road, Mohart became the lead technician at a restoration facility when he was only 23 years old. The young technician dipped his toe into many different facets of the automotive industry before he began working at his current place of employment, asTech.

At asTech, Mohart started as an in-shop technician managing a fleet of cars by using an asTech device and submitting the vehicles for diagnostics to the company's remote technicians. He also worked to expand his industry knowledge. He

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went from having two ASE certifications to 12, becoming a certified ASE Master Technician, along with procuring his B2-B5 and C1 certifications.

“As time went on, Derek started learning all the OEM scan tool software and became more efficient at the process,” Chesney notes. “[He] started scanning the vehicles that he was hooking up in the shop, no matter what manufacturer the vehicle was from, [and] eventually became the highest scanning technician in the company, while still managing a shop full of cars.”

Early on in 2020, Mohart’s career shifted once again. This time, he found himself working as a remote diagnostic technician. “Remote” isn’t a word most people think of when it comes to fixing cars, and four years ago when Derek started at asTech, he never thought he’d eventually be a technician working from home.

“It’s a different mindset,” Mohart explains of his transition from in-shop to remote. “You can’t really see what happened, even though the shop will tell you where the damage is, [and] what kind of damage it is. You’ve got to think in different ways once you go remote.”

As was Mohart’s norm throughout his career, Chesney notes that as a diagnostic technician, Mohart focused on

DEREK MOHART’S TOP 5 FAVORITE TOOLS:

1. Milwaukee Tool 1/2” electric impact
2. Milwaukee Tool hood lamp
3. General stethoscope from Amazon
4. Snap-on tap and die set
5. Milwaukee Tool 1/4” impact

becoming the most efficient and best technician he could be. Through that determination, Mohart became the top remote technician in the company within a month. On average, Chesney says Mohart was scanning 80 vehicles a day, compared to the company average of 40-50 per technician. Eventually, his scanning average hit 100 vehicles per day with an all-time high of 203 scans in one day.

“After becoming efficient in his own work,” Chesney says, “Derek started looking for ways to make everyone around him more efficient.”

Congratulations to all the talented participants of the 2023 Best Young Tech Awards!

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All about efficiency

Mohart's drive to create efficiency in his workplace perfectly set him up for the position he's working now – continuous process improvement manager.

Though he still jumps into helping with scanning when need be, his current job has him scrutinizing the processes they have in place in order to streamline them, making work a bit easier for everyone.

"Derek's ability to review processes and identify areas of improvement in a short amount of time is unique," Chesney says. "He brings a 'can-do' attitude to work every day and has become an essential team member on every project in our organization."

Mohart notes that he's always worked this way, looking for a different way to do things.

"I've always just kind of tried to find the inefficiencies in everything I do and just find ways to make any processes better," Mohart explains.

For example, he notes that for his remote office set-up, he has multiple computer screens on his desk. While he worked as a diagnostic technician, he would set the screens up in a way that created a natural flow with the information he was looking at, which helped to create a good working rhythm.

For the love of a challenge

After having worked in many parts of the automotive industry, diagnostics is still Mohart's favorite part of being a technician.

"One-off instances are my favorite because you just get to dive into the wiring diagrams or the exploded parts view diagram," Mohart says. "It's really fun being able to diagnose an issue that nobody else has figured out."

RUNNERS-UP

Be on the lookout, starting January 2024, for the first online exclusive interview featuring one of the talented top nine runners-up for this year's Best Young Tech Award. Throughout the year, *Motor Age* editors will be chatting with the top nine to get the inside scoop on how these techs have come to thrive in the industry. The top nine include the following:

Josh Whiteman

Melina Algier

Nick Kolodgie

Aaron Schnabl

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Blaine Vanderberg

Nathan Wonderly

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It's challenges like these that keep the young tech motivated to continue growing his knowledge as new technology emerges in the industry. Though he notes, now that he's in a leadership position it's not just about expanding his own knowledge, it's about helping others learn as well.

"This industry is ever-changing," Mohart says. "There's never day-to-day, month-to-month, year-to-year — nothing stays the same with automotive."

GRAND PRIZE

As the winner of the Best Young Tech Award, Derek Mohart received the following prize pack:

- All expenses paid trip for two to the 2023 AAPEX/SEMA Show in Las Vegas provided by Motor Age and PTEN magazines
- All expenses paid trip for two to the 2024 STX Supplier and Training Expo in Nashville provided by CTI-WTI (Advance Auto)
- A tablet and complimentary ALLDATA subscription for 12 months provided by Duralast Parts
- Haynes Model V8 Engine provided by TechForce Foundation
- A TBD prize provided by Solera
- An award plaque and uniform patch

For Mohart, it's about helping the other technicians become better technicians. Looking ahead, he wants to do much of the same — continue learning, build more skills, get more certifications, and just do anything that can help him do his job better, so he can continue helping others be their best.

"[Derek] represents the talent that is in our industry that comes from a traditional path but didn't allow himself to get trapped into a role that many find themselves in," Chesney says. "His example of continuing to look for a rich challenge to express his skills is worthy of sharing with entry-level technicians as they consider a career in our industry. As well, his path serves as a wake-up call to shop owners and other business owners that they should continue to invest in and stretch the talent on their teams to allow people like Derek to find their best opportunity."



EMILY MARKHAM is the editor of *Professional Tool & Equipment News* (PTEN) and *Professional Distributor* magazines. These publications are part of the Endeavor Business Media Vehicle Repair Group.

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TECHNICAL

PAVING THE ROAD FOR EV MAINTENANCE AND GENERAL SERVICE

SAFETY, TRAINING, CERTIFICATION, AND TOOLING WILL BE REQUIRED TO PREPARE TECHNICIANS AND SHOPS FOR THE TRANSITION TO ELECTRIC VEHICLES AND OTHER ADVANCED TECHNOLOGIES.

BY DAVE MACHOLZ // Contributing Editor



OLD MEETS NEW: The electric motor under the hood of the classic Jeep “CJ Surge” concept vehicle displayed at the 2022 SEMA Show produces a peak output of 200 kW, or 268 bhp. The electric motor is powered by a 50kWh battery pack with 24 modules that is mounted in the rear section.

The emergence of electric vehicle technology is evident. Lawmakers at the state and federal level have charted a course to a future that’s likely free of internal combustion engines, with aggressive mandates placed on auto makers that will result in a seismic shift in the automotive technology landscape. Is your shop prepared for the transition?

In 1959, Ray's Auto Service opened on the north service road of Sunrise Highway in Islip, New York, just around the corner from Long Island's iconic Islip Speedway. Ray Sr. bought the American Oil Company station that included a two-bay repair shop with the intention of setting up Ray Jr. in the auto repair business. The first day on the job, Ray Jr. learned how to set distributor points, change a cap and rotor, and set the gap on a spark plug. In a short time, Ray learned enough to run a successful repair shop and he was able to purchase a home and raise a family.

In 1969, Ray Jr. was forced to close the shop due to an expansion of the highway and took a job with a familiar company, Snap-on Tools. Over the course of his 25 years at Snap-on, he learned automotive technology the hard way, through on-the-job training and what little education was available at that time, and in 1990 he became a Snap-on Tech representative. I know this story well— as a 12-year-old kid I started riding around in the truck on summer vacations with my grandpa, Ray Jr.

Now at 90 years of age, Grandpa Ray and I recently had a conversation about electric vehicles, and he remarked how he could not conceive how a technician like him, with no experience and training could make it in a world of advanced technology electric vehicles. During the conversation, we discussed what would be required for technicians and shops to be successful in maintaining and repairing these vehicles. As he remarked, "This is truly not your grandpa's automotive business any longer."

One of the most staggering realizations about our automotive workforce is that there is no minimum standard for career

entry. In 1972 The National Institute for Automotive Service excellence (ASE) was formed to professionalize the industry and provided a framework for voluntary automotive certification. Today, the automotive technician workforce is made up of roughly 733,200 workers (according to the Bureau of Labor Statistics). Of the 733,200, an alarming 3,409, or less than one percent of technicians, hold the ASE L3 Light Duty / Electric Vehicle Specialist certification. Overall, just 24 percent of technicians hold any certification through ASE. While the number of OEM certified technicians is unpublished, the percentage of those not holding certification brings to question the preparedness of the workforce.

This requires a closer look at the safety, training, certification, and tooling that will be required to prepare technicians and shops for the transition to electric vehicles (EVs) and other advanced technologies.

Safety considerations

A good starting point for those seeking to prepare for electric vehicle service and repair is an awareness of the safety issues related to EV high-voltage systems. In Spring 2023, ASE released new electric vehicle safety standards and certifications that cover the essentials of electric vehicle safety awareness.

The xEV Electrical Safety Awareness Certification (Level 1) is intended for anyone working around electric vehicles in a shop environment including sales, service, and related personnel.

The xEV Technician Electrical Safety Certification (Level 2) is intended primarily for technicians who are responsible for maintaining and repairing electric vehicles.

These certifications and standards are available via the web at: <https://www.ase.com/ev> and are priced at \$38.99 and \$49.99 respectively.

These tests can also be taken anywhere in which there is web access, and the test-taker does not need to visit a computer-based testing center. The test has a 60-minute limit and when successfully passed the site will generate a downloadable, print-ready certificate.

Training

As with any new technology, technical training for EV's is essential. Currently, EV training is available from auto parts companies, technical and career and education providers such as community colleges and trade schools, and independent training entities.

As with any training, look for affiliation with accrediting bodies that align with automotive technician training standards such as ASE. ASE's Training Manager Council (ATMC) provides training organizations with an accreditation that is rigorous and ensures that the training provider, its material,



FACTORY SCAN TOOLS such as the Nissan Consult III are extremely valuable in diagnosing EV system faults as they tend to offer more capability than aftermarket J2534 devices.

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WHEN BEGINNING THE TRANSITION to servicing electric vehicles, safety certification is a key first step. This is the insignia representing ASE's xEV certification.

and its trainers are qualified.

A list of ATMC accredited training providers can be found on the ATMC website: <https://atmc.wildapricot.org/>

Keep in mind that any high voltage training requires a fundamental understanding of electricity and electronics. If you are planning on servicing high-voltage vehicles, start with the basics. Seek training that will build your electrical and electronics skills. Understanding the fundamentals will make the transition to high-voltage AC and DC current much easier.

Certifications

A certification can be defined as a credential provided by a third-party industry-recognized entity that provides a measurement of competency in a given area. Keep in mind, certifications are different than certificates of completion. Simply completing a course or attending a training class does not result in certification, even though you may have been given a certificate at the end.

The two main industry-recognized certifications in the automotive repair sector are OEM-specific certifications and ASE certifications. OEM certifications require that a technician work for the brand in order to earn certification, or they can also be obtained in OEM training programs at trade schools and community colleges.

ASE is an independent voluntary certification available to any technician who possesses two years of industry experience and who takes and passes the certification exam. There is no

training required as a pre-requisite to certification although ASE strongly recommends training before certification.

ASE's L3 Light Duty Hybrid / Electric Vehicle Specialist Test is the industry standard for hybrid/electric vehicle certification. To take the L3 exam, a technician must first possess the ASE A6 Electricity and Electronics and A8 Engine Performance Certifications.

Recently, a National Science Foundation grant at Central Oregon Community College created a set of safety and technical standards for EVs. This grant resulted in the formation of EV Pro Plus, an organization that provides training leading to a certification and is registered with a division of the society of automotive engineers (SAE) known as SAE-ITC. The EV Pro Plus certification has four levels that include several days of classes and hands-on testing which are required before taking the certification exam through SAE-ITC's website. The EV Pro Plus SAE certification is unlike ASE certification in that it is not independent of the training provided by EV Pro Plus. In other words, you must first complete the training provided exclusively by EV Pro Plus to qualify for the examinations for each level. For more information on the program visit: <https://www.evproplusprogram.com/>

Factory service information and diagnostics

As technology advances, the complexity of the repairs we will take on will follow. It may become essential to have access to the latest, most up-to-date information and tooling in order to perform service, diagnostics, and repair.

Most manufacturers have a subscription to service information and diagnostics available through an independent service website. The National Automotive Service Task Force (NASTF) is a great place to start with your search for assistance in obtaining factory information and diagnostics.

OEM scan tool interfaces are also available to use in conjunction with the factory software through vendors such as Drew Technologies, AE Tools, NC Auto Rescue, and AES Wave.

Tools and equipment

Many of the tools that you currently use will remain in use for electric vehicles. However, there are quite a few new tools and equipment required for electric vehicle diagnosis and repair.

Personal protective equipment (PPE)

Class "0" linesman gloves are required when performing a high-voltage system service disconnect and at any time specified by the service information.

These gloves are available from a variety of retailers and typically come as a set that includes high-voltage gloves and leather over-shell gloves that are worn over the insulated gloves.

These Class 0 gloves require certification every six

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THESE CLASS 0-RATED HV Safety Gloves are high voltage safety gloves essential for safe high-voltage system diagnosis and repair.

months, which includes mailing the gloves to a certified testing center. At the time of recertification, the gloves will be date-stamped, starting the next six-month window.

An insulated retrieval hook (or “hot stick”) should be purchased for the facility. This special hook is used to rescue an electric-shock victim. A victim’s physical response to being shocked by high-voltage will be to increase their grip, so the “hot stick” or retrieval hook allows the rescuer to safely remove the victim from the hazard.

Physical barriers, signage and boundary guarding should be acquired to properly mark vehicles in service and make those around the shop aware of the hazards of an electric vehicle. A physical barrier should be used to restrict work areas around the vehicle to prevent unwanted interference by unaware individuals that could affect the safety of the work area.

Lockout or tagout boxes should be used when deactivat-

ing the high-voltage system. These lockable boxes should be used to store high voltage fuses or manual disconnects as well as vehicle keys so that the system is not accidentally energized.

Insulated hand tools may be used when servicing components of the high-voltage system. While these are not required, they are strongly suggested to protect the worker as well as the vehicle from high-voltage currents.



THESE BARRICADES HELP to create an environment of awareness about the dangers of HV in the workshop.

Meters and test equipment

The majority of professional automotive multimeters are typically suitable for electric vehicle testing and diagnosis providing that the meter and the meter leads meet the Category III – 1000 volt working voltage standards. Keep in mind, if working on higher voltage charging infrastructure you may need a Category IV meter.

Proving unit - To verify proper operation of your multimeter, a proving unit provides a battery supplied voltage that can then be measured by your meter before connecting to a vehicle and afterwards, to verify meter accuracy and ensure the voltage levels at the vehicle are safe to come in contact with.

Megohmmeter - The megohmmeter, or insulation meter, functions in a very similar fashion to the resistance or diode check feature on your traditional DMM. These features use a current that is sent through the leads to determine a voltage drop which is then displayed as a unit of resistance, measured in Ohms.

The traditional multimeter does not produce enough voltage or current to truly load the circuit. The resistance or ohms function uses approximately 2-3 volts and relatively low current. This amount of current is not nearly enough to properly test the high-voltage (HV) system’s insulation. The Megohmmeter

A BEST PRACTICE

for EV high-voltage repairs is to store the manual safety disconnect and vehicle keys in a lockout/tagout box.



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THIS MEGOHMMETER is an insulation tester, an essential tool for determining if a high-voltage component has an unwanted path to chassis ground.

provides a high-voltage/ low current output to properly test the motor-generator (MG) units and other HV components found on hybrid and electric vehicles.

Think of these tests as you would a pressure test of a hydraulic circuit. If you were to pressure-test a hydraulic circuit, you would most likely pressurize the system more than the system pressure rating to determine if there are leaks in the system. The insulation of HV systems is very similar to that of a hydraulic system and insulation of the wire is very much like the hose or pipe that carries the hydraulic pressure.

If the electrical pressure compromises the insulation, a faulty reading will be displayed on the meter. For the sake of your safety, do not attempt to test these circuits while the HV system is operational. Follow the manufacturer's instructions and perform your testing accordingly. Be sure to use Class "0" -rated gloves as required by service information.



THIS MILLIOHMMETER makes accurate minute measurements of resistance by utilizing a 4-wire test.

Milliohmmeter - Much in the way that the DMM was limited in its ability to test high resistance values, the DMM also cannot measure very small resistance values. Milliohmmeters offer the ability to measure resistance between phases of the MG units when dealing with trouble codes relating to the MG units.

The main difference between the megohmmeter and the milliohmmeter is that the milliohmmeter is designed to read a very small amount of resistance. To get a precise reading, the milliohmmeter uses a 4-wire resistance measurement, in which two of the wires pass the current through the circuit while the other two wires make the delta (difference between two points) voltage measurement.

Like any inrush of new technology, we as automotive technicians have faced in the past, EV will surely initially challenge us as we begin to grow and adapt to it. But waiting for the wave to pass is not an option, because EV is here to stay. We have to prepare now. If you fail to plan, you are indeed planning to fail. *TL*



DAVE MACHOLZ is an instructor for the Toyota T-TEN, Honda PACT and general automotive programs at Suffolk County Community College in Selden, NY. He is an ASE CMAT and L1 technician and holds a NY State teaching certification in vehicle repair.

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BY JOHN BURKHAUSER // Contributing Editor



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Drivers walk out to their vehicles, open the door and get in, start the vehicle, and drive off to whatever their destination is. Rarely do they stop and look under the hood, at the tires, or even at the passenger side of the vehicle! It is our job to be their eyes and ears when we get the vehicle into the shop.

Digital inspections are our way to open the driver's eyes and let them see their vehicle through the eyes of a technician. Focus their attention on those items that need to be addressed today and in the future. Digital inspections can not only focus the driver's attention on the vehicle's mechanical needs; they can also be built to show customers some other views of their vehicle, which promotes trust and clears the shop of some liabilities.






Being the customers' eyes and ears

Let us revisit what I said about the driver not always seeing the passenger side of the vehicle. Even if they approach their vehicle from the passenger side as it is parked in the driveway, customers' minds are elsewhere and not really looking over their vehicle. Unless something draws their attention, they just get in and drive away.

You know that there is one time that customers are more likely to walk around their vehicles inspecting it, and that is when they are picking it up after you service it. This is when they notice the scratch or dent that may have been there for days or months. But now it is your fault. Does that situation sound familiar?

“TAKING PEEKS UNDER VEHICLES WHEN I AM IN A SHOP, I AM SURPRISED TO SEE THE ORIGINAL STRUTS AND SHOCKS ON VEHICLES THAT HAVE HUNDREDS OF THOUSANDS OF MILES ON THEM.”

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- Perform visual inspection of the system
- Test and Identify Refrigerant Type 
- Set up vehicle per OEM requirements for test
- Check the blower and dash airflow operation 
- Install thermometers and connect gauges for test
- Note temperatures and gauge readings 
- Perform Directed Diagnostics 
- Make recommended repairs
- Retest AC System after repairs 

If your shop is currently using digital inspections for safety and courtesy checks on customer vehicles and your software gives you the ability to edit or build your own inspections, why not make an inspection to record the vehicle's condition on arrival? Be it a night drop, tow-in, or customer drop-off, you will use this inspection to document the exact condition of the vehicle when it is first approached by any of your staff.

A picture is worth a thousand words

Take photos of all angles. If damage is found, photograph it and mark it up. Don't forget to check the interior, too. Send the inspection to the customer, even if they are waiting. Let them know you have the vehicle and the condition it is in.

The undercarriage is out of sight and out of mind. It is on the shop to keep the condition of the suspension in the customer's view too. With the average

age of vehicles being over 12 years, it is more important than ever to check the suspension and use a digital inspection to record your findings.

Taking peeks under vehicles when I am in a shop, I am surprised to see the original struts and shocks on vehicles that have hundreds of thousands of miles on them. Also overlooked are bushings that are cracked and worn out. Using the inspections, we can put these items in front of our customers so they can make the educated decision to replace the worn parts and raise our ARO.

Inspections that give you the ability to use video can be used to show unwanted wear and looseness. Take a video and shake that wheel grabbing at three and nine, then at 12 and six showing loose tie rods, bearings, and more. Don't forget that video will also record sound. Bounce that vehicle and make it squeak.

With inspection software that gives you the option to edit and create new inspections, you can build a diagnostic inspection. The idea here is an inspection that is used to record the steps to diagnose a customer concern. I see this as a way to show customers, who balk at paying for diagnosis, to see what happens during the process. Show them it's not just pulling a code and replacing a

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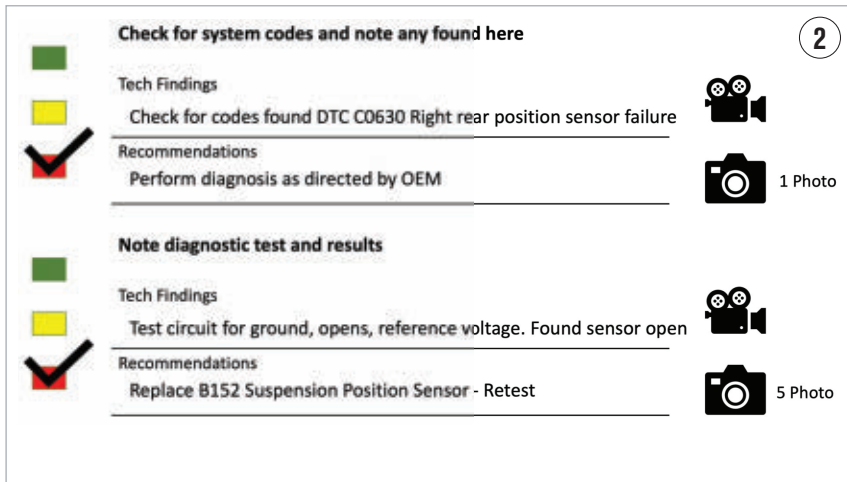
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Establishing trust and a rapport with customers

When the diagnosis is completed and you are looking to get the customer's authorization to repair the found issue, the estimate can be put on the inspection and the whole thing sent to the customer. Imagine their reaction when they get this diagnostic inspection. Now, instead of them seeing only the diagnostic fee now grow into a larger bill with the repair parts and labor, they see some of the diagnostic steps that found the problem. You just built value and trust into your diagnostic fees. I feel that once your customers see what goes into diagnosing issues on their vehicle, you will have less pushback when asking for it in the future.

Mind you that you do not have to put every step of diagnosis or repairs on these suggested diagnostic inspections, or even put an estimate on them. But hopefully, you will see that using digital inspections that let the customers see can reduce the instances of paying for customers' body damage. While at the same time, this builds a new level of trust by showing customers some of what is done to repair and service their vehicles. *ZZ*



JOHN (JB) BURKHAUSER has 40-plus years of automotive experience to share. He attended tech school, grew up in dealerships, worked with independent shops, taught 10 years of post-secondary automotive, and trained shops on how to eliminate daily roadblocks to their service process. In his goal to help shops become more successful, he is published in numerous publications such as this one and gives regular webinars sharing what he knows works.

part. Build value in what is done to get to the answer.

Live and in color

When building a diagnostic inspection, each inspection point can be a step in the process. Let's look at what one of these inspections could look like with an example.

The customer's concern is the electronic stability control (ESC) system light is on. The first step of the inspection would be to verify the condition. The next step would be to check for codes and so on. Each step of the process would be documented on an inspection point (**Figure 1**).

A picture included with each line would show what was done. At the first point where the codes were found, we could have a screenshot of the scan tool screen, showing the codes. When work is completed and the repair is made, another screenshot showing all codes being cleared could be added.

Another use for diagnostic inspec-

tion would be to guide a technician step-by-step through the process. When the inspection is built and edited, it is assembled using each inspection point as a diagnostic step. When the technician performs the diagnosis, they perform each step in the given order entering what test was done and the results on each inspection point. The advisor can go look over the diagnostic inspection and see that the tech followed each step properly.

This is a suggested diagnostic inspection for an A/C Performance test (**Figure 2**). Each step is listed in the order it is done. Directions for the tech can be listed for each step so they can read it and do it properly. If the test on the point passes or the step is completed, they can tap the green swatch, marking it as such. If the test results are borderline, yellow can indicate it. Red will be used if the item fails the test. The camera symbol indicates that the point has photos of what was done or a photo of the results of the test.

“ INSTEAD OF THEM SEEING ONLY THE DIAGNOSTIC FEE NOW GROW INTO A LARGER BILL WITH THE REPAIR PARTS AND LABOR, THEY SEE SOME OF THE DIAGNOSTIC STEPS THAT FOUND THE PROBLEM. YOU JUST BUILT VALUE AND TRUST INTO YOUR DIAGNOSTIC FEES. ”

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1

MORTON WAS DUBBED

“Sherlock Holmes with a wrench” by renowned *Motor Age* writer Joe Woods.

BY BRANDON STECKLER // Technical Editor

With the wide range of vehicle years, makes, and models prevalent in today’s workshops, diagnostics is difficult enough. Interrogating the customer before approaching

the vehicle can save hours of time and sometimes thousands of dollars.

With every system and component we will face as automotive diagnosticians, physics is one thing they all have in common. With Newton’s third law always dan-

gling overhead, for every action lives an equal and opposite reaction. That statement holds significance because as automotive diagnosticians, we always chase symptoms or customer complaints. But it’s not the symptoms we must be seeking,



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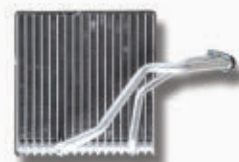
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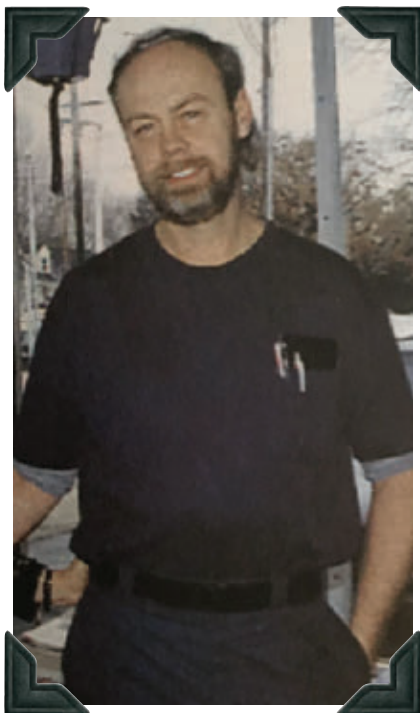


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MY MENTOR, Jim Morton, standing alongside one of his three shops in Philadelphia.

It's the root cause of those symptoms that are the true culprits.

Back to my roots

As a young and inexperienced technician, although fascinated by diagnostics, I struggled to gain a sense of direction early in the process. Even simple tasks like replicating the customer's concern proved to be no easy feat. Years later, I have grown to learn that the cause of my aches and pains was because I wasn't asking the correct questions.

My mentor, Jim Morton, owned a series of repair shops in Philadelphia (Figure 1). On average, he and his team tackled 28 of the ugliest, "eat-your-lunch" myriad of electrical and driveability faults you could've imagined (I heard the stories a thousand times, Ha!).

Keep in mind that this was the '90s. If you think troubleshooting today's vehicles is difficult, try doing it back then with very little available scan tool data. To tackle an average of 28 problem vehicles a day, do you think he had a game plan? You had better believe he did. In fact, he was labeled as "Sherlock Holmes with a wrench" by renowned writer Joe

Woods (of Motor Age magazine and many others). Why? It was because of his questioning methods.

The interrogation process

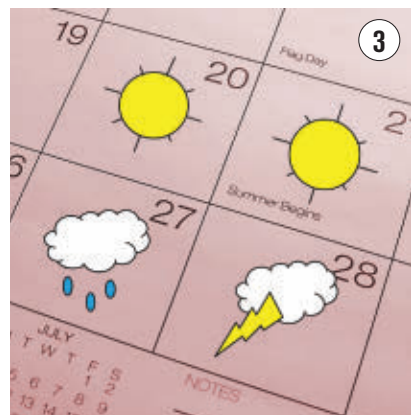
A common occurrence (even today) is that the person delivering the vehicle to the shop for diagnosis is not necessarily the person experiencing the fault/has the complaint. Most often this is due to a convenience factor. Mr. Customer experiences the fault but he must be at work early, so Mrs. Customer brings the vehicle to the shop because she has a paid day off. The issue with this is that complaint descriptions are either lost in translation or not discussed at all.

Jim has a rule at his shops. He will gladly tackle any electrical or driveability fault. However, the person experiencing the fault must agree to a 15-minute interview in the comfort of the office. If the customer couldn't agree to those terms, he would politely decline the job or have them rescheduled for a time when he could conduct a thorough interview (Figure 2).

A calendar that correlated the local weather conditions with each day of the week was kept in the office as well. Many times, the complaint being discussed

was weather-related (rain/heat/cold). This was determined by listening to the customer speak of the complaint. It was followed up with a review of the calendar and recognition of the weather that day. Jim would simply ask them if the fault had also occurred the previous day that it was raining. Often, the customer couldn't recall the weather that day but did know what day of the week the previous occurrence surfaced. That is where the calendar came in handy. More often than not, the fault correlated with specific weather conditions (Figure 3).

The significance of that anecdote is that frequently, these cars visited at least



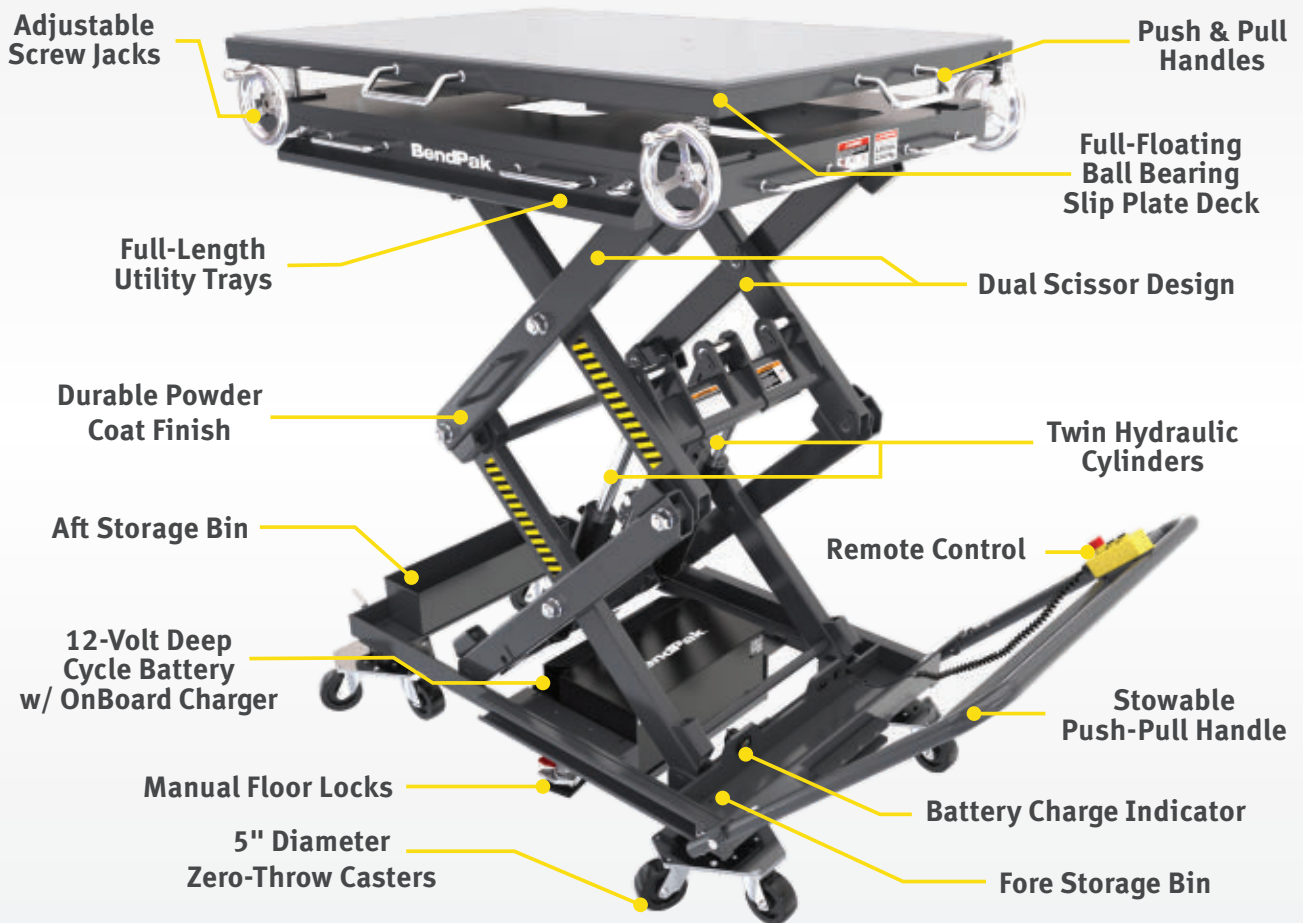
DOCUMENTING THE DAILY WEATHER on a calendar is a great asset to your diagnostic approach.

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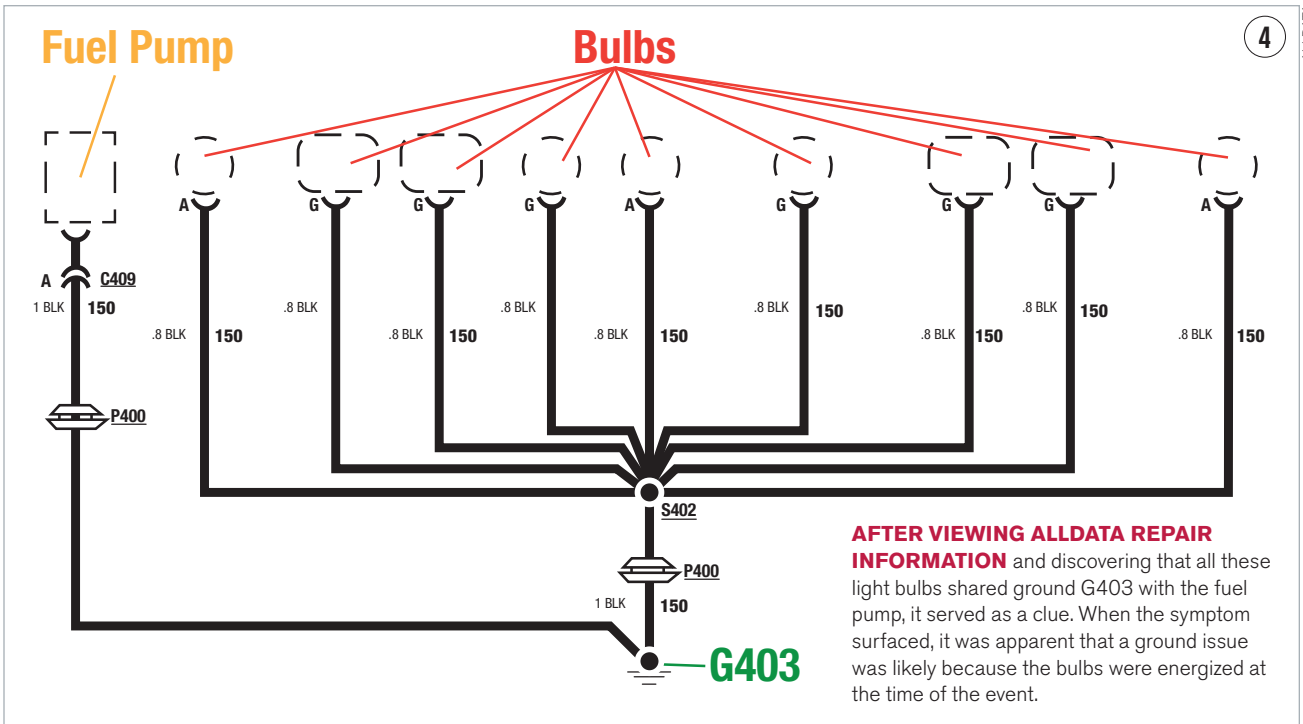
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three other shops that failed to find the issue. Jim had a sense of direction right from the comfort of the office without having even started the vehicle first. He'd simply head out to the parking lot, douse the engine compartment with water, and the fault surfaced immediately, pinpointing the area of fault to focus on.

Horror stories from the trenches

1996 OLDSMOBILE CUTLASS CIERA, 3.1L:

A sweet old man was at several repair shops with a seemingly unsolvable complaint before visiting Jim's diagnostic shop. The customer interrogation revealed several key pieces of information:

- The car would stall intermittently.
- Weather was not a factor.
- The car would run for approximately the same time before stalling (about 10 minutes).
- The stall tended to occur more at nighttime and when coming to a complete stop.
- The customer could "fix" the problem each time by kicking the tires.

A road test with the customer was the

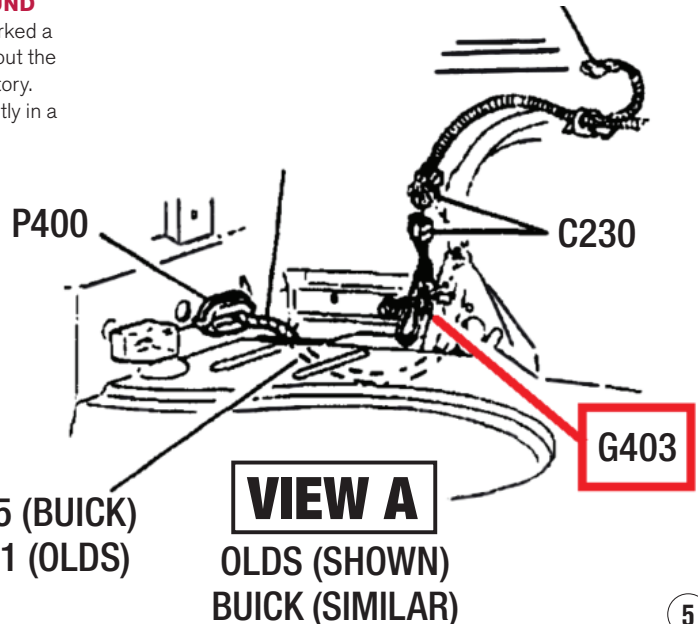
best course of action. With the vehicle owner in the driver's seat for about 10 minutes, they approached a stop sign and the car finally stalled. Attempts to restart the vehicle were futile, as the engine just cranked. However, the old man exited the vehicle, making his

way around the car, and stopped to kick each one of the tires twice. When he re-entered the vehicle, he said to Jim, "Now, watch and see." To no surprise of the owner, the engine fired right up, and they drove back to the shop to arrange a drop-off for the day.

RESEARCHING THE GROUND

location sparked a question about the vehicle's history. Was it recently in a collision?

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As Jim now had a sense of direction before even approaching the vehicle, he considered the clues (revealed in the interrogation) divulged above. The two biggest clues were:

- The stall occurred each time after approximately the same amount of run-time.
- The stall occurred more frequently at stop signs.

Putting the puzzle pieces together, Jim thought it was logical that the fault was heat-related (due to the run-time factor). With that, he considered the stop sign and nighttime factors and referenced a wiring diagram for the exterior bulbs. He learned that nine bulbs shared ground G403 with the fuel pump (**Figure 4**). Before approaching the vehicle, he referenced the diagram for the G403 location and learned it was above the right rear wheelhouse and accessible from the interior of the

THIS OTC PROPANE ENRICHMENT TOOL allows a diagnostician to quickly triage a symptom. If drivability symptoms improve with propane, it implies a fuel delivery issue should be pursued.



6
OTC TOOLS

vehicle (**Figure 5**).

Without ever having left the office, Jim called the customer and asked if the car had ever been in an accident. The customer acknowledged that the vehicle had been hit in the right rear and was repaired several months ago.

At this point, Jim was out to prove the fault before taking the vehicle apart. He first noticed that the lights dimmed with the engine/fuel pump running before heading out for a subsequent road test.

Equipped with a propane enrichment tool connected to a vacuum port,

he proceeded to a subsequent road test to replicate the stall. When the vehicle did stall, Jim introduced propane and cranked the engine. The engine fired right up (**Figure 6**).

The evidence presented in the result of Jim's hypothesis and experimental road test took only minutes to gather with almost no effort. But equally as important, it led to the next test like

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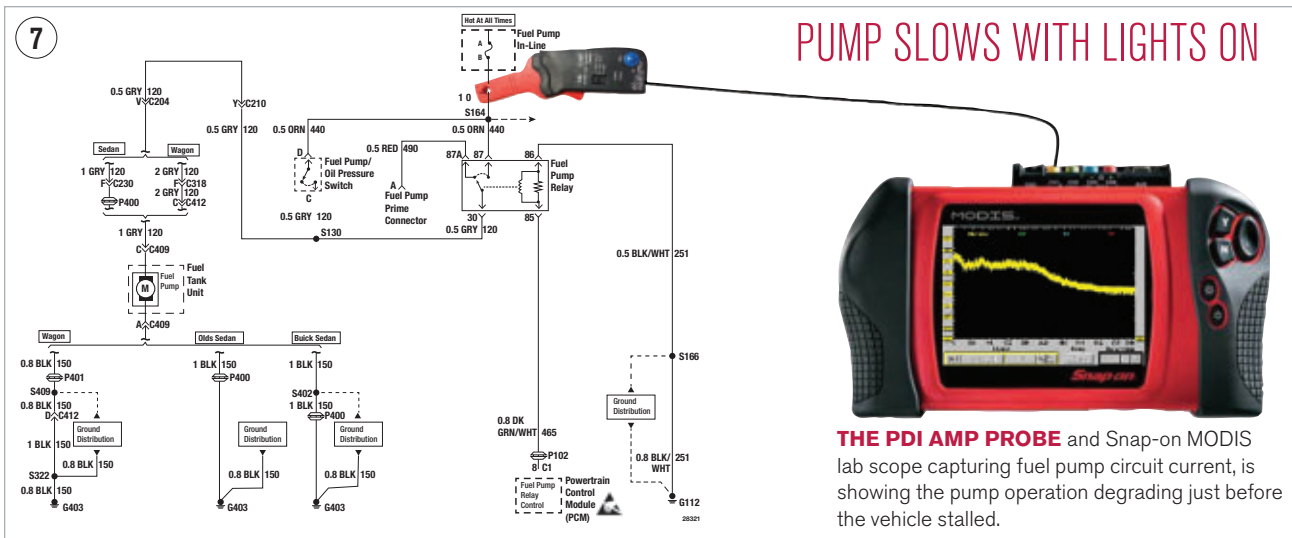


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a steppingstone. Jim simply hung a current probe/ lab scope on the fuel pump circuit, started the vehicle, and energized the exterior lights (Figure 7). A correlating drop in pump current occurred when the lights were energized (Figure 8).

Jim then began the disassembly process to find a poorly installed ground (at G403) and made the quick repair, confirming afterward that the pump had suffered no apparent damage (via a repeat of the pump current waveform) and no longer was a stalling symptom present (sorry, no post-repair capture available).

2001 PONTIAC SUNFIRE, 2.2L

Frustrated, a teenage girl had dropped off her vehicle at the GM dealership for the fourth time with the same complaint of “rattle/noise while driving.” The technician took the vehicle for a long ride and under multiple driving conditions throughout the entire engine rpm/load and vehicle speed range. Unable to reproduce the fault, he reported it to the service advisor, and the customer was called to retrieve the vehicle.

Overhearing this conversation, I placed a call back to the customer and began the interrogation process before she arrived. After speaking with her, I learned the following facts:

She heard the noise and her passengers (friends from school) confirmed they could also hear the noise.

Her parents could not hear the noise when they had driven the vehicle, and neither could her older brother.

The noise occurred on all roads regardless of speed.

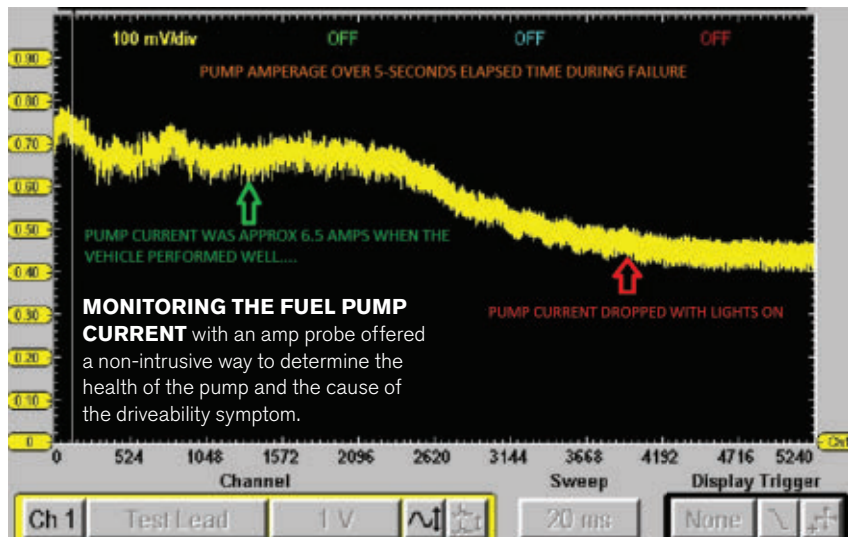
The noise was present in all weather conditions but had been present for only the previous two weeks or so.

Not finding a clue that I was excited about, I felt it was best to accompany the young girl on a road test. I began with a road test in the driver’s seat. After about 15 minutes, the girl was frustrated and

told me she couldn’t believe the noise wasn’t present.

Upon returning to the dealership, she agreed to return if the noise did come back. Before she even got out of the parking lot, she turned the vehicle around to alert me that the noise had returned. This time, I climbed into the passenger seat and allowed her to drive. The rattle-type noise was crystal-clear.

We switched seats so I could pinpoint the noise and just as quickly as it appeared, it mysteriously vanished. At this point, we were both laughing about it. But once again, we switched seats, and this is when I saw the cause



of the noise. I abruptly said, "Stop. What did you just do with your left hand?" The girl was removing her lip balm from her left pocket and placing it in the pocket of the door panel. Another short drive across the parking lot proved to be the source of the noise, our embarrassment, and her frustration.

The point is that a simple and thoroughly conducted interrogation process may have solved this issue from the get-go. Remember, rectifying this situation took many visits that customers (as well as shop owners and technicians) don't enjoy. True, it's unlikely any question I would have asked her at the time would have shortcut the diagnostic process. But I learned from that experience and have since implemented a change in my strategy to include questions about vehicle contents anytime a noise complaint is involved.

Implementing an interrogation process in your shop takes time and practice. It may seem like a poor investment in time, but it is in fact, an investment. The time you invest in the interrogation process can save you hours, and in some cases, even save you days of wasted time and money. It's unfortunate that the customer knows a lot more about the nature of the present faults than they are readily willing to offer up, but it is not up to them to tell us. However, it is up to us to ask them.

Give it a shot. Begin by asking yourself if you could have solved that last pain-in-the-neck diagnostic job any more efficiently than you have. It's likely that you will discover that had you only a few more bits of information, the fault could've been diagnosed just a bit more efficiently. Take notes in a journal and commit to improving your process. A

strive for greatness can never cease.

We are in business to make money. Diagnosing and correcting faults accurately the first time is crucial to customer satisfaction. However, doing so in a timely fashion doesn't hurt, either. It does wonders for the customers' confidence in your abilities, confidence in yourself, and thickens the wallet a bit more. *ML*



BRANDON STECKLER

is the technical editor of *Motor Age* magazine.

He holds multiple ASE certifications. He is an active

instructor and provides telephone and live technical support, as well as private training, for technicians all across the world.

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THE RETURN OF DRUM BRAKES:

COULD THE AUTO INDUSTRY SEE THE RESURGENCE OF THE HISTORIC BRAKING SYSTEM?

BY DR. MARK PHIPPS // Contributing Editor

The automotive industry is undergoing a monumental shift toward electric vehicles, placing a renewed emphasis on sustainability. Sustainability goals outlined by world governments and supported by industry leaders means investments and resources are being funneled to-

ward reducing emissions. In fact, brake dust, a major source of vehicle emissions, is under the microscope in the fight to reduce emissions – and an unlikely braking system could play a role in addressing it.

Most sustainable solutions require new or innovative technologies – but could there be a case for drum brakes,

a long-surpassed braking solution, to be implemented on passenger vehicles going forward?

Drum brakes were first developed in France in 1902 and quickly became a standard brake solution for passenger automobiles due to decent performance and inexpensive cost. However, as new safety measures were implemented in

the '50s and '60s, most drum brakes began to be phased out of passenger vehicles in favor of the disc brake. Although more expensive to produce, disc brakes offer better stopping power, especially important for the heavier cars of that era. Disc brakes were also a more reliable option as they were better equipped for drivers who were taking longer and more frequent trips.

Brake dust is contained within a drum brake, reducing pollution

However, the open-air design of the disc brake leaves much to be desired from an emissions-reduction standpoint – thus making room for the potential return of drum brakes.

When it comes to environmental impact, brake dust – or small particulate matter that is produced during the braking application – contributes up to 20

percent of overall fine particulate matter traffic pollution. It's a considerable amount, knowing that exhaust fumes contribute 7 percent. It's not just harmful to the environment; brake dust can actually lead to inflammation and impair the body's ability to fight off bacteria.

Brake dust is created from the friction used to stop the wheels. Disc brakes, for example, use clamping or pushing motions to create that friction, whereas drum brakes use brake shoes fitted with brake linings (the friction material) to press against the brake drums from the inside in order to stop the car.

The inherent design of drum brakes ensures that most of the brake dust that's produced is caught in the drum – allowing the vehicle owner or technician the ability to clean the brake with a soft bristled brush or wheel washcloth – though the drums aren't a perfect system, as some of the particulate matter

can get into the air. However, it's more effective at limiting brake dust emissions than is the disc brake.

Outside of the sustainability elements, drum brakes do offer certain advantages over disc brakes as they are generally cheaper to manufacture, require low input force to be activated and are slightly easier to maintain since there's better corrosion resistance. These advantages, along with an increased focus on sustainability, make a solid case for implementing drum brakes on modern ICE and electric vehicles.

Drum brakes are a great option for electric vehicles and hybrids, as they can work in tandem with regenerative braking, which slows the car down and captures kinetic energy. Additionally, the drum brake's lack of drag makes it a great braking solution for EVs and hybrids.

Another signal of the potential return for drum brakes is the proposed Euro

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7 standards — set to begin in 2035 — which call for the need to reduce brake emissions by 27 percent.

Cautious outlook for drum brake resurgence

That said, there’s a long way to go before drum brakes return to modern vehicles. Disc brakes offer better performance, are more reliable during high-braking conditions (e.g. going downhill) and are easier to service. For instance, many modern disc brake solutions are designed for maximum durability and consistent wear, which prolongs the lifespan of the brake systems. These advantages position disc brakes as the optimal brake systems for front wheels. In fact, the Volkswagen ID.4 Electric crossover has rear drum brakes, but disc brakes on the front wheels.

The case for drum brakes is set to get stronger as we see OEMs and policy-

makers take steps to address emissions on passenger vehicles. The argument is bolstered even more when considering the emissions reduction capabilities, the cost advantage and ease of use in vehicles. While drum brakes may not be a perfect solution, their potential return could provide significant benefits to automakers striving to achieve vehicle emissions goals, as the brake system’s drum design can capture brake dust and can be easily cleaned and discarded. The stopping power and overall performance of disc brakes cannot be understated, and any implementation of drum brakes will be limited.

Automakers’ adaptability and innovation in refining drum brake technology will be a key aspect to watch in the future. They may focus on enhancing drum brakes’ design, exploring new materials, or integrating advanced electronic systems to further improve their performance. Al-

ternatively, the industry might witness the exploration of cutting-edge braking technologies, potentially revolutionizing braking efficiency and emissions reduction. The race to find the optimal braking system will not only drive competition among manufacturers but will also shape the industry’s journey toward a more sustainable automotive landscape. *TM*



DR. MARK PHIPPS is a lead engineer in the brake product category for Bosch Automotive Aftermarket. Mark received a Ph.D. in material science from Kingston University in the U.K.

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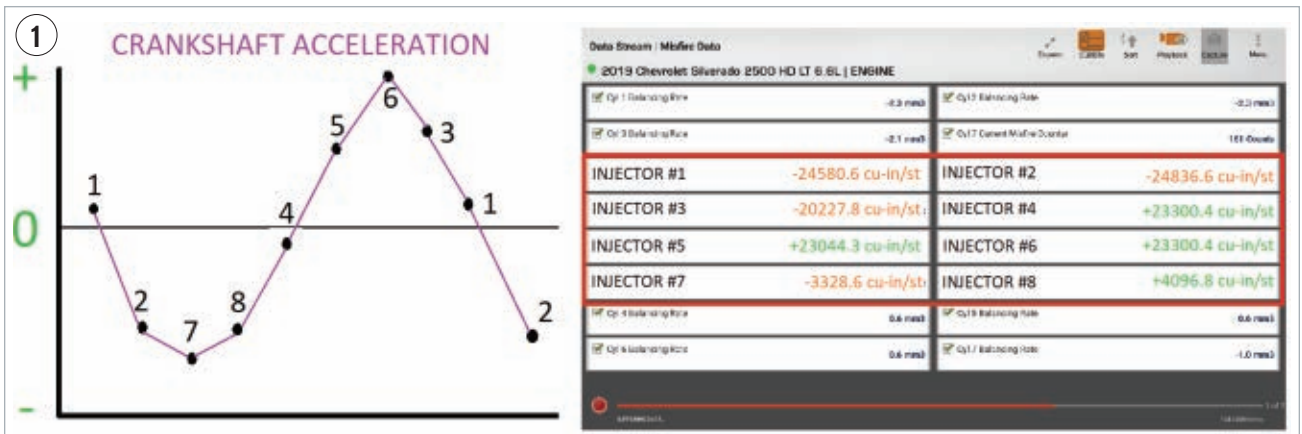
WELCOME BACK TO
ANOTHER EDITION OF
"THE DATA DOESN'T LIE,"
A REGULAR FEATURE IN
WHICH I POSE A PUZZLING
CASE STUDY, FOLLOWED
BY THE ANSWERS TO THE
PREVIOUS ISSUE'S PUZZLE.

A MISFIRE IS A MISFIRE, REGARDLESS OF WHAT FUEL IS BEING UTILIZED TO POWER THE ENGINE.

BY BRANDON STECKLER // Technical Editor

Today's challenge comes from my friend Jonathan Martin. It's a Chevy truck with a 6.6L Duramax diesel engine exhibiting misfire under lightly elevated rpm. The vehicle came from an auction, so the history is unknown. Jonathan connected his Mac tool MDT10 scan tool and the collected data indicated cylinder #7 was the culprit. I advised Jonathan to monitor the injector balance rates, as they may provide some easy-to-obtain information.

Individual injector balance rates are very similar to fuel trim (on a gasoline engine) in that they are corrective factors. They differ from fuel trim in that they are per individual injector, not an entire bank of fuel injectors. Negative rates indicate a reduction in fuel delivery to that cylinder, and positive rates indicate an increase in fuel delivery to that cylinder. Referencing balance rates can offer some clues, as they are compensating for variations in crankshaft speed.



TO AID IN VISUALIZING the injectors firing, I created a graph of crankshaft acceleration over time. It's clear that cylinder No. 7 contributes the least to crankshaft acceleration and is the reason the ECU is flagging it as misfiring.

Preliminary data

Clearly, the captured data (when plotted in a graph, pardon the approximation) shows a trend in that cylinder #7 contributes least to the crankshaft speed (Figure 1). A relative compression test revealed virtually no variation in starter load, from cylinder-to-cylinder.

I then advised Jonathan to evaluate the injectors' performance with a lab scope and amp probe. Jonathan mated his PicoScope 4425A and TA473 amp probe to the injector circuits (Figure 2+3). The current ramps for each injector are all of the same amplitude, indicating electrically they are all performing the same work. Although it is normal for die-

sel injectors to multistrike, injector #7 is energized at least twice as many times as the other injectors. This is evident by the number of consecutive pulses (Figure 4).

This engine has already had the #7 injector replaced twice (both with OEM parts). The tech reached out for my input, as he was no longer confident in his diagnostic approach or the information he had previously analyzed.

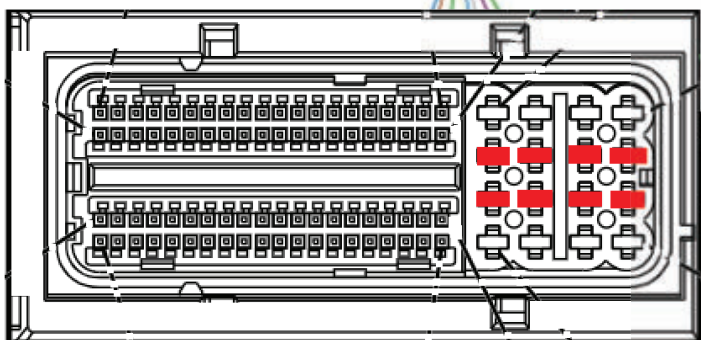
The data doesn't lie

With all the information in front of us, we are faced with deciding how to proceed. Here are some bullet points of what we know to be factual, and I will ask all of you, diligent readers, for your input:

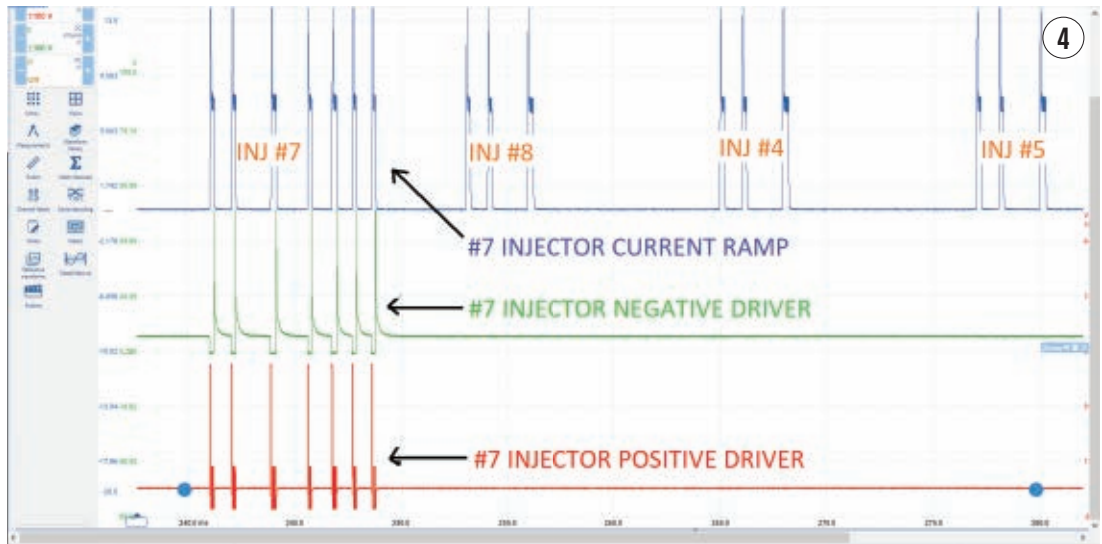


THE INJECTORS' CURRENT FLOW is easily monitored by acquiring the data with a current probe at the ECU.

THIS REPRESENTS HOW the lab scope and amp probe are connected to the vehicle's wiring harness.




THE RESULTS OF THE TEST show the ECU multistriking the No. 7 injector many more times (compared to the other injectors), showing the ECU attempting to compensate for the detected misfire.



- Cylinder #7 is misfiring erratically (injector has been replaced twice with GM injectors)
- Injector current ramps are equal in amplitude
- No cylinder integrity issues are evident in the relative compression trace
- Injector balance rates align with symptom (#7 weakest contributor)
- Replace injectors
- Send cylinder head out for machine work/inspection
- Replace fuel/ inspect for contamination in fuel/rail
- Test for low-pressure fuel system supply issue

Given this information, what would you do next?

Be sure to read next month's *Motor Age* for the answer to this month's challenge and what was discovered! 

SCAN THE QR CODE TO READ THIS AND RELATED ARTICLES ONLINE




BRANDON STECKLER is the technical editor of *Motor Age* magazine. He holds multiple ASE certifications. He is an active instructor and provides telephone and live technical support, as well as private training, for technicians all across the world.

SOLVED: (September 2023 *Motor Age*) 2017 Ford F150 5.4L, Misfire at tip-in

What would you recommend doing next, given the data bullet points in last month's challenge?

- 1) Replace spark plug for cylinder
 - 2) Perform induction cleaning service
 - 3) Clean VVT oil control valve
 - 4) Perform cranking pressure waveform analysis on intake and/or exhaust system
- For those of you who chose answer 4,

congratulations! The evidence presented in the captured ignition waveform indicates a variation in conductivity within the combustion chamber. This could be caused by poor injector spray pattern, EGR dilution, or air/fuel charge displacement from a cylinder leakage. Although the relative compression test is used to reflect starter load variations per cylinder, it didn't indicate a large leak. With a small loss of charge, the starter amperage draw doesn't change significantly. However, the disruption within the cylinder (due to charge displacement past a leak point) can hinder the combustion process and create a misfire.

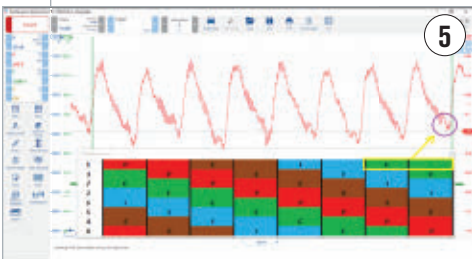
While cranking the engine, an anomaly could be seen in the cranking intake trace (**Figure 5**). Each time the suspect cylinder (Cylinder #1) was on its compression stroke, the correlating intake manifold vacuum

pull (from the No. 6 induction stroke) suffered. This alludes to a poorly sealed #1 intake valve.

Answer 1 is not the best answer, as the fault only occurred under light load. Compromised spark plugs more often exhibit a driveability symptom under heavier engine loads, as the spark tends to deviate toward the easiest path to ground.

Although answer 2 is a valid test, it's best to prove a fault rather than to begin introducing repairs and services as an experimental countermeasure.

Answer 3 is incorrect; although bank-to-bank VVT issues can create driveability faults, it will affect an entire engine bank on this V8 engine design. It will also cause bank-to-bank fuel trims to oppose/mirror one another (for instance Bank #1= -18% / Bank #2= +18%).



THE REPEATABLE LOSS of the indicted intake pull correlates with top-dead-center of the suspect-cylinder's compression stroke. This is evidence of a leaking intake valve allowing cylinder turbulence to cause a misfire/flameout condition.

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This ratchet kit fastens and removes small nuts, bolts, and other fasteners in tight areas and provides maximized versatility with the ability to swap between 1/4" square drive, 3/8" square drive, and 1/4" quick change hex interchangeable anvils as well as the ability to change from forward to reverse for increased efficiency. The tool's trigger lock prevents accidental activation and the integrated LED light helps to brighten the user's workspace.

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The Milwaukee Tool 13" Long Reach Pliers are available as a straight nose plier and as a 45-degree nose plier. Both pliers feature a deep-reach cross handle design which delivers a wide jaw opening while maintaining a slim profile for extended reach in tight spaces. The single joint pliers provide maximum gripping force and allow for more control when handling different materials and objects. The jaws are designed with multi-function gripping zones for common applications such as fasteners, washers, wires, and more. Both pliers also feature a corrosion-resistant black oxide coating for increased durability and slip-resistant grips for better leverage.

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The No-Spill Coolant Filling Funnel Kit, No. 87007, from OEMTOOLS funnels automotive fluids, such as radiator coolant and oil, into any vehicle. The long burp funnel is designed to prevent spills and trapped air during refills after a coolant flush. This kit includes five adapters, two 45-degree elbow adapters, two 5" extensions, and four radiator cap adapters to fit most passenger vehicles and light trucks. Additionally, the kit features a rotary switch to prevent drips and spills and stop overflow.

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THE TRAINER #141: CAPITALIZING ON MULTIPLE SCAN TOOL FUNCTIONS FOR TRANSMISSION ANALYSIS

USING A CAPABLE SCAN TOOL'S FEATURES TO DIAGNOSE TRANSMISSION CONCERNS IS A RECIPE FOR EFFICIENT TRANSMISSION DIAGNOSTICS.

BY BRANDON STECKLER // Technical Editor

In my experience navigating through dozens of shops over the last two decades, it's quite common to find that one of the largest areas of mystery lies with the automatic transmission. Its intricacies include electrical and electronic control of hydraulic circuits to create mechanical outputs. All of them require an inquisitive mindset and gentle touch, and care must be taken during disassembly, inspection, reassembly, and verification processes. But all of that applies only after committing to disassembly.

Like all facets of the automobile, technology continues to find its way into every component we encounter, including the automatic transmission. Electronic components like transistors and MOSFETs within the transmission control modules or PCMs drive or control solenoids, and it's these solenoids that will route pressurized hydraulic fluid accordingly to create mechanical movement of the components within the transmission, allow the vehicle to drive down our motorways.

However, we are faced with that initial question at the point a failure occurs: Is the problem inside or outside the transmission? And it's that very question they may mean the difference between a successful/affordable repair or the customer getting rid of the vehicle because



the cost of transmission replacement exceeds the value of the car. It's important we determine easily that the electrical components have everything they need to function and are indeed functioning correctly before condemning a transmission for disassembly.

In this episode using a diagnostic platform and its multiple features will aid in an efficient diagnosis of a transmission related driveability concern. Beginning in the driver's seat, a global scan for DTCs will be carried out fol-

lowed by a comprehensive road test capturing graphed transmission data PIDs for analysis. This will lead to logical testing of the solenoids and related circuitry responsible for delivering the pressurized hydraulic transmission fluid to the respective hydraulic components internal to the transaxle. Stick with Motor Age magazine's Technical Editor Brandon Steckler as he walks you through a logical approach to automatic transmission analysis and diagnosis. *MA*

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