

# MOTOR AGE

DECEMBER 2023

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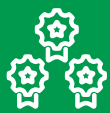
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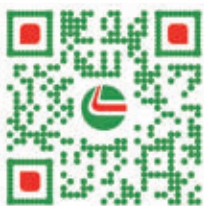
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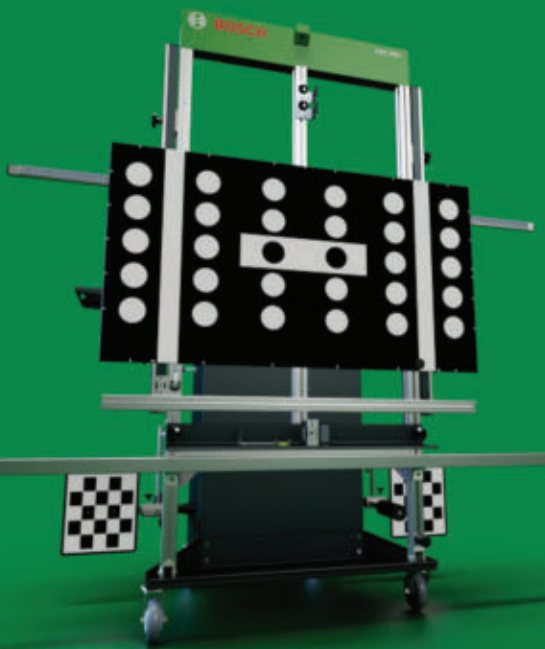
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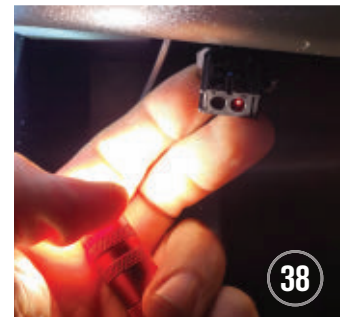
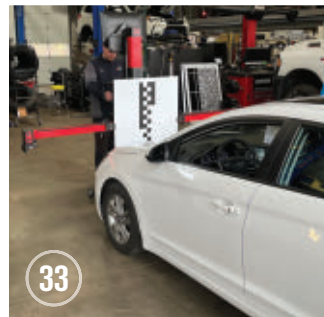
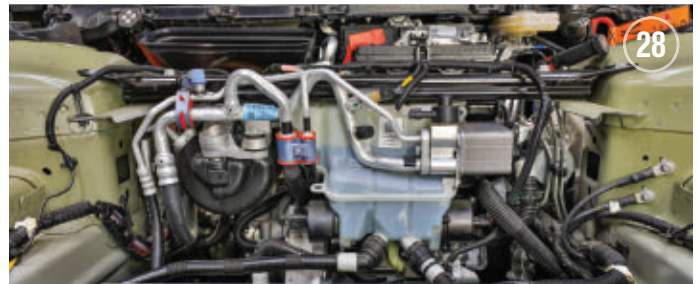
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### MASTERING DIAGNOSTICS #7: DRIVING EFFICIENCY THROUGH THE USE OF AUXILIARY SCAN TOOL FEATURES

In this seventh edition of Mastering Diagnostics, take a guided tour of the Bosch ADS 525x scan tool platform with *Motor Age* Technical Editor Brandon Steckler. Stick with him as he demonstrates how to capitalize on auxiliary scan tool features to drive technician efficiency through the roof. Brandon utilizes multiple features of the Bosch ADS 525x scan tool to take "troubleshooting from the driver's seat" to the next level.

With this powerful, Wi-Fi-accessible scan tool, being able to stay in the vehicle (instead of stepping away to visit a computer) makes system/component research that much more efficient. Incorporating a full system DTC scan and referencing service information for TSBS, system description/operation and wiring diagrams will allow today's technician to build a diagnostic game plan quickly and without leaving the driver's seat.

Click here to learn more about the Bosch ADS 525x scan tool.



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## RECOGNITION



## MOHART ACCEPTS 2023 BEST YOUNG TECH AWARD AT AAPEX

BY KAYLA NADLER //  
Contributing Editor



This year's Best Young Tech Award recipient, Derek Mohart, accepted the prestigious award at the AAPEX show in Las Vegas on Tuesday, Oct. 31.

Presented by Motor Age and PTEN, the annual Best Young Tech award honors technicians aged 35 and younger who are moving the service repair industry forward, excel in their current role, and are passionate about their work.

From rebuilding transmissions and doing custom engine work to working as a remote diagnostic technician to now, his current role, as a continuous process improvement manager, Mohart has learned a great deal throughout his

journey as a technician — and he's just getting started.

"It was awesome to get the nomination from my boss, Chris, and to hear that I won out of all the nominees was a pretty cool feeling," notes Mohart.

Mohart advises other young techs to "never settle" and to "always strive to be better."

As the grand prize winner of the Best Young Tech Award, Mohart received travel and admission to AAPEX 2023, a trip for two to the STX Supplier and Training Expo in Nashville in March 2024, and prize packs from the program sponsors that include tools and equipment. **TZ**



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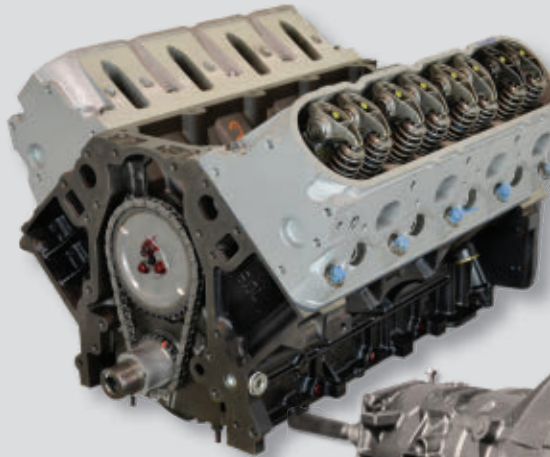
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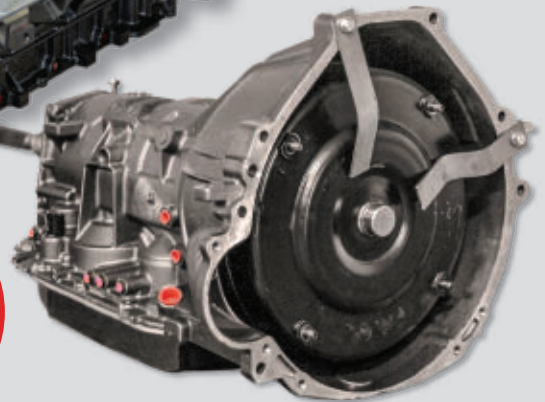


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# EPICOR

## EPICOR LAUNCHES AUTOMOTIVE B2B ECOMMERCE PLATFORM AT AAPEX

➔ At AAPEX, Epicor announced its newest B2B ecommerce platform to serve automotive replacement parts distributors and their customers. Named the Epicor Commerce for Automotive (ECA), the solution represents a comprehensive reimagining of existing industry B2B e-store technologies.

The cloud-based ECA platform is designed to help automotive parts distributors and other users increase sales and customer satisfaction by providing up-to-date, customer-specific part pricing and availability. With cloud native architecture, customer setup and control is simplified, streamlining each step in the online selling and buying experience. ECA is integrated with the Epicor aftermarket product content engine, featuring the industry's premier parts and application catalog, aftermarket-to-aftermarket and OE-to-aftermarket interchange, labor database, pre-configured jobs packages, and more.

"Epicor Commerce for Automotive delivers on our promise to create the aftermarket's most user-friendly, flexible, future ready B2B ecommerce solution to help fuel faster, more profitable growth for distributor customers," said Tim Hardin, Epicor's senior vice president of global automotive, data, and extend services. "This solution is the result of years of study and collaboration with distributor partners and other aftermarket distribution businesses."

Major features of the new B2B ecommerce platform include:

### Self-service account management

– Distributors can manage customer networks and customize their presence for a branded user experience. Users can easily set up and modify account settings, control viewable inventory and pricing, and establish sales team members as "Power Users." Distributors using the existing Epicor B2B eStore or an Epicor ERP solution can easily import customer, product, pricing, and other information into ECA.


**Multi-seller support** – ECA will enable connected service/repair businesses to switch among multiple parts sellers without a separate login.

**Easier lookups** – ECA provides consolidated views of rich data, including product specifications, images, diagrams, and cross-references to speed product identification and purchase.

**Third-party integrations** – The solution allows for easy integration with a variety of logistics applications, non-application (tools and supplies, etc.) catalogs, and more.

**Buy Again functionality** – ECA enables service dealers to easily find and repeat previous orders. The solution automatically checks part availability to ensure the complete order can be filled.

**Promotions management** – Distributors can create and manage targeted promotions to their customer networks.

**Quote builder** – The solution organizes and prints shopping cart content for presentation to service dealer customers. 

## JOHNDOW LAUNCHES EV AND HYBRID VEHICLE SERVICE SAFETY PRODUCT LINE

➔ JohnDow Industries introduced its new line of electric vehicles (EV) and hybrid service and safety product line at AAPEX 2023 in Las Vegas.

The new line offers 30 safety products including gloves, face shields, aprons, blankets, insulated tools, jackets, and boots among other products to keep technicians safe while servicing electric and hybrid vehicles.

"JDI listened to the market and grew our product lines to offer high quality, reliable, and safe equipment service repairers needed," said Robert Christy, president of JDI. "Understanding where the automotive industry is going, we are not shying away from living



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## NEW TRAINING OPPORTUNITIES AND 496 NEW PARTS FROM DELPHI

➔ At AAPEX, Delphi had parts from each of its product lines on display for both light and heavy duty applications, as well as test benches.

Delphi's AAPEX booth was packed with the nearly 500 new parts it launched throughout 2023. Jenna Boone, the vice president and general manager of North America Aftermarket for Delphi, expressed the company's excitement to showcase its expanding product range, but the expansion doesn't stop at just new products. The company is also offering increased training opportunities to support the aftermarket repair industry.

Boone, along with Delphi Marketing Director Lou Kafantaris, noted that these new training opportunities are made to meet the market's needs and fill any gaps that may be present in the industry.



### What's new?

Delphi recently revealed the addition of 104 new parts to its portfolio in the fourth quarter. However in total, in 2023, it introduced 496 parts across various categories, such as:

**Fuel management** — This line added 53 parts and covers 38 million vehicles in operation (VIO) in the U.S. and Canada.

**Vehicle electronics** — This line gained 211 new parts, including ABS wheel speed sensors and manifold absolute pressure (MAP) sensors. It covers over 261 million VIO in the U.S. and Canada.


**Steering and suspension** — This line expanded by 167 parts to include alignment parts and represents more than 135 million in VIO coverage for the U.S. and Canada.

**The Sparta fuel line** — This line handles earlier model vehicles with higher mileage and received 65 new parts in eight different part types.

With all these new parts added to the lineup, Boone explained that much of the inspiration for the new additions comes from the conversations they have with technicians and distributors telling them what they need.

### On the show floor

Throughout the week at AAPEX, Delphi representatives showcased parts from all product lines for both light and heavy duty applications, along with test benches. They also presented an HPI Application Kit for the Hartridge HK1400 Cambox, which is used for testing electronic unit injectors and electronic unit pumps in commercial vehicles. The Hartridge Sabre CRi Expert, an advanced common rail injector tester with a wide pressure range, was also on display.

Recognizing the importance of ongoing training for technicians, Delphi hosted live training sessions during AAPEX that were led by ASE-certified master trainers to help technicians stay up to date with the latest developments in vehicle electronics and complex systems. 

>> CONTINUED FROM PAGE 8


this principal and expanding our offering to include service and safety equipment for electric and hybrid vehicle repairs.”

One notable product included within the safety line is the Vehicle Fire Blanket. Since Li-ion battery fires cannot be extinguished using traditional fire extinguishing methods, service repairers must be prepared for these potentially devastating disasters during a repair.

JDI's Vehicle Fire Blanket is designed to suppress vehicle fires and prevent fire from spreading and damaging nearby property while preventing toxic fumes and smoke from releasing into surrounding areas.

This Fire Blanket is ideal for parking lots, auto repair shops, firefighters, underground parking lots, service stations, and charging stations.

Product benefits include:

- Contains vehicle fire and its debris to protect property, staff, and customers
- Limits damage and spread of fire to nearby areas
- For use on any passenger vehicle including internal combustion and EVs
- Keeps toxic smoke derived from combustion contained
- Two people can deploy the 19.5' by 29.5' blanket in seconds
- Easily deploy from a convenient storage rack with oversized straps 





## Help Federated Make The Holidays Happy

Federated is honored to serve as a corporate partner of the U.S. Marine Corps Reserve Toys for Tots campaign. This holiday season, Federated and its members will be raising money and collecting toys at their stores nationwide that will be donated to Toys for Tots.

For more information about participating or donating, visit [www.federatedautoparts.com/ToysForTots.aspx](http://www.federatedautoparts.com/ToysForTots.aspx).

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# MANUFACTURING, ENGINEERING, EDUCATION: ILLINOIS' NEW EV INNOVATION HUB

How an EV compressor manufacturing facility became a center for innovation and careers.

BY KACEY FREDERICK //  
Contributing Editor



➔ As vehicles head down the path of electrification, every aspect of the industry is impacted throughout the transition: from supply chains to research and development, to workforces.

TCCI Manufacturing has sought to address this with its new EV Innovation Hub currently in development in its hometown of Decatur, Illinois, along with the help of Illinois Governor JB Pritzker, Richland Community College, and the city of Decatur.

TCCI President Richard Demirjian and Vice President of Global Marketing Kara Demirjian Huss have offered a look into the work being done at the EV Innovation Hub and why it's needed in the industry today.

## Manufacturing: TCCI's EV Compressors

TCCI specializes in compressor manufacturing and began developing electric compressors for EVs in 2018.

Around two-and-a-half years ago, TCCI was looking to expand its manu-

facturing operations. It has electric compressors produced in Ningbo, China, but was looking to bring more of that work to North America.

Illinois has been pushing for green energy projects within the state, so TCCI began conversations with Governor Pritzker's office seeking support for an EV compressor manufacturing plant.

"Illinois has had this vision early on of being one of the leaders in electrification and the EV and energy industry, and so they really were instrumental," recalls Huss.

This new facility will be equipped with a state-of-the-art assembly machining center that will produce anywhere from two kilowatts to 30 kilowatts and 24 volts up to 850-volt compressors.

## Engineering: The Climate Center for Innovation and Research

As TCCI continued to have discussions about climate friendly technology, the topic of a facility for testing electric vehi-

cles was brought up, sparking the idea for the climatic center and turning the manufacturing plant into something more.

The Climate Center for Innovation and Research is housed in the same facility but operates independently from the manufacturing segment. It will be a climatic tunnel that contains a 60-foot by 25-foot chamber, equipped with solar and a three-road dyno that is 800 horsepower per roll.

The tunnel will also be able to accommodate hydrogen fuel cell vehicles and will contain a fast charger inside the tunnel for EVs to test how well the charging works at all types of extreme temperatures, ranging from -30 degrees to 130 degrees.

The main purpose of the climatic center is to test innovations in not only the EV sphere but clean energy and climate technology as a whole, which can often branch out into other fields such as agriculture. It's built in such a way that it has made ample room for potential

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expansions and add-ons in the future to accommodate different types of research.

“If there are particular researchers, or research programs that come down, this tunnel has a very flexible capability with it for add-ons,” Demirjian explains.

Many such research facilities are not open to other companies, with them often having to simply build their own if they wish to conduct tests—but TCCI will be opening access to the climatic center to any organization looking for somewhere to test equipment.

**Education: The EV+ Energy Workforce Training Academy**

The third piece of the EV Innovation Hub is the EV + Energy Workforce Training Academy, created in part with Richland Community College.

The program will be offered to high school students, allowing them to earn dual credits at the Innovation Hub campus while attending high school and having the opportunity to earn an Applied Associates of Science or an Applied Science Degree from Richland upon graduating high school.

**“THE DAYS OF THAT DARK, DIRTY, DINGY MANUFACTURING FACILITY JUST AREN’T THERE ANYMORE. WE’RE TALKING ABOUT AUTOMATION ON LINES, TECHNICAL SKILLS.”** – KARA DEMIRJIAN HUSS

TCCI has also established agreements with several universities throughout Illinois—such as the University of Illinois, Grainger College of Engineering, and Northern Illinois University—to allow students that have graduated to continue their education by transferring their credits to engineering or computer science programs in pursuit of a four-year degree.

Students will have access to assembly lines and the climatic center right outside their classroom doors, allowing for an immersive, hands-on experience for them. TCCI also has plans to connect with companies such as Rivian, Lion Electric, Caterpillar Inc., and Navistar to establish apprentice programs and co-op programs.

“The days of that dark, dirty, dingy manufacturing facility just isn’t there anymore. We’re talking about automation on lines, technical skills,” Huss says. “We need students coming either out of high-

school or out of college, we need more engineers, we need more individuals that have a computer science (background) with both the software and hardware capabilities because of the technologies needed in this space.”

The facility plans to launch in August 2024 and hopes to impact the auto industry and beyond.

As the transition to clean energy and electric vehicles continues, TCCI believes it’s imperative that the entire industry do its part to help hoist the sails. Demirjian hopes that similar projects will soon be seen elsewhere and is open to others visiting the EV Innovation Hub to use it as a template.

“Our involvement isn’t just about what we’re doing here at TCCI. It’s about helping the industry transition; making sure that our leaders in our company are out there being involved,” Huss says. **TZ**

**RECOGNITION**

**NOMINATIONS OPEN FOR TECHFORCE FOUNDATION’S ANNUAL TECHS ROCK AWARDS**

**T**echForce Foundation announced it has joined forces with Mecum Auctions for its 6th annual Techs Rock Awards. This year, the Awards will honor working and aspiring student technicians, marking a significant milestone in the program’s history.

Nominations are accepted until January 14, 2024, at <https://tinyurl.com/y9u3e6n4>.

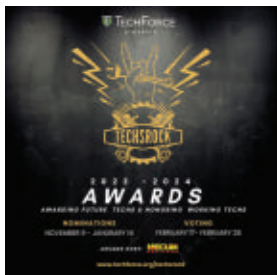
Eligible nominees include professional transportation technicians and technical students studying or working in any of the award categories.

The Techs Rock Awards recognize outstanding students and professional technicians in five categories: Automotive and Motorsports; Diesel; Collision, Restoration and Welding;

Aviation, Motorcycle and Marine; and Evolving Technologies. Category winners will go on to compete in a public vote, with one student and one professional tech will be selected as grand prize winners and receive a trip to Glendale, Arizona to enjoy Mecum Auction Glendale and meet and be honored by industry leaders at TechForce’s National Partner Summit.

TechForce established the Techs Rock Awards to honor the dedication and passion for the profession that aspiring and working technicians demonstrated. These individuals serve as true role models, inspiring the next generation of tech enthusiasts.

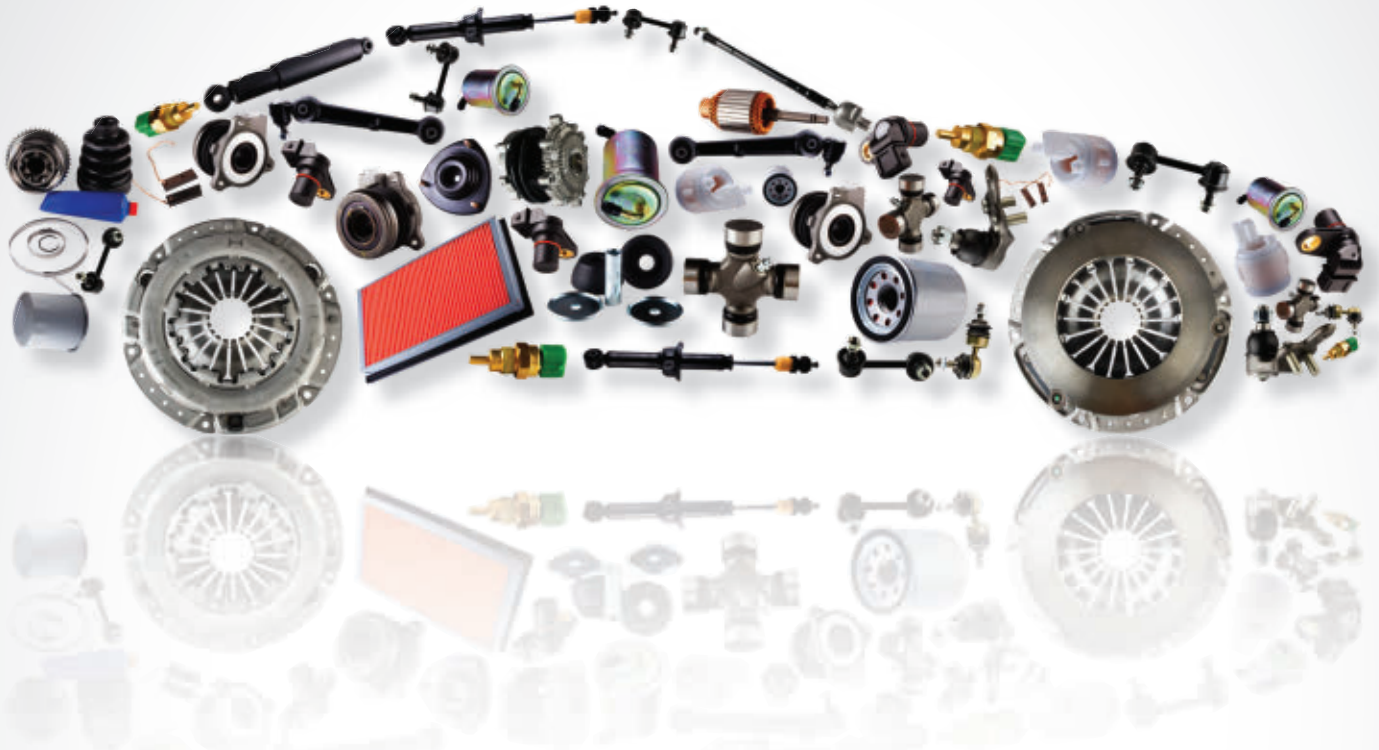
Since its inception in 2018, the Techs Rock Awards have recognized 75 technicians and technician students, providing over \$131,000 in scholarships and prizes. This program has been instrumental in promoting the importance of technical education and highlighting the immense value that skilled technicians bring to our world. **TZ**





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## A step-by-step guide to conducting annual reviews

Annual reviews are not just a routine; they are a critical practice to maintain and improve the quality of service.

BY MIKE HALEY // Contributing Editor



In the fast-paced world of automotive service, precision and efficiency are paramount. Service writers and technicians are pivotal in ensuring prompt and effective repairs on our customers' vehicles. Annual reviews are not just a routine; they are a critical practice to maintain and improve the quality of service. Let's dive into the reasons for conducting annual reviews, the process involved, and how to build a growth plan based on these assessments.

### Why are annual reviews necessary?

Annual reviews serve several vital purposes within the automotive service industry. These assessments are more than a formality. They are a strategic tool that benefits employees and the organization because your technicians' skills and performance directly impact your business's reputation and profitability.

Regular performance evaluations provide an opportunity to recognize and reinforce strengths, address areas for improvement, and foster a culture of continuous learning and development. Moreover, they can serve as a vital tool in retaining top talent and ensuring that your team remains up to date with evolving automotive technologies and industry standards.

#### 1. PERFORMANCE ASSESSMENT

The foremost reason for annual reviews is to assess the performance of service writers and technicians. It allows man-

agers and supervisors to gain insight into the strengths and weaknesses of everyone, helping them understand where improvements are needed.

#### 2. GOAL ALIGNMENT

Annual reviews help align the goals of individual employees with those of the organization. This process ensures that everyone is working towards a common objective, which is crucial for the overall success of the service department.

#### 3. SKILL DEVELOPMENT

Annual reviews pave the way for skill development by identifying areas that need improvement. The review process, in turn, enhances the proficiency of service writers and technicians, making them more valuable assets to the company.

#### 4. FEEDBACK AND COMMUNICATION

Annual reviews provide a platform for open and honest communication between employees and management. Constructive feedback can be shared, allowing for a better understanding of expectations and areas for growth.

#### 5. MOTIVATION AND RECOGNITION

Recognizing the hard work and dedication of service writers and technicians during annual reviews can boost their motivation. Employees who feel appreciated are more likely to remain engaged and committed to their work.

“REGULAR PERFORMANCE EVALUATIONS PROVIDE AN OPPORTUNITY TO RECOGNIZE AND REINFORCE STRENGTHS, ADDRESS AREAS FOR IMPROVEMENT, AND FOSTER A CULTURE OF CONTINUOUS LEARNING AND DEVELOPMENT.”

### The annual review process

Conducting an effective annual review requires careful planning and execution. Here's a step-by-step guide on how to go about it.

#### 1. PREPARATION

Begin by gathering all relevant data, such as performance metrics, customer feedback, and supervisor notes or observations. This information forms the foundation of the review.

#### 2. SCHEDULE A MEETING

Arrange a private, one-on-one meeting with each service



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writer and technician. This ensures that the employee feels comfortable discussing their performance and goals.

**3. SELF-ASSESSMENT**

Encourage employees to complete a self-assessment beforehand. This helps them reflect on their achievements and areas needing improvement, facilitating a more productive discussion during the review.

**4. DISCUSSION**

Discuss the employee's self-assessment during the review meeting and share your observations and feedback. Focus on specific examples to provide clarity and context.

**5. SET SMART GOALS**

Collaboratively establish Specific, Measurable, Achievable, Relevant, and Time-bound (SMART) goals for the upcoming year. These goals should align with both individual and organizational objectives.

**6. DEVELOPMENT PLAN**

Create a development plan that outlines the steps needed to achieve the established goals. The plan might include training, mentorship, or additional responsibilities.

**7. RECOGNIZE ACHIEVEMENTS**

Acknowledge the employee's accomplishments from the past year, no matter how small. Recognition is a powerful motivator.

**8. CONSTRUCTIVE FEEDBACK**

Offer constructive feedback on areas that need improvement and provide guidance on how to address these shortcomings.

**9. DOCUMENT THE REVIEW**

Keep a record of the annual review, including the discussion, goals, and development plan. This serves as a reference point throughout the year.

**10. FOLLOW-UP**

Regularly check in with the employee to monitor progress, offer support, and make necessary adjustments to the development plan.

programs, mentorship opportunities, or access to new tools or technology.

**4. CREATE A TIMELINE**

Develop a timeline that outlines when the employee should accomplish specific actions and milestones. Having a structured plan with deadlines helps track progress effectively.

**5. MONITOR PROGRESS**

Regularly review and assess the employees' progress toward their objectives. Provide ongoing feedback and adjust the growth plan as needed.

**6. CELEBRATE ACHIEVEMENTS**

Recognize and celebrate achievements along the way. Positive reinforcement motivates employees to stay committed to their growth plans.

**7. REVIEW AND ADJUST**

At the end of the year, conduct another annual review to evaluate the employee's progress and determine whether the growth plan needs adjustment or expansion.

**It's time to conduct your annual reviews**

Annual reviews for service writers and technicians are indispensable for this industry. They provide a structured approach to assessing performance, setting goals, and fostering growth. By following a well-defined process and building growth plans based on these assessments, automotive service organizations can ensure their teams remain agile, skilled, and aligned with the company's mission. Annual reviews are not merely a formality but a vehicle for driving excellence in service delivery. *TLZ*



**MIKE HALEY** started in the auto industry in 1985, working part-time for his father's friend at a four-bay Western Auto while also attending community college. He joined Pep Boys in 1987 as an assistant manager, soon became one of the youngest store managers in the chain, and was eventually promoted to District Operations Manager in the Washington and Northern Virginia market. He went on to serve as service and facility director for 23 service departments in the mid-Atlantic market. In 2005, he served as operations manager for CarMax Toyota, the second largest Toyota dealership in the country, where he was exposed to new technologies and processes for acquiring and retaining customers. Mike uses his decades of experience and certifications to help shop owners become successful both personally and professionally and is what Mike describes as his greatest reward. ATI's 34 full-time, certified coaches, including Mike, have helped ATI's members earn over \$2 billion in return on their coaching investment since ATI was founded.

**Building a growth plan**

An annual review is not just a standalone event but a catalyst for continuous growth. To build an effective growth plan, consider the following essential steps.

**1. IDENTIFY PRIORITIES**

Start by pinpointing the most critical areas for improvement based on the annual review. Focus on those aspects that will significantly impact the employee's performance and the organization's goals.

**2. SET CLEAR OBJECTIVES**

Transform identified priorities into clear and actionable objectives. These objectives should be specific, measurable, and realistic.

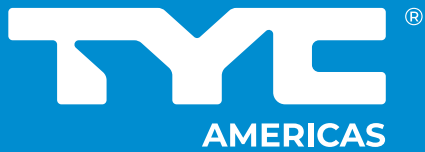
**3. DETERMINE RESOURCES**

Assess what resources are necessary to support the employee in achieving their objectives. This might include training

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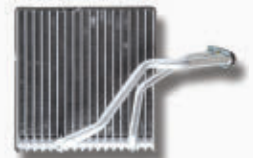
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If you're not using loaded/dynamic circuit-testing, you may cause a misdiagnosis.

BY BRANDON STECKLER // Technical Editor





**S**o, you've done your due diligence and have attended many an electrical course. You've invested in yourself and your career and have acquired the proper tools to get the job done right. So, why is it that you're struggling with electrical fault-finding?

So many times, I've faced disheartened technicians. They looked as if they'd lost their best friend. When inquiring with them what the issue might be, they've responded with, "I just can't seem to get it. Why does electricity always seem to kick my butt? It makes perfect sense in class but when I put it to use in the shop, it all seems too wrong?"

Well, I've been there before, and it's not fun. In fact, a series of misdiagnoses or comebacks is all it takes to knock the wind right out of a technician's sail. But it's not from a lack of trying. What many take for granted is the location of their chosen test point (relative to the circuit, as a whole) is not revealing the entire story.

### **Loaded/dynamic testing**

This is a huge oversight that many technicians still don't consider. The difference between testing a circuit dynamically versus when it is open is the difference between truly locating the problem and hoping the open-circuit test reveals the fault.

What I'm getting at is as follows:

When a circuit has been opened and an ohmmeter is used to evaluate the health of a component or related circuit, that ohmmeter is simply checking continuity. In other words, is there a completed path between the two test meter leads and the points in the circuit they are both referencing? If there is a gross failure, it might be detected by the ohmmeter (with a continuity/resistance test), but that is not a likely scenario.

The reason is an ohmmeter doesn't "load" the circuit like when the circuit is functioning under its intended design. An ohmmeter places a very small current in the section of the circuit being tested. This current is typically far less than that of a circuit under normal operation.

As current flows, voltage will drop (the basis for Ohm's Law) because all portions of a circuit have resistance (**Figure 1**). Regardless of how much or how little resistance, the voltage will always drop (proportionally to the circuit resistance) across two test points in a resistance test. This is because there is a relationship between resistance, voltage/voltage drop, and current flow.

- If resistance is fixed, current will increase with voltage increase
- If voltage is fixed, current will decrease with added resistance
- If the current is fixed, the voltage will drop with an increase in resistance

The ohmmeter uses that voltage drop (and Ohm's law equation, **Figure 2**) to calculate resistance.

Now, because no current is flowing through the circuit being measured when it is opened (during a continuity/resistance test) the circuit isn't being loaded. You can picture this concept as a stress test that a cardiologist would perform on a person experiencing blood circulatory issues (**Figure 3**). It should be plain to see that a person's cardiovascular system may function normally when the person is at rest but placed on a treadmill

for a period of time, and the fault is likely flushed to the surface.

With that, it's far more accurate to test that circuit under loaded conditions. When a circuit is under normal operating conditions, it carries its intended current flow. But if there is a fault present related to the resistance of the circuit (the copper wiring) or the devices within that circuit, a voltage drop will occur; it's just plain old physics.

**Testing locations**

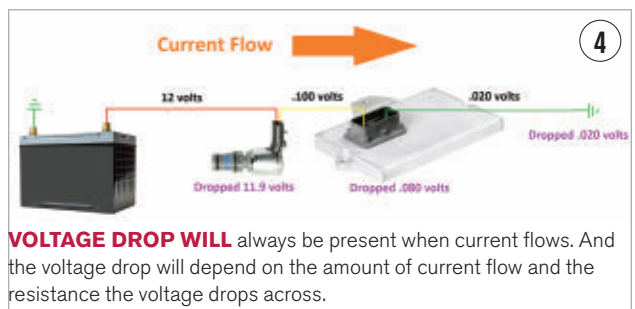
The basis for this entire article is right here. What you read above was a precursor to good testing techniques. As mentioned in the title, being in the right place at the right time is absolutely crucial for accurate fault detection in an efficient manner.

Keeping in mind that a circuit is either classified as one that performs work (like illuminating a light bulb, sounding a horn, or operating a motor) or one that does not perform work (simply carries a signal, like that of a crankshaft position sensor or fuel tank pressure sensor), we have to strategize to test in different locations depending on which circuit it is. This is best explained by way of real-world examples.

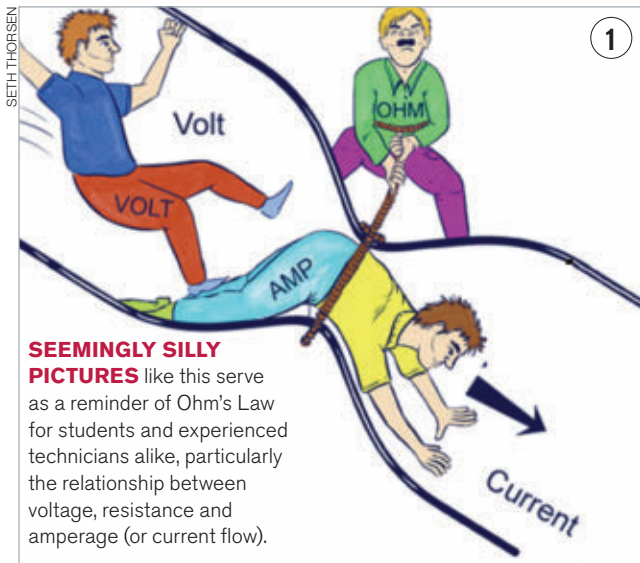
This is a simple and typical port fuel injector circuit (**Figure 4**). The current must flow through the injector properly for the injector to do its job and deliver fuel properly. As can be seen, the current leaves the battery and passes through the injector toward the path to ground (located externally to the PCM but switched internally to the PCM.)



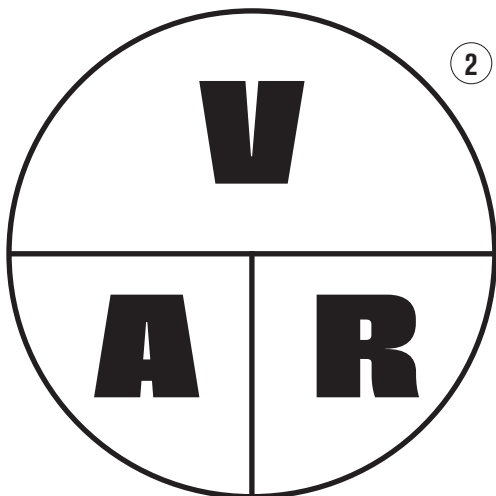
**JUST AS A PHYSICIAN** uses a dynamic stress test as a load for the cardiovascular system (to determine a fault), a technician should test a circuit dynamically to flush faults to the surface.



**VOLTAGE DROP WILL** always be present when current flows. And the voltage drop will depend on the amount of current flow and the resistance the voltage drops across.



**SEEMINGLY SILLY PICTURES** like this serve as a reminder of Ohm's Law for students and experienced technicians alike, particularly the relationship between voltage, resistance and amperage (or current flow).



**2 THIS PIE CHART** demonstrates how to perform the math to calculate resistance, voltage or current flow. All that is required is two of the three variables to determine the missing third variable.



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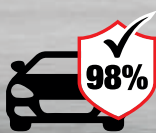
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Because voltage drops as it passes over resistances, we would expect the injector to use up (or drop) almost all the available voltage, leaving very little to drop across electrical connections or the switching device (the transistor or MOSFET) internal to the PCM.

If one were to test the control circuit (when the injector is energized) at the back of the injector connector, one should anticipate reading near zero volts (reading in millivolts) (Figure 5). If the meter test lead were then positioned to take that same measurement at the injector control circuit of PCM, again one should anticipate near zero volts (Figure 6).

Now, let's change the scenario a bit. Perform those same measurements with a fault present in the circuit (blue star). When testing at the same injector connector terminal, there is still voltage available. This reading should alert you of a resistance issue somewhere downstream of the injector (between your test point and the ground point of the circuit) (Figure 7).

However, if you made that same measurement at the PCM, you would still see nearly zero volts, not readily alerting you to a fault (Figure 8). So, did the test let you down? Is the test result a lie? No, and no. We must ALWAYS consider the limitations of the tool we are using and the test we are performing. The test measures the available voltage at the test point. At that point, we measured near zero. That is the absolute truth.

“ I HAVE A STRONG FEELING YOU WILL BE PLEASANTLY SURPRISED BY HOW EASY IT IS WITH A LITTLE BIT OF PRACTICE. ”

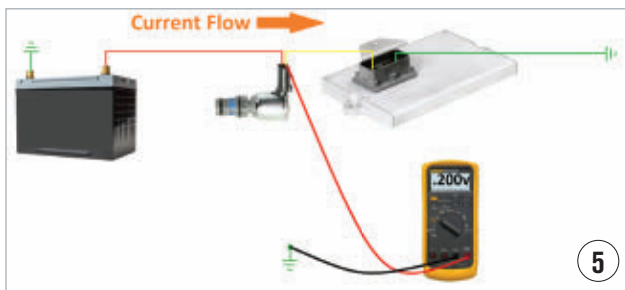
What the test cannot tell you (its limitation) is that some of the voltage was dropped across the injector (the intended load) and the rest was dropped across the green corrosion in the injector control wire.

When using a voltage test on a non-work-performing circuit (a signal circuit) I want to test as close to the receiving/processing computer as possible. For instance, just because a signal was output from a crankshaft position sensor properly doesn't mean it made it to the ECU unscathed.

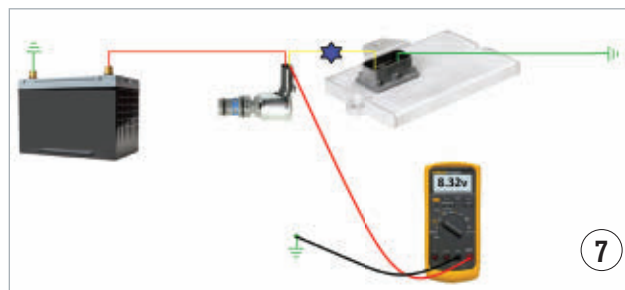
To sum it up, when using only a voltage test on a work-performing circuit, I perform the test as close to the load device as possible. I simply want to see if the intended load is using all the voltage or not. When testing.

**Overcoming test limitations**

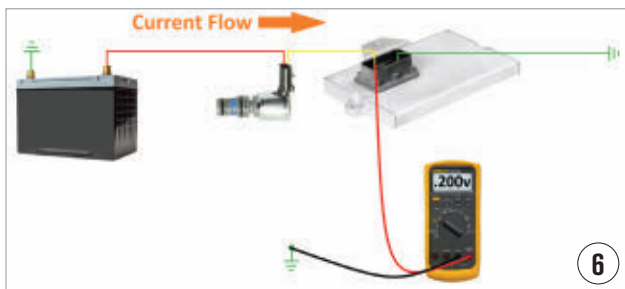
Clearly, the above test was not ideal for the scenario. But that's okay, as long as we are aware of what the test can reveal to us and what it cannot reveal to us. The real question is how can



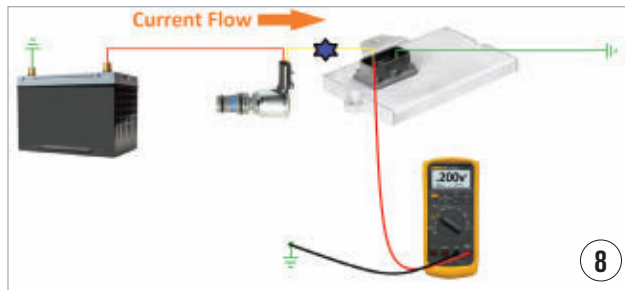
**TESTING AT THE** fuel injector, as displayed, will show not only how much of the voltage is dropped across the load the injector provides to the circuit, but also how much voltage (if any) is unused by the rest of the ground-side circuit.



**TESTING AT THE** injector (the load) uncovered the unwanted resistance (blue star) located on the injector control circuit. The resistance created an 8V drop when the circuit was energized.



**TESTING AT THE** PCM shows the same available voltage as was measured at the back of the injector connector, which indicates there is no voltage drop between the injector and the PCM. However, testing here cannot determine if any unwanted voltage drop exists before this test point.



**THE UNWANTED RESISTANCE** and correlating voltage drop would not be seen if the measurement was taken at the PCM, as displayed. All the voltage would have been dropped (across the intended load of the injector and the unwanted resistance of the blue star). It would be impossible from this measurement alone to detect a fault in the circuit.



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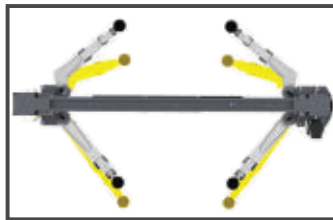


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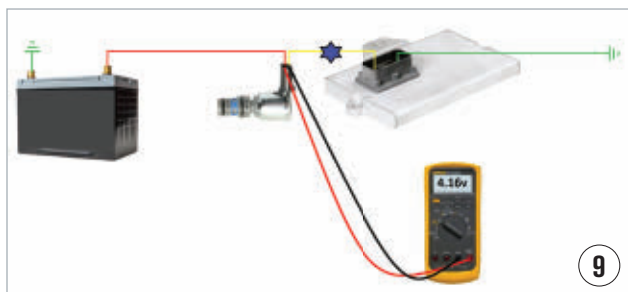
potential mishaps like that be avoided altogether? Consider implementing a different version of the same test.

I would describe the previous testing technique as an “available-voltage test.” A true voltage-drop test means letting the meter do what it does as a voltmeter. It displays the potential indifference between the two test leads. Creating a series of tests by placing the test leads across different sections of the circuit would’ve revealed the fault and its location to us.

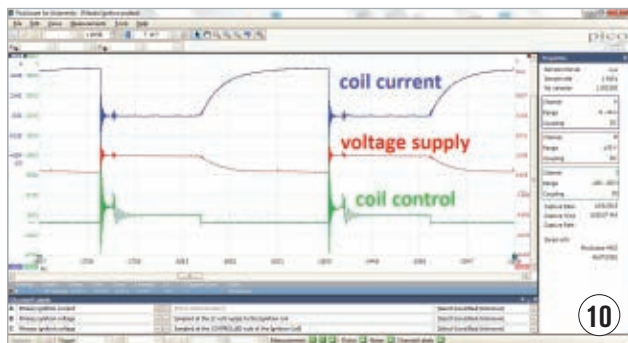
For instance, placing the meter leads across the injector (with the same fault present as described earlier) would show the injector only using some of the voltage (not “almost all” the voltage, as it should). This reveals a problem is present, but it doesn’t yet tell us where the problem is located. Moving the meter leads to different sections of the circuit is then required to find the location of the voltage drop (**Figure 9**).

Here is another technique altogether. I’ve discussed many times using a current probe to measure amperage flow. The current probe measures the “work” being performed by the circuit. If nothing is wrong, we should anticipate normal amperage values. However, if there is any added resistance/voltage drop anywhere in that circuit, the current probe will reveal a lack in current value (less work being performed).

The current probe can be coupled to a DVOM, can be used stand-alone (depending on if it’s designed with its own display),



**TESTING ACROSS THE** fuel injector only reveals that the injector DOES NOT drop the source voltage (as intended). further testing would determine if the other remaining 8 V was lost on the positive-feed side of the circuit, ground-control side of the circuit, or a combination of both.



**A PICTURE IS** worth a thousand words. This three-trace scope capture reveals a voltage drop in the positive-feed side of the circuit when energized. This test was very easy to perform and revealed a fault existed and what side of the circuit the fault was located.

we can now look at these four different aspects, for instance (**Figure 10**):

- Voltage feeding the injector
- Voltage on the control-side of the injector circuit (back probed at the injector connector)
- Voltage on the control-side of the injector circuit (back probed at the PCM connector)
- Circuit current

This simple yet complete view of the entire circuit simultaneously not only easily revealed an issue was present but also where in the circuit the fault was located. A voltage drop existed on the voltage-feed side of an ignition coil due to a spread terminal at an inline connector. This is revealed by the lack of current amplitude.

As the current began to flow, voltage started to drop, leaving a lack of available voltage feeding the ignition coil. This was the cause of a misfire under loaded engine conditions but was quite simple and quick to discover. I love it when a good plan comes together.

### The experiment

So, what I don’t want you to do is take my word for it. I want you to conduct an experiment for yourselves and I’d like you to contact me with your conclusions (bsteckler@endeavorb2b.com). I want you to research a simple circuit in a wiring diagram. I then want you to print out that diagram (so you can annotate it). Conduct the tests I described above for yourselves and document the measured voltage at the test points called out early (regarding the work circuit).

I have a strong feeling you will be pleasantly surprised by how easy it is with a little bit of practice. Once these tests and techniques are mastered, they can be applied to any circuit on virtually any vehicle you encounter, making you the go-to tech for electrical fault finding.

Let me leave you this question. How would it feel to actually be profitable with electrical diagnostic work? There is only one way to find out. I hope I’ve empowered you to implement my suggestions. I am really looking forward to reading about all your success stories. *ZZ*



**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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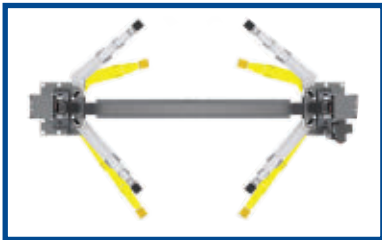
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# TESLA SERVICE AND REPAIR

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BY SCOTT BROWN // Contributing Editor

**T**esla vehicles have been entering the market for several years now and you may have already had one or more visit your service facility. Nevertheless, there are about 1.7 million EVs on the road in the U.S. and according to Electrek.com, over two-thirds of those are Teslas. I strongly believe that Tesla vehicles are revolutionizing the way vehicles are built and serviced, but it's all not positive. As an owner of one of these machines, I've seen some interesting trends and feature changes with these vehicles. So, let's dive in and take a closer look.

Now as far as service goes, Tesla vehicles are generally considered to be relatively easy to service. They are designed with long-term reliability and minimal maintenance in mind, and many of the maintenance tasks that are required can

be done by using a few basic tools.

There are also more complex maintenance tasks that may be required, such as diagnosing and repairing issues with the electrical system. These tasks may require specialized tools and knowledge, which is where the service professional comes in. And regarding knowledge, keep in mind that most Tesla owners are more connected and aware of how their vehicles operate. Anyone considering stepping in to provide service on these vehicles will greatly benefit from possessing a higher level of knowledge of Tesla vehicles. Hopefully, this article will provide a jump start and encourage you to learn more about these machines.

Overall, the level of difficulty in servicing a Tesla vehicle will depend on the specific task that needs to be performed, as well as the skills and experience of the person doing the work.



## Warranties

Tesla currently offers a new car warranty for its vehicles that covers the following:

- The battery pack and electric drive components are covered for eight years or 100,000 miles (160,000 km), whichever comes first.
- The remaining vehicle components are covered for four years or 50,000 miles (80,000 km), whichever comes first.
- The paint and finish are covered for four years with no mileage limit.
- Corrosion perforation (rust-through) is covered for six years with no mileage limit.

Please note that these warranties may vary depending on the specific model and location and are subject to change. It is always a good idea to consult Tesla's website for the most up-to-date information on warranty coverage.



**Service mode - Accessing data without any special tools**

Tesla recently opened access to the basic service mode within their vehicles to anyone via a hidden activation feature. Prior, this access was geo-fenced, meaning that it could only be activated when the vehicle was within a specific geographic area such as a Tesla service center. This is good news because prior to this, there was a significant barrier for anyone attempting to properly perform a task such as a wheel alignment.

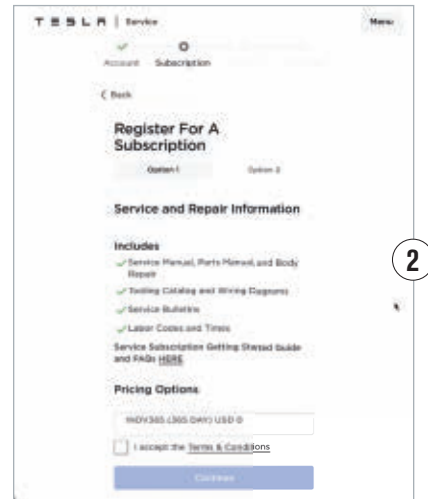
Now keep in mind that although one has access to these options, special care should be taken in order to avoid something going wrong. I recommend that if you're going to carry out actions, you do so with advanced knowledge acquired through study and attending technical training.

Additionally, activating 'Service Mode' does not provide access to all ser-



**TESLA DIAGNOSTIC** software subscription.

vice modes. You will need to have a subscription to the Tesla Toolbox Software (Figure 1) that will allow you to activate 'Service Mode Plus' which will provide access to additional resources. Access to service information however is now



**TESLA SERVICE** information subscription.

available at no charge, all you need to do is sign up at service.tesla.com (Figure 2).

To enter service mode, refer to Figure 3. From the software page, "long-press" on the vehicle model name for about 5 seconds. Once you release, you'll be

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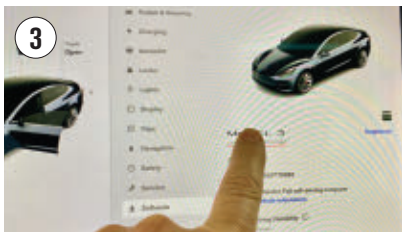


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**TRIGGERING** 'Service Mode' access.



**TESLA MODEL 3** 'Service Mode' menu.



**THIS LIST** shows service alerts.

presented with a login screen. Enter 'service' and then you'll be presented with a warning screen you'll need to acknowledge in order to activate. Once you're in you'll see a red border added to the display screen with various options as shown in **Figure 4**.

If there are issues to address, you'll see a message at the bottom of the screen with the number of active service alerts you should be aware of as shown in **Figure 4**. Touching the 'Service Alerts' button will present you with a list and their visibility levels (**Figure 5**).

### Wheel alignment

Did you know that a Tesla vehicle can alert the owner or service technician if it requires a wheel alignment? The Tesla vehicle's onboard computer continuously monitors the performance of various systems, including the suspension and steering, to detect any issues that may need attention. If the vehicle's wheels are out of alignment, the computer may detect unusual tire wear or handling characteristics and alert the owner or service technician through the vehicle's onboard diagnostics system or via the Tesla mobile app. However, when you are in service mode you can pull up the chassis tab and have a look at the overall applied offset which is what the system has arrived at after monitoring certain data parameters to

detect a vehicle tracking issue. You will not receive a notification until there is a very large offset. I've inspected several vehicles and have found many vehicles in the 2-3 degree range as shown in **Figure 6**. I've personally aligned many of these vehicles and have taken the learned offset inside of 0.4 degrees.

Performing a proper alignment should be done as recommended by the service manual, which is with 300 lbs of ballast added to the vehicle and adjusted to achieve the ride height specifications (**Figure 7**).

As with most vehicles today, not all angles are adjustable through conventional means however the service manual states the following:

*"The Model 3 and Model Y vehicles do not have dedicated adjustment points for camber and caster. Instead, camber and caster are adjusted by manipulating the suspension lash and slop. The real-world accuracy of these adjustments is achieved by installing ballast bags to simulate the presence of a driver and front passenger. Performing this service procedure without ballast bags compromises the real-world accuracy of the adjustments."*

There are options as some aftermarket companies are now offering solutions for achieving proper alignment angles. We have begun installing components

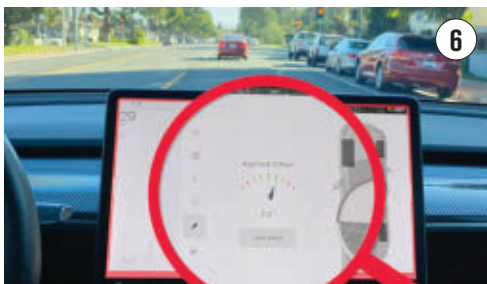
offered by a company called Unplugged Performance located in Los Angeles. We've seen a few Model 3's and Y's requiring rear camber adjustment and their replacement control links work well (**Figure 8**).

### Diagnostics

From what I've observed thus far, Tesla's service information doesn't really have any diagnostic flow charts. However, when you're chasing down a service alert and running actions, you may be presented with connector numbers (**Figure 9**) where you would then look at service information, wiring diagrams, and connector locations (**Figure 10**).

Tesla's wiring diagrams may take a little getting used to. I recommend taking some time to study the initial pages on any of their current diagrams to learn more about the legend. A lot of information is shared there that can help you navigate the wiring diagrams with more efficiency.

When you're within the Toolbox application running on your PC or laptop, oftentimes you'll find contextual links taking you right into the service information. However, there are features within service information that (as of the writing of this article) are not available to the aftermarket such as the 'Interactive Schematic Tool.'



**TESLA WHEEL** alignment offset.



**PROPERLY PREPPING** a Tesla for wheel alignment.



**Case study**

I own a 2018 Model 3, and I recently had a service issue related to the thermal management system. I was never alerted to the issue via the publicly visible notifications. When I entered 'Service Mode,' I was presented with the following error shown in **Figure 11**.

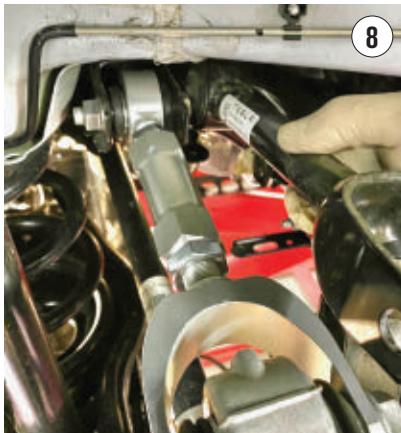
I proceeded to look in 'Service Information' for any testing info and there was none. The only support provided was in the description shown on the screen, "Check coolant valve harness and/or replace actuator."

I checked the harness connector, and all looked fine, so I ordered a new actua-

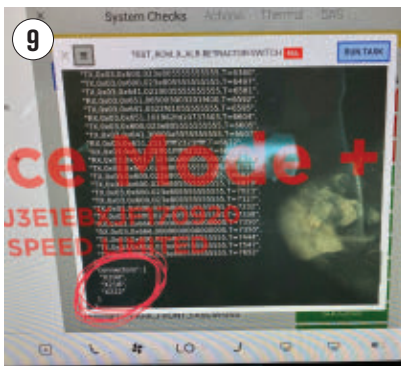
tor and replaced it. After replacement, I performed a cooling system bleed procedure where the five-way valve went through a calibration routine resulting in the error message disappearing. I decided to do a post-mortem on the five-way valve and found the failure (**Figure 12**).

**High-voltage systems**

Hybrids have been around for about two decades and HV training has been available for quite some time, so I will suggest that if you haven't had proper HV training you do so ASAP if you're going to be servicing any of these systems. The HV tab in 'Service Mode' offers quite a bit of information about the HV system



**AFTERMARKET** camber adjustment link.



**CONNECTORS** of interest.



**TESLA SI** – Connector location guide.



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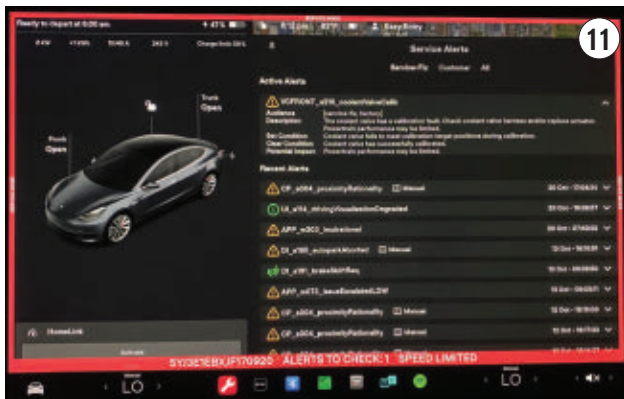


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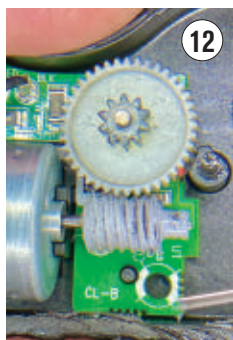
(**Figure 13**). Always refer to the latest service information when performing service on Tesla vehicles.

**Comfort systems**

Tesla vehicles use either R-134 or R-1234yf for their refrigeration systems with newer vehicles utilizing a heat-pump system which brings a new level of complexity to the refrigeration loop. Performing system service on these systems will require the technician to enter ‘Service Mode’ and prepare the system for service. As mentioned earlier, reference the latest service information before service. Regarding the heat-pump system, a recent software update to the ‘Service Mode’ menu provides a highly verbose view of the overall system where the technician can operate various modes and observe the refrigerant flow, temperatures, and pressures (**Figure 14**).



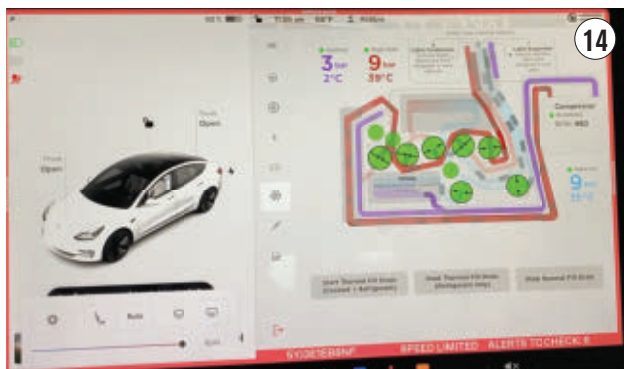
**FIVE-WAY** coolant valve calibration failure.



**FIVE-WAY** coolant valve stripped gear.



**HIGH VOLTAGE** information.



**MODEL 3** with heat pump.

Cabin air filters are a service item we perform regularly not only on Teslas but all vehicles. In addition to that, we also recommend performing an ozone sanitization treatment service using the TEXA AIR2SAN tool (**Figure 15**). This is a service we sell a lot of and is highly effective. All my employees also perform this service on their own vehicles as well.



**TEXA AIR2SAN** ozone service.

**Conclusion**

Although we’ve touched on several areas, there’s still a lot more to be aware of on these vehicles. However, service training and knowledge will go a long way in developing a higher level of awareness of Tesla vehicles. See the sidebar for some more useful resources.

**RESOURCES**

**Tesla Service Information and Diagnostic Software:**  
[service.tesla.com](https://service.tesla.com)

**Tesla Diagnostic Cables:**  
[aeswave.com/Tesla-2-in-1-Ethernet-Adapter-Cable-Not-Plaid-p10310.html](https://aeswave.com/Tesla-2-in-1-Ethernet-Adapter-Cable-Not-Plaid-p10310.html)

**Weber State HV Training:**  
[continue.weber.edu/professional/programs/evtraining/](https://continue.weber.edu/professional/programs/evtraining/)

**Future Tech Auto HV Training:**  
[futuretechauto.com](https://futuretechauto.com)

**Texa AIR2SAN Ozone Sanitization System:**  
[texa.com/products/air2-san/](https://texa.com/products/air2-san/)

**HV Hand Tools:**  
[beta-tools.com/en/products/electrotechnics/other-tools-insulated-1000v.html](https://beta-tools.com/en/products/electrotechnics/other-tools-insulated-1000v.html)

**Unplugged Performance Aftermarket Chassis Parts:**  
[unpluggedperformance.com](https://unpluggedperformance.com)



**SCOTT BROWN** is an ASE Master Certified Automobile Technician with L1, L3, & L4 credentials and has over 39 years of professional service industry experience. As an independent shop owner in Southern California and with his engagement at various levels of within our industry, he continuously strives to move the industry forward through networking, education, communications, and training. Scott is a founder of the Diagnostic Network (<https://diag.net/>).

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# THE REPAIR INFORMATION SYSTEM – A MANDATORY TOOL FOR SUCCESS

YOU SHOULDN'T EVEN CONSIDER FIXING TODAY'S CARS WITHOUT IT.

BY ROSS COLKET // Contributing Editor



PHOTO 5640216 © CLEARVIEWSTOCK | DREAMSTIME.COM

**W**hen it comes to fixing modern vehicles, I will not accept a vehicle for work if I do not have the proper service information. This system from Mitchell 1 (as well as other sources) has served our shop well for years. (Figure 1). There are certain vehicles out there that are considered low-production vehicles, and they will not typically be included in most aftermarket sources of service information as a result. There are too many factors on today's vehicles that require you to consult the service information. From wiring diagrams to torque-to-yield bolt specifications, there is no way to ensure an accurate repair unless you have the

service information to consult. Think of all the things that can go wrong if you don't have the correct information available to you. The potential for a comeback is staggering when you begin to think about it.

Due to our shop's reputation for problem-solving, we receive many problematic vehicles from other shops for our diagnostic abilities. We are known in the area for getting to the bottom of these so-called problem vehicles.

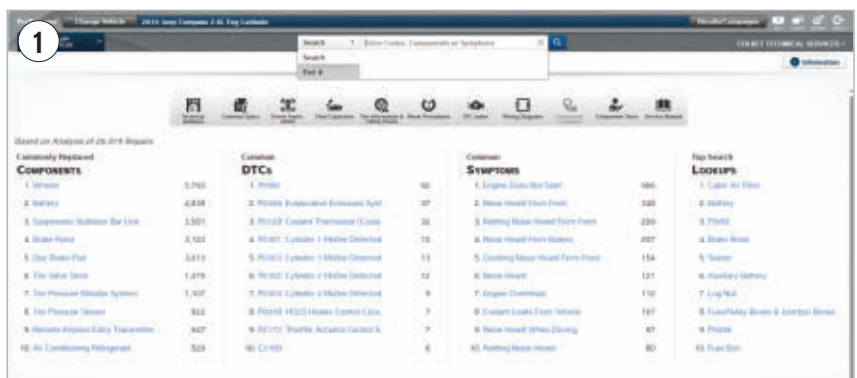
## Don't lean on flowcharts

Our diagnostic process starts with duplicating the problem. We explain to the client that if we cannot duplicate the problem, we are not going to proceed any further, as we would otherwise just

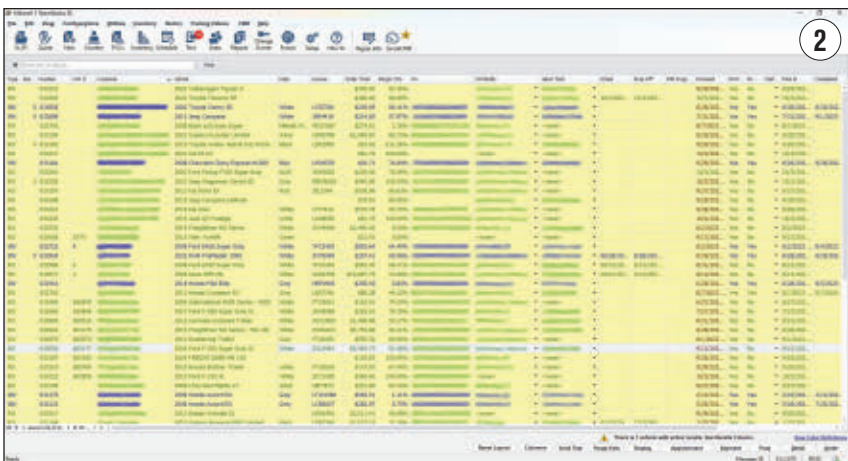
be guessing at what the problem is. We make a point of making sure the client understands our approach to finding the problem. First, duplicate the problem and then do the necessary research to pinpoint the cause of the problem. Remember, if you are testing a car from a diagnostic flow chart to find a problem, you are guessing; you simply don't know what the actual problem is at that point. When performing testing on a vehicle, the tests should be to verify the problem, not to find it.

Many years ago, I took a class from Jorge Menchu about color-coding wiring diagrams. The premise was to use specific colors on an electrical circuit that would indicate the voltage level in each part of the circuit: red for power all the time, blue for switched power, and so on. This forced me to look harder at the circuits and understand the different voltages throughout the circuits.

It was an amazing class for me and made me look at circuits in a totally different way. As a result, I no longer use diagnostic flow charts; I use wiring diagrams to diagnose vehicles. It saves me time, as I no longer try to interpret the engineer's thought process. I can look at the wiring diagram and I am able to determine what the voltage should be and test for that.



**THIS SCREENSHOT OF** a Mitchell 1 search screen helps illustrate the importance of having and knowing how to use an information system.



ROSS COLLIET

**THIS WORK-IN-PROGRESS** screen illustrates the time savings of using a management system that integrates works with your information system.

There are only so many conditions for a circuit. Remember, it is either TTL (transistor-to-transistor logic), your 0-to-5-volt range or CMOS (complementary metal-oxide semiconductor), 0-to-12-volt range. Yes, networks can have different voltage levels, but that information is typically easily found in your information system.

**Streamline your process**

When we receive a problem vehicle, the very first thing I will do is scan the vehicle. I will typically do this at the end of the day. I will look at the codes and also use Direct-Hit by Identifix to see if there are common failures or bulletins for the specific problem. If there are no common problems, I will simply let it sit in the back of my mind until the next morning. It is not that I am thinking about it, but subconsciously I begin to think it through. I had great success with this and pick up with the vehicle first thing the next morning. I will start with pulling a wiring diagram from Mitchell 1 or ALLDATA and begin to look at common points and what type of testing will be required to identify the problem.

I prefer to use Mitchell 1. Since that is our management system, we can easily access a work-in-progress screen and I can get right into the service information without having to identify the vehicle or copy-and-paste the VIN (**Figure 2**).

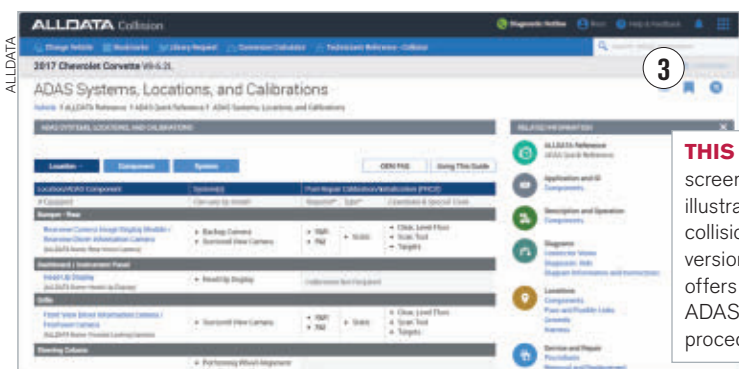
Mitchell 1 has a service information button that you can go to right from the vehicle work order to the service information for the vehicle. With ALLDATA and Direct-Hit, I have to copy and paste the VIN number.

Each of the information systems has its benefits and drawbacks. I am not going to discuss the drawbacks, as I feel they are more pet peeves on my part rather than a negative point of the information system. Mitchell 1 also has a medium- and heavy-duty truck information database that we use on a regular basis. For Alldata, I have the collision version, which has a great ADAS support menu. Direct-Hit is great for finding common pattern failures. We do not use Direct-Hit as the “be-all, end-all,” we use it to get a potential start to our diagnostic approach and to identify potential failures. Identifix is also a great way to identify bulletins and service procedures related to your search.

Once we have done our research, we will begin our testing process. Again, we will test to verify the problem, not to try and figure out what the problem is. Once we have found the problem, we will take a step back and see if it makes sense and if there could be more than one problem. I cannot think of anything much worse than selling a job and then finding out that it wasn't the actual problem, then having to call the client to explain the repair did not fix the problem but we need to keep going. I have had this happen, and I took care of the second repair without charging the client. It is all about how you communicate with your client. If there is any doubt in your mind there could be more than one problem, explain to the client this is where the process needs to start.

We do quite a bit of work for local body shops, and because of that we need to know labor times for body repairs. With performing ADAS calibrations, we frequently need to remove bumper covers. With ALLDATA, we have the collision version which provides the labor times for these operations (**Figure 3**). We also like the ADAS menu within ALLDATA for determining when calibrations are needed. Mitchell 1 has this as well, but we have become accustomed to ALLDATA's ADAS menu.

I have worked with Mitchell 1 since 2000. I am very used to it and that is my go-to information system personally. There are many team members in my shop who have begun using ALLDATA all the time instead of Mitchell 1. I pay for all three information systems, and I am simply glad to see them being used.



**THIS ALLDATA** screen shot illustrates a collision shop version which offers many ADAS calibration procedures.



It is not my place as their manager to tell them which system to use. I do, however, expect them to follow a diagnostic approach.

Many years ago, back in the '90s, I had the privilege of going to GM's SET electrical class. The SET stood for Specialized Electrical Training. One of the things we were taught in that class was Strategy-Based Diagnosis, a specific path to take when diagnosing a vehicle. I teach that approach to my technicians to this day.

I expect them to test drive the vehicle and duplicate the problem, then check for trouble codes by performing a full vehicle scan. At that point, I expect them to check Identifix. More times than not, this will give us very quick traction on identifying the actual problem. We recently had an older technician who felt he was above this process, and he is no longer with us. He spent way too much time trying to diagnose vehicles. My lead technician walked over more than once



4

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**AN ADAS** calibration being performed to illustrate the diversity of repairs that we perform in our shop on modern vehicles.

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**THE IMPORTANCE OF** keeping up with technology is something that some technicians and shop owners still don't realize. Attending training regularly is something technicians must do for the rest of their careers to stay on the cutting edge of technology.

and ran the concern on Identifix and found the problem right away.

As part of working with the body shops, we do quite a few ADAS calibrations for them (Figure 4). There are many instances where we need to consult the OEM source for information on trouble codes, measurements, and system operation. Identifix is not as effective on three-year-old or newer vehicles since they are still under factory warranty. It still has some of the OEM information, though.

More and more of today's vehicles use torque-to-yield bolts. From engine fasteners to suspension fasteners, they are

replacing regular fasteners. Remember that they are one-time use bolts. Do you want to send a vehicle out with the potential for the suspension to come loose?

Yes, we are at a point where we need to check factory repair information, even for simple suspension repairs. In the 1960s, you needed to know the equivalent of about two big city phone books to repair all cars. In the early 2000s, it was estimated you needed to know the equivalent of 400 big city phone books to fix all cars. I cannot even begin to estimate where that number is now. My point is to know the theory and know where to find the specific information.

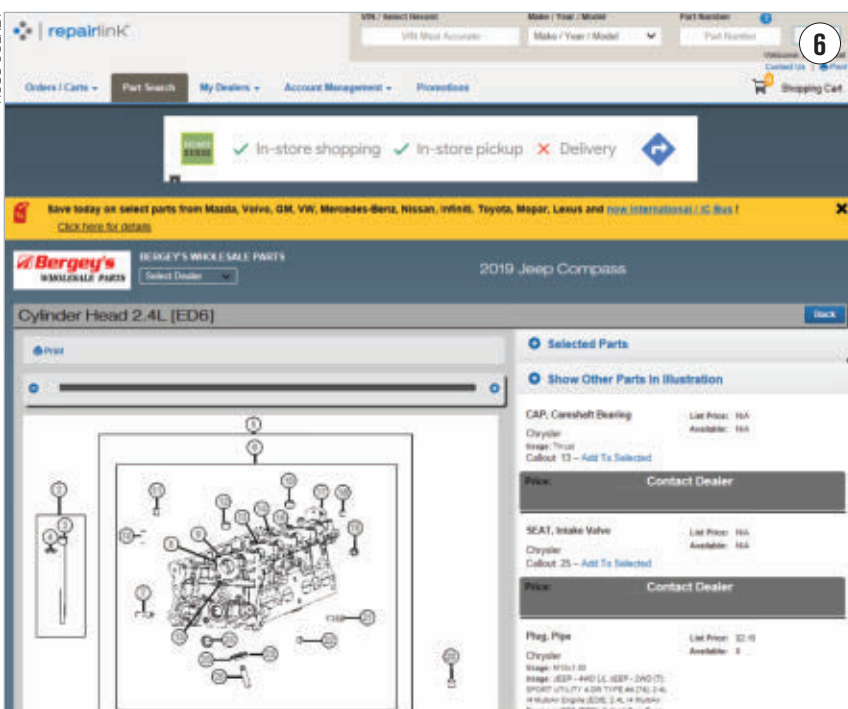
We are human and we are not computers with endless storage capability. We as automotive technicians need to understand we are at a point in the industry that we must consult the repair information even for simple repairs to ensure a proper and safe repair.

**Information doesn't cost; it pays**

Take the time to learn how to use your specific information system properly and efficiently. They all work a little differently, but the concept is all the same. Our shop has daily access to three different systems, and there are also times I will pay for the manufacturers' specific information. Typically, I can find the information that I need in the aftermarket information, but there are those times that I cannot. Most of the aftermarket information systems are simply the manufacturers information reprinted, but sometimes the aftermarket does miss things.

Consider attending training for your specific information system or having your system's rep come out and help train your team (Figure 5). I personally find a group learning experience is better than just a one-on-one type of environment. Understand that there are times it is more cost-effective to pay for the manufacturer's information than to spend the time trying to find it in the aftermarket. Mitchell 1 is great in that you can contact them and they will try and locate it on their end and then send you the information you requested.

ROSS COLKETT



**REPAIRLINK INFORMATION** source screenshot demonstrating electronic cataloging. At times, it's more efficient to source information here, especially for counter staff such as service advisors.



**THIS TOPOLOGY MAP** demonstrates how many computers communicate together on this vehicle and the complexity of the networks they communicate on.



**Thinking outside the box**

Now let's look outside of the box. I also consider my electronic cataloging to be an information system (Figure 6). As an example, I use my electronic cataloging for brake drum and rotor specifications. I can get to it quicker through this channel than I can through my actual information systems. Yes, it is personal preference, but it is easier to train a new service writer who is working with a fleet company to find it there rather than through the actual information system. This way, they are working with the management system and not trying to learn an information system on top of it.

I also consider OEC's RepairLink to be a service information system. It has all the VIN attributes for the vehicles. As a result, I do not have to call the dealer to find information ranging from gear ratios to transmission information. It also has the factory parts diagrams that are VIN-specific. If there are multiple choices for the vehicle, RepairLink will narrow it down to your specific vehicle. This is great when it comes to the bigger jobs. My service writers will print out the diagram and give it to my technicians to highlight the needed parts. This method has helped reduce technological layers of complexity.

Our industry technology has gotten to a point where we cannot do our jobs without repair information. Even the scan tool software of today can offer insight about vehicle configuration, such as this topology map (Figure 7). If we continue to just wing it, we may hurt our clients financially and physically. It is our responsibility as professional technicians to train, educate, and learn to teach ourselves to ensure we are fixing cars the correct way. The only way we can ensure that is to read the repair process ahead of the repair. We are at a point in our shop that I would prefer my technicians take the time needed for a correct repair than worry about how long it takes them. Yes, my shop could be more productive, but I value reputation over quantity. As a result of this mindset,

we have very few comebacks. Maybe it is time for you to reevaluate your information system and look to expand what you have. *ZZ*

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**ROSS COLKET** is the owner of Colket Automotive Technical Services in Lansdale, Pennsylvania. He is an ASE Certified Master

Technician with over 30 years of experience as both a technician and educator. As a former CTI instructor, he believes in the importance of training and giving back to the industry. Ross fully supports and believes in Motor Age's mission to "advance the automotive professional."



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# THE EVERLASTING QUEST TO SOLVING EURO VEHICLE ISSUES

EUROPEAN VEHICLE FAULTS CAN SEEM LIKE A NIGHTMARE, BUT WHEN YOU ARE EQUIPPED TO HANDLE THEM IT'S LIKE MONEY IN THE BANK.

BY G TRUGLIA // Contributing Editor

This series of vehicles gave us a run for our money, but it all came together in the end with the correct tools and information in hand.

## The running water pump

We had a 2011 BMW X5 35i E70 with 148,312 miles on the odometer. We received the vehicle with a complaint from the vehicle owner that his battery was going dead. At first, he just wanted us to check the battery and replace it, but we explained that the proper way is to diagnose the vehicle for the cause of a parasitic draw.

His description of the battery going dead multiple times indicated that our suggestion would be the diagnostic path to take. The BMW owner listened to our explanation and authorized us to diagnosis the problem. My tech, Franklin was assigned to this vehicle and followed a proper diagnostic game plan. It included the following:

- A visual inspection
- Vehicle DTC / health scan
- Testing of the battery, starter and charging system, followed by RTFI (reading the friggin' information)

After all the previous tests were performed, the following DTCs were displayed:

- 378F BSD (bit n date) message from the electric coolant pump
- Missing static fault currently missing (Car Access System)
- D904 K CAN wiring
- 6EC4 80PP DSC (Dynamic Stability Control) Steering Angle Sensor Adjustment

Additionally, there were about 10 more codes (**Figure 1**) that had nothing to do with the water pump staying on.

## Gaining diagnostic direction

The battery test resulted in a failure, so we recommended replacing it. The starter and charging system test performed as designed, making our next step digging into service information.

In ALLDATA, we found a TSB for the BMW BSD and Local Interconnected Network (LIN) yielding an issue with the water pump as described in the 378F code. The bit-serial data inter-



PHOTO: 141880262 © VANDERWOLFFIMAGES | DREAMSTIME.COM

face is a single-wire data bus that the electric coolant pump communicates on. What else is on this bus?

The following components are connected to the digital motor electronics (DME), or ECU:

- Alternator
- Intelligent battery sensor
- The electric coolant pump
- The oil condition sensor

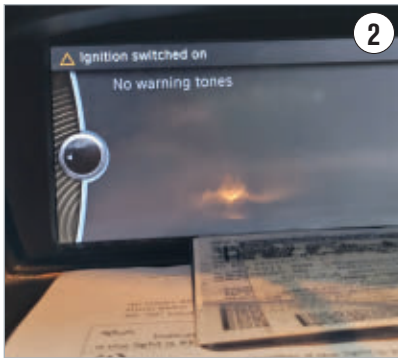
That information allows us to target our diagnosis on those components that have influence on allowing the water pump to operate. If there is an issue with any of them, that would be the reason the water pump would still operate with the key / fob out of the ignition.

With the information we just reviewed Franklin proceeded to check the BSD system carefully due to the issue of the water pump that was staying on. He figured more heads were better than one and contacted our friend Pierre Respaut, a BMW expert, who advised him to disconnect the battery sensor to see if the water pump would stop running. Since the dis-



**THE RESULTS** of a full-vehicle DTC scan.





**THE RADIO DISPLAY** is totally inoperable.

connected battery sensor failed to stop the pump from running, his next step was to disconnect the alternator, and that also made no difference. Franklin

lastly disconnected the oil level sensor that also controls the water pump, but that still did not resolve the problem. Pierre, Franklin, and I thought the best thing to do now to protect the new battery (that had already been installed and coded to the DME) from going dead was to disconnect the radiator switch that controls the water pump.

Our next step was to call the BMW owner and recommend a water pump that must have had an internal failure causing this vehicle's parasitic draw. Franklin explained to the BMW owner that the water pump is a bit different on this engine. He told the owner that the pump is used for heat management that determines the current cooling requirement regulating the cooling system that utilizes the water pump to achieve proper results.

Under conditions where engine cooling is not needed the water pump can even be switched off completely. On a cold engine condition for example where a proper warm up is required to provide even temperature the water pump may not be turned on until a certain engine temperature is achieved. If the engine is not running but the coolant or oil is very hot the water pump will be commanded to operate even with the vehicle locked. This was the problem that killed the battery.

Believe it or not, the vehicle owner decided not to replace the water pump because it was too expensive. We reconnected the radiator switch to prevent the engine from overheating and causing damage, followed by disconnecting the negative terminal to the battery to prevent it from going dead. As of this writing, he has still not returned and must disconnect and connect the battery negative terminal every time he enters or exits the vehicle. You can't fix stupid, can you?

**The locked trunk**

Our next vehicle is 2011 BMW 335i Convertible (with 72,629 miles) that came in with a report of no radio and no warning tones (**Figure 2**). My tech, Bill, first spoke to the vehicle owner then performed a visual inspection, followed by performing a full vehicle scan using the OPUS IVS legacy software. The result of the scan was an amplifier that failed to communicate, and other modules that needed updates (but had nothing to do with the issue on this vehicle) (**Figure 3**).

As with most Euro vehicles, there are often water intru-

**THE RESULT** of a full vehicle DTC scan.

WBAD37CS8BE743361 2011BMW335I	<b>3</b>
<b>AMPLIFIER (AMP)</b> Control unit failed to communicate. Possible cause of error: - Power, ground, plug and fuse connections to the control unit - Control unit defective	
<b>CAR ACCESS SYSTEM (CAS)</b> There is an update available. Program 62E7314 - 10/05/14. Estimated programming time: 11 minutes.	
<b>JUNCTION BOX ELECTRONICS (JBE)</b> There is an update available. Program 6200004 - 10/05/14. Estimated programming time: 8 minutes.	
<b>DIGITAL MOTOR/DIESEL ELECTRONICS (DME/DDIE)</b> There is an update available. Program 6E2704 - 04/07/14. Estimated programming time: 20 minutes.	
<b>CONTROLLER (CON)</b> There is an update available. Program 6200002 - 10/05/14. Estimated programming time: 1 minute.	
<b>FOOTWELL MODULE (FRM)</b>	

sion issues associated with electrical problems. This BMW convertible was no exception. As Bill was performing his visual inspection, he noticed the usual clogged drains (**Figures 4, 5 + 6**). This was the first time this vehicle had been to our shop; otherwise, the drains would have been cleaned. When any vehicle comes in for service or inspection, we make it a habit to remove leaves, pine needles and other debris from the cowl and trunk areas. We use an air vacuum that we have in each bay to remove anything we cannot remove by hand. Bill took pictures to show the vehicle owner the issue and told her she would need to stop by the shop periodically to have us make sure no debris is present.



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Since the drains were clogged, our first step was to get them free of debris and properly flowing again. Bill had assigned the job to Mary (our newest tech and former student of mine). Mary lives over four hours away and drives to my shop to work in a professional environment and learn from master techs such as Bill, Franklin, and me. Her job for this BMW was to clean the drains and work on getting the trunk unlocked.

The trunk would not open with the key fob command or the trunk release button ever since the vehicle owner disconnected the battery (while trying to fix this problem). Bill located the wiring diagram in Mitchell ProDemand to see where the wires from the trunk to the switch were located. Bill located the wires under the dash that were buried in the right-side kick panel and discovered that they were connected to a module before going to the switch.

Bill made an executive decision to

cut the wires that were connected to the module instead of taking a chance of manually energizing the circuit and damaging it. He located the wires and double checked the wiring diagram before proceeding to cut them. After the wires were cut Bill had Mary supply power and ground to the correct wires that were connected to the trunk latch. The results of her action were the trunk latch now released, allowing access to the trunk area.

Once they were in, Bill proceeded to check the amplifier located on the left side of the trunk (Figure 7). Mary then temporarily connected the cut wires to make sure the trunk would release from the fob command and trunk release button. Since both worked as designed, she proceeded to repair the wires properly with solder and shrink tubing before retesting.

In the meantime, Bill tested the Media Oriented Systems Transporter

network (MOST). It is a fiber optic system that transmits light signals for communication between ECUs (Figure 8). Before condemning any part (and in this case the amplifier) just because there is a DTC for the component would be the wrong move to make. Remember that the system needs to be tested first to confirm that the fiber optics are good.

You ask, how do you check the fiber optic system? Well, there are two ways available. One with a fiber optic bypass loop tester (that is an excellent tool for diagnosing and bypassing MOST components). The other way is to use a laser pointer to check if light comes out of the other end of the fiber line, confirming that there is no damage or restriction to the MOST lines.

Bill confirmed that the fiber lines were good using both test methods, leaving the amplifier as the issue. Once again poor maintenance practices were the cause of this BMW problem. We provided pricing to the BMW owner, but she thought it was too expensive and decided to live without a radio and chimes. Let's see how long that lasts before she needs her music back.

**All lit up**

The owner of a 2014 Mercedes Benz SL550 (with 34,767 miles) has a complaint that the rear taillights would stay on after the vehicle was parked and locked (Figure 9). Franklin performed a scan of all modules and found no



**4 DEBRIS PRESENT** makes a clogged sunroof drain a likely suspect.



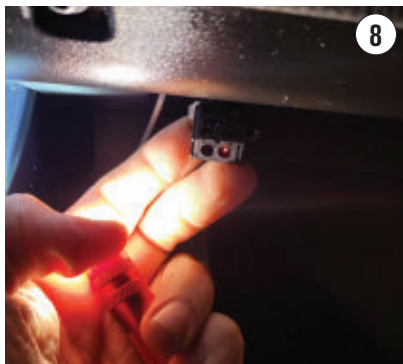
**5 THE ROOT CAUSE** of many interior water leaks is clogged drains.



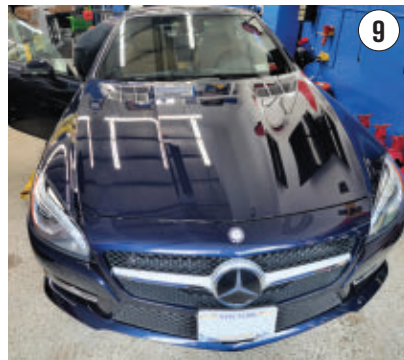
**6 EVIDENCE OF WATER** ingress is present.



**7 THIS AUDIO SYSTEM** amplifier is located in the trunk and was accessed for circuit testing.



**8 THIS MEDIA ORIENTED** System Transporter network is comprised of fiber optic media to carry light waves for communication messages.



**9 THIS MERCEDES-BENZ'S** lights remained illuminated, even with the vehicle off, secured and keys in hand. This will drain the vehicle's battery in a very short period.



codes related to the rear lights staying illuminated.

After he “RTFI” he discovered what we already knew from our previous experience with these Benz’s, that the signal acquisition module (SAM) had a problem. He asked the owner if the vehicle was involved in an accident or if someone had worked on the vehicle recently, she said neither one was true. The customer also explained that this issue had just started a couple of weeks ago when the lights stayed on and eventually prevented the engine from cranking over.

Franklin checked all voltage and ground feeds, finding them all within specification. That only left the SAM that could cause the problem. We ordered the new SAM and installed it followed by using our Opus IVS. We then contacted their tech support to code the module. Using the Opus IVS tech support saved us time doing it ourselves, allowing us to catch up on other work that we had backed up. Franklin rechecked the vehicle after the module coding was complete and found all DTCs were cleared and everything worked like it should, the Benz was fixed.

**The underachiever**

The next vehicle was a 2011 VW Tiguan SEL 2.0L Turbo with 132,514 miles and a list of customer complaints, including oil leaking, low power, engine coolant leaks, water leaks, mildew smell, dimming lights and hard starting.

This vehicle seemed to be a complete mess. The tires were as bald as my head, along with the brakes being down to metal, lights out, axle boot ripped, and to make matters worse, water leaks inside the vehicle. I always say the best tools we have are our brain, eyes, ears, nose, and hands; and look at what we seen and felt that led us to locating the problem, a wet headliner (Figure 10). The headliner issue led us to check the moon roof drains, where we located broken drain tubes that were the cause of the big water leak. We followed the water



**THESE WATER STAINS** on the headliner are a telltale sign of a water leak.

trail to the trunk area, where we found over two inches of water (Figure 11). We had to remove the headliner to get access to the moon roof tubes and replace them with new ones prior to checking the drain system for proper operation.

Once the tubes were draining as designed, we dried everything up and reinstalled the headliner. That fixed the water leak, mildew smell, and some of the lighting issues, but there were more. We tested the battery, starter, and alternator. We found the alternator to be defective; the battery was just low and needed to be charged and retested. The oil, coolant leaks and low power were



**SURE ENOUGH**, the trunk is full of water.

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due to a turbo issue. We replaced the turbocharger after receiving the owner's approval. This resulted in a leak-free engine and the vehicle was now fixed and running like new again.

**Inspection failure**

This vehicle is a 2005 BMW Z4 2.5L with 128,089 miles on it. It's having a problem getting a passing grade for New York state emissions inspection. The vehicle's monitors would not become "ready" after the battery went dead with the vehicle sitting around for a while.

We checked the vehicle by performing a full vehicle scan and found that there were no DTCs and one emissions monitor "not ready." We switched scan tools to the eScan (from Automotive Test Solutions) because its plotted data is easier to see. Over the years, I noticed that there is a load of issues with the cooling system that prevent the monitor from becoming "ready." Using the eScan, we can see instantly if there are problems with the cooling system.

If we notice the time to temperature is not in the "green" after the engine is up to operating temperature, we go into Sharpshooter, under the Temperature tab. There, we will check to see what the issue is (**Figure 12**). The results of the test were that the engine was heating up too fast. This problem can be caused by a thermostat that is out of calibration, coolant issues or a few other problems (even if the engine is not overheating and supplying good heat).

Bill installed an OE thermostat and BMW antifreeze/coolant and made sure the time to temperature was good when he finished. Since the monitor was still

"not ready," he asked the owner if he wanted us to drive the vehicle, or did he want to drive it himself. The vehicle owner chose to drive the vehicle himself after Bill and I explained how to drive the vehicle and making sure not to fill the gas tank more than 75 percent of full.

Well, we should have known that the vehicle owner who loves driving this Z4 like a race car would not stay in the parameters to get the monitors "ready." We had to print out the drive cycle and tell him to stay under 65 miles per hour. Finally, he paid attention (since his car inspection was going to expire in days). The BMW needed to pass, or he was risking a ticket. The owner followed our driving recommendations, and all the monitors were "ready." The vehicle now passed New York State emissions inspection. The fix was two parts, one the engine needed a new thermostat and antifreeze/coolant and two it needed to be driven properly.

**Wipers won't work**


Our last vehicle was a 2007 VW Tiguan that came in with a complaint about the wiper not always working. We checked the vehicle out and found that the wiper motor was not operating as designed. Before we replaced the wiper motor, we checked the voltage and ground supplies.

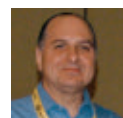
We always load the circuit up to mimic the intended load of the wiper motor making sure that voltage and ground is supplied properly (**Figure 13**). We use a headlight that pulls about five to six amps to make sure the circuit can carry a load. Many techs make a mistake of not testing the circuit dynamically,



**THIS SEALED HEADLAMP** bulb provided the electrical load for the wiper motor circuit. Testing in this fashion loads the circuit dynamically and is a more accurate way of determining the health of the entire circuit prior to replacing a failed component.

instead relying on open-circuit testing, which could indicate a false positive. Since we had a circuit that was working properly, we ordered a new wiper motor and installed it. Problem solved!

In the end, the challenge isn't the nightmare-vehicles you must face. It's being sure you understand how the systems function and have the know-how and tooling to diagnose the issues. 

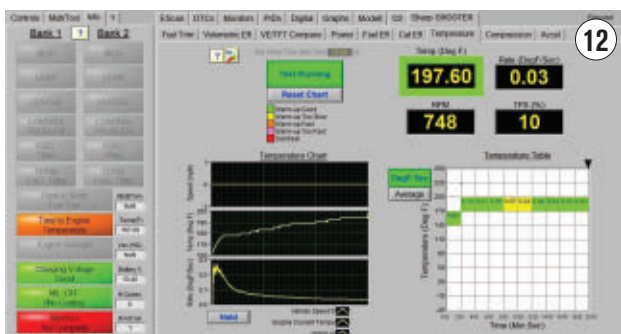


**JERRY TRUGLIA**, also known by "G," is an automotive instructor and author whose work with the US Environmental

Protection Agency, Society of Automotive Engineers, National Automotive Service Task Force, Council of Advanced Automotive Trainers, Motor Age and Motor Age Training, Professional Tool and Equipment News, and the not-for-profit Technicians Service Training has made him nationally recognized in the automotive repair industry. G. is an ASE World Class Triple Master Technician Auto, Truck & School Bus, L1, L3, F1, A9, X1 C1. Connect with him at LinkedIn.

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ATS is a brilliant tool with many great features including this "time to temperature" test. The result helped infer the engine was heating up too quickly.



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# INTEGRITY IS EVERYTHING

**FOR AUTOMOTIVE EMISSIONS CONTROL, IT TAKES A TEAM. IN THIS CASE, THE EVAP'S CONTRIBUTIONS COULDN'T BE COUNTED ON.**

**BY BRANDON STECKLER** // Technical Editor


**F**or automotive emissions control, it truly takes a team. One of the team members is the evaporative emissions control system (EVAP). But,

in the case of this 2013 Honda Crosstour, it seems this EVAP system is a huge letdown on just about every trip the vehicle makes.

### Preliminary data

As the vehicle is driven and meets the criteria for an EVAP large leak test, a failure occurs, and the vehicle displays the message “Check fuel cap” on the instrument panel cluster. The strange part is the vehicle has no pending, current, or history DTCs. Even stranger, the message is displayed whether the driver made a pit stop for fuel or not. I mention that because in my experience, most vehicles will correlate a loose fuel cap with a large leak test failure that occurs only after a change

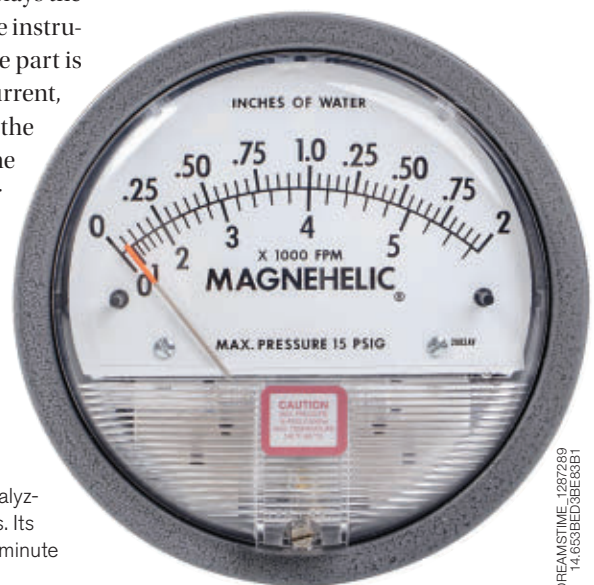
in fuel level (usually a change in level of about 25 percent). And that typically sets a pending DTC. What's more, this vehicle (like most today) implements a key-off natural vacuum testing strategy. This type of testing all but eliminates the fuel-volatility issue that can mask smaller leaks during driving conditions



**THE DATA DOESN'T LIE**

**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.**

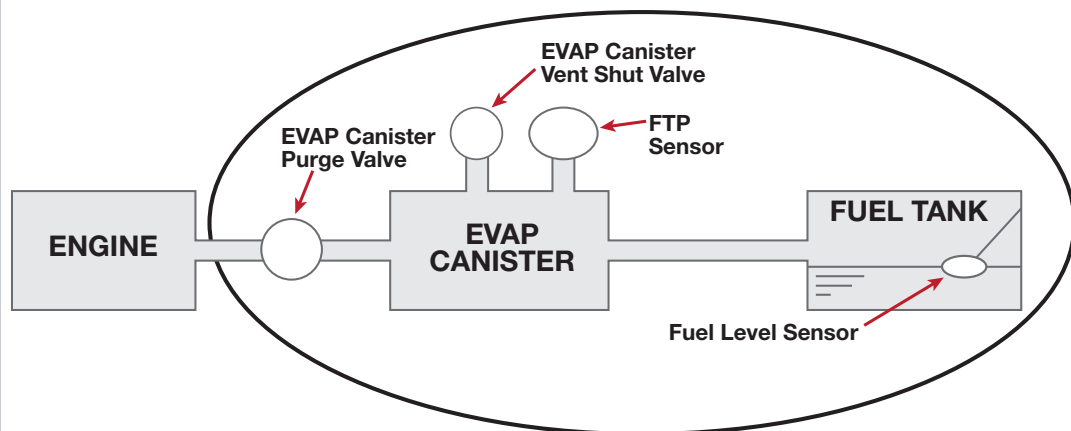
**THIS GAUGE, KNOWN AS** a manometer, reflects inches of water and is tremendously beneficial in analyzing very low pressure EVAP systems. Its high sensitivity allows it to measure minute changes in pressure.



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## EVAPORATIVE EMISSION (EVAP) SYSTEM

1



**THIS SIMPLE EVAP** system diagram shows the layout and integration of the components. This information, combined with the literature from service information, allows techs to test appropriately and to anticipate what a passing result or failing result may look like.

MITCHELL 1

and with the heat of the exhaust system beneath the fuel tank. Today, systems are capable of detecting EVAP leaks as small as 0.010.”

An EVAP function test was carried out using the scan tool’s bidirectional control. This allows the PCM to run the engine (vacuum source) and systematically operate the EVAP vent valve and purge valve to check the integrity of the

EVAP system by placing it in a vacuum state (Figure 1). It monitors the integrity of the system from the feedback signal of the fuel tank pressure (FTP) sensor. Very little change in FTP signal occurred during the test, meaning no leak was present. As a result, the EVAP function test passed with flying colors each and every time it was conducted.

According to Mitchell 1, the crite-

ria to be met to run the test for a large leak/loose fuel cap (P0455) are as follows (Figure 2):

- After engine shutdown, monitor for engine-off natural vacuum (EONV).
- The FTP is monitored for pressure change for at least 11 min, 37 seconds, and no more than 36 minutes, 37 seconds.
- The engine must be off for at least

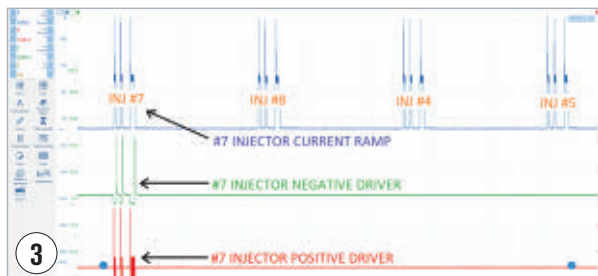
### SOLVED: (October 2023, Motor Age) 2019 Silverado Duramax 6.6L, Misfire at elevated rpm

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

- 1) Injector replacement
- 2) Send cylinder head out for inspection/machine work
- 3) Replace fuel/inspect for contamination in fuel and rail
- 4) Test for low-pressure fuel system supply issue

For those of you who chose answer #3, congratulations! According to the data, it appears that the #7 injector is not performing like the others. However, considering it has been replaced with a factory component, there is likely an underlying cause of its failure. It is prudent to inspect for fuel system contamination. Because of its location at the end of the rail, #7 is more prone to contamination than the other injectors.

Contamination was found after inspecting the fuel filter. The high-pressure system is also contaminated with metal and a crystallized substance (likely DEF). The low-pressure system was cleaned, and all high-pressure components were replaced. The vehicle ran flawlessly and the capture of injector current ramps now all matched (Figure 3).



**AFTER CLEANING** and replacement of the high-pressure fuel system components this Duramax performed well, and the proof is in the pudding. This injector current trace proves the injectors are all being cycled similarly, with no excessive compensation in balancing rates.

Answer #1 is not incorrect, considering the electrical testing proves no circuit or computer driver faults are present. However, the new injector will fail again if the root cause is not discovered.

Answer #2 is not high on the list of things to address, as none of the previous nonintrusive (and easy-to-perform) engine-mechanical tests yielded a mechanical failure.

Answer #4 doesn’t make sense to test for, as this fault would affect the high-pressure system performance and all the injectors would fail to deliver fuel properly.



**Monitor Execution, Sequence, Duration, DTC Type, OBD Status**

2

Execution	Once per driving cycle
Sequence	None
Duration	At least 11 minutes, 37 seconds but not more than 36 minutes, 37 seconds
DTC Type	Two drive cycles, MIL on
OBD Status	PASSED/FAILED/NOT COMPLETED (STILL TESTING)

**BE SURE TO REFERENCE** the DTC set criteria as it offers you the threshold in which the failure occurs and the conditions necessary to run the test. This saves time during road tests and other diagnostic procedures.

six hours in order to begin a new drive cycle.

- A sufficient amount of intake air temperature and coolant temperature change must occur.
- These tests occur once per drive cycle and must fail twice in a row to set a DTC.

Now, for another strange series of events. As you can see, the criteria clearly state the test is conducted with the engine off. However, the failure only occurs when driving down the highway

after about 20 minutes of runtime. I advised the technician to drive the vehicle until the message appeared. I then instructed the technician to conduct the EVAP function test again. However, the results of the test still showed it passing. Again, the test passed. This data was contradictory to what the PCM sees during the self-test while driving the vehicle down the road.

The technician attempted to graph the EVAP purge solenoid duty cycle, EVAP vent solenoid, and FTP PIDs (dur-

ing the 20-minute test drive when the failure occurred). However, there was no way to configure the scan tool to display all three of those PIDs simultaneously. Although it was frustrating, the technician used two different scan tools with the same results.

**The data doesn't lie**

With all the information in front of us, and the desired information not yet obtained, 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 “check fuel cap” message appears after every drive of 20 minutes or more
- No pending, current, or history DTCs are stored, although it's been an ongoing issue for more than two years
- The EVAP system function self-test never fails
- According to service information, the PCM tests for large leaks and small leaks at key-off only

Given this information, what would you do next?

- Smoke-test the EVAP system
- Replace the fuel cap because it's the cheapest part to try
- Replace PCM
- Monitor FTP, vent solenoid and purge valve with a lab scope during failure

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



PHOTO 74605340 © TAWATCHAI KHID-ARNI | DREAMSTIME.COM



**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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## UPDATES FOR ADAPTIVE CRUISE CONTROL

The Autel 2023-'24 ADAS Calibration Coverage Updates provide ADAS calibration coverage for the most common systems on many Audi, GM, Porsche, Hyundai/Kia, Mitsubishi, Nissan, and Stellantis models to all MaxiSYS tablet owners as well as MS906 Pro and higher, with active ADAS calibration software subscriptions. Additionally, the software release is for the component calibration of the following safety and convenience systems including adaptive cruise control (ACC), central ADAS decision module (CADM), central vision processing module (CPM)/surround view, lane departure warning (LDW), driver assist system module (DASM), forward facing camera module (FFCM), haptic lane feedback (HALF), image processing module B (IPMB), night vision system (NVS), park assist module (PAM), and rear collision mitigation (RCM).

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## FOR EVs' HIGH DEMANDS

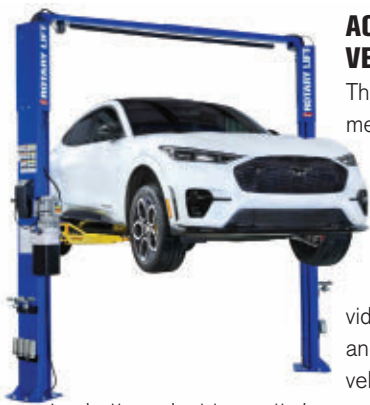
DieHard EV is the first aftermarket 12-volt EV battery specifically designed for the high demands of hybrid and electric vehicles. DieHard EV includes xEV by Clarios technology, offering 30% more cycling than standard AGM batteries, which contributes to extended battery life. The DieHard EV 12-volt battery, available from Advance Professional, works with the high-voltage battery to deliver power and support for safe operation. It is designed to meet the intensive power requirements of modern vehicles.

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## ACCOMMODATES ALL LIGHT VEHICLES

The Rotary Lift Two-Post Asymmetric Lift with All-Vehicle Lift Arms, No. SPOA10-AV, is designed to accommodate all vehicle types under 10,000 lbs with its all-vehicle (AV) lift arms. The arms provide technicians the ability to lift and service almost all roadgoing vehicles on a singular lift, including battery electric, exotic low profile, truck frame, and unibody cars and SUVs. Additional features include a 3-3/8" minimum adapter height, as well as 20 percent more reach than 30-stage arms with thread-up adapters, and 30 percent larger arm sweep than conventional two-stage arms with flip-up adapters, according to the company. The lift comes standard with adjustable round, truck, and stackable adapter extensions.

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## FEATURES 10" TOUCH SCREEN

The Mastercool Semi-Automatic R-134a RRR Machines, Nos. COMMAND-ER1100 (110V) and COMMAND-ER1100-E (220V), are design-certified for compliance with SAE J2788 and have a 10" color command center with a touchscreen. The machines have a programmable automatic vacuum leak test and manual procedures, as well as multiple languages to choose from during setup. Additional features include an auto oil discharge, an auto and manual air purge, an auto filter and full tank alarm, a low refrigerant alarm, large analog gauges, an on-board unit conversion calculator, a 3 cfm vacuum pump, hose coupler storage, a hard-wired power cord, durable wheels with locking caster, and a Mastercool dust cover.

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## RATED CAT III 1,000V

The Electronic Specialties EV Insulation Tester, No. 550, is designed to check high-voltage circuits on electric and hybrid vehicles for voltage leaks to ground. It can supply 250V, 500V, and 1,000V test voltages for doing complete insulation testing. The 550 also serves as a capable volt/ohm meter with a large, dual-backlit LCD display. Additionally, the 550 is rated CAT III 1,000V for overvoltage protection. Includes six AA batteries, test leads, instruction manual, and a blow-molded case.

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## AUTOMATICALLY DETECTS WHEEL DIMENSIONS

The Hofmann Armored Series 2400P Wheel Balancer is designed for high-volume shops. Developed using forged steel, the wheel balancer offers resilience even in tough environments. It features a large high-resolution touchscreen display with easy-to-read large digits, a compact frame-work, a laser scanner that automatically detects the number and position of rim spokes, and it incorporates a power clamping device that secures the wheel with a constant force. The unit also automatically detects wheel dimensions and selects the appropriate balancing mode, weight type, and weight position, and automatically detects the rim width by utilizing sonar sensors.

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## FEATURES SMART DEVICE CONNECTIVITY

The Teledyne FLIR ONE Edge is a wireless dual thermal and visible camera for mobile devices. It offers the same detachable form factor as the FLIR ONE Edge Pro with Bluetooth and wireless connectivity but with features tailored to the needs of consumers and small businesses. Smart devices can be connected through the FLIR ONE app, allowing users to identify thermal hot or cold spots that could indicate faults and developing issues. Additionally, the ONE Edge provides ideal context and clarity for everyday decision support through Multi-Spectral Dynamic Imaging (MSX), a patented image enhancement feature that overlays visible edge detail on the thermal image without sacrificing any thermal details.

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## HIGH-DEFINITION FRONT AND SIDE CAMERAS



The Milwaukee Tool M12 Auto Technician Borescope, No. 3150-20, is designed to deliver 5mm access and clear diagnosis. The 5mm camera head, paired with a 3' cable optimized for rigidity, allows for ideal access in tight spaces, including glow plug holes and fuel injector ports. With high-definition front and side cameras with adjustable LED brightness as well as a 4.3" rotatable display, the borescope provides enhanced

application viewing. Additionally, it offers 4x zoom capabilities, includes a 32GB SD card, and is equipped with Heat Sense temperature alert technology that notifies the user when the vehicle being inspected is too hot to use the camera without potential damage.

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## SUPPORTS CAN FD/DOIP

The Foxwell TS5000 Smart TPMS Service Tool is designed to offer a complete solution for TPMS service. The professional TPMS service tool can activate/decode universal TPMS sensors, program Foxwell TPMS sensors, and diagnose the original car TPMS. Additionally, it offers OE number search ability, automatic VIN reading, three types of sensor relearn procedures, and supports CAN FD/DoIP. It operates wirelessly and updates with one touch.



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## FEATURES OVER 40 SERVICE FUNCTIONS

The Autel MaxiSYS Ms908CVII is a 9.7" wireless touchscreen tablet with advanced diagnostics coverage for light, medium, and heavy duty vehicles. The tablet can read and erase codes, view and graph live data, and perform bidirectional control active tests. Additional features include all systems fault detection via auto scan, an expert mode to enable technicians to access the system directly, a service menu with over 40 service functions, and wireless printing.



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## ELIMINATES NEED FOR FLYWHEEL MACHINING

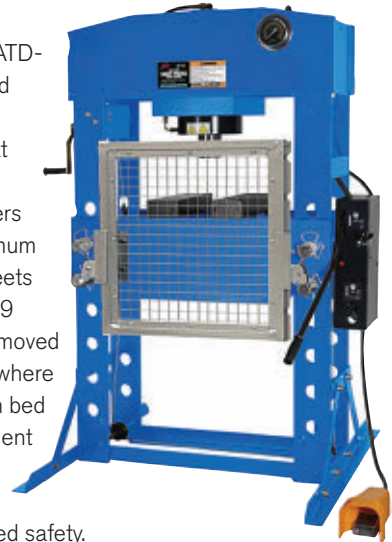
Clutch Industries' UniClutch is designed to eliminate the need for flywheel machining, and its Flex Fit technology and pre-alignment allow for hassle-free "bolt on" installation in minutes. The patented modular technology adapts to different engines and transmissions, aiming to reduce installation times and allow technicians to service a wider range of vehicles. Its dual core helps to boost torque capacity without compromising driveability.



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## FEATURES A DOUBLE-SPEED PUMP

The ATD Tools 100-Ton Shop Press with Safety Guard, No. ATD-7463, features a double-speed pump for improved efficiency and a foot control air valve that allows handsfree air motor operation. The shop press offers a fully welded frame for maximum strength and durability and meets or exceeds ASME/PASE 2019 standards. Its cylinder can be moved left or right to apply pressure where it's needed, and its six-position bed allows working height adjustment of 5.5" each. Includes a set of non-slip steel V blocks and a protective work guard for added safety.



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## BEVEL GEARS PREVENT STALLS

The AIRCAT 1/4" Mini Angle Die Grinder, No. 6250, features a .3hp motor that produces 18,000 rpm free speed. Weighing just 11lb and measuring 5" in length, the 6250 provides added control and maneuverability while allowing access into tight spaces. It also offers heavy-duty bevel gears that prevent stalls, a variable speed trigger that allows users to control the tool speed, an over-mold grip for added user comfort, safety lock-off throttle levers to prevent accidental start-ups, and a rear exhaust with AIRCAT's silencing system to reduce noise levels to 81.5 dBA without reducing the tool performance.



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**LIMITED EDITION GHOST SERIES 2023 ROLLING TOOL CART, NO. MSC4FDGST23**

The Matco Tools Limited Edition Ghost Series 2023 Rolling Tool Cart, No. MSC4FDGST23, is an MSC4 cart with an overall dimension of 39.4" height by 34.5" width by 21.2" depth. Equipped with full-extension roller bearing slides, the six drawers come in various sizes, accommodating tools of different dimensions and functionalities. The cart features four corner bumpers to prevent car and cart damage and four 5" by 2" casters, including two locking and two non-locking, for easy mobility. Additionally, the design incorporates two gas pistons that automatically open the lid to the proper angle when unlocked.



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# THE TRAINER #142: LEVERAGING THE POWER OF AUTEL'S REMOTE EXPERT FEATURE

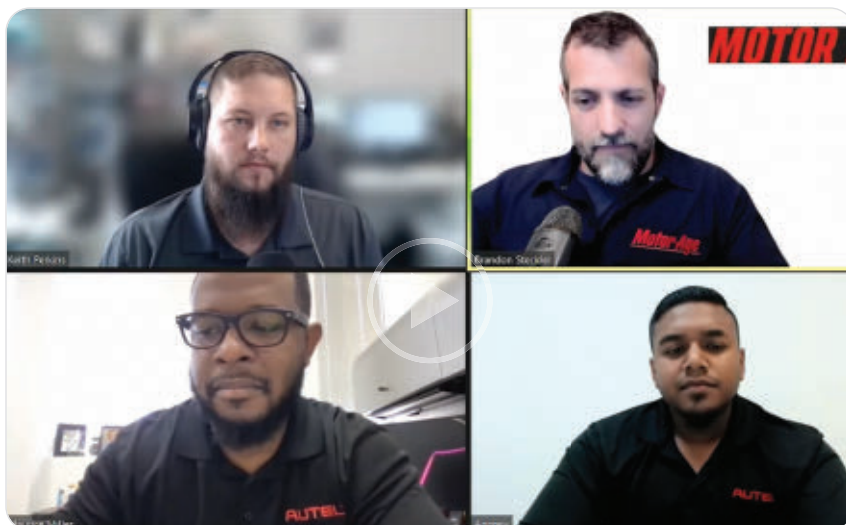
LEVERAGING AUTEL'S REMOTE EXPERT FEATURE TO INCREASE SHOP REVENUE AND DECREASE VEHICLE REPAIR TIME.

BY BRANDON STECKLER // Technical Editor

As time passes, the technological advances made throughout the automotive industry have been increasing exponentially and almost daily. The capability of today's vehicles and their computerized systems is light years ahead of where they were just a few short years ago. But with this increase in technological ability comes the ever-evolving challenges that all shops must face.

Years ago, replacement of most vehicle components and many ECUs was a simple plug-and-play procedure, meaning no additional programming or configuration/coding was required. The average shop would have no issues completing a repair because no special tooling or procedure was required.

But times have changed, components have changed, and so, too, have the procedures for replacement of those components. Many of the components interact with ECUs and must be programmed with software to even function. Some of these components could be considered as an add-on feature, requiring existing ECUs to be reconfigured as a new vehicle system configuration. Either of those situations will often require specialized tooling and software to complete and finalize a repair. In many cases, these procedures are only available using the OEM scan tool and/



or J2534 interface, often accompanied by a very hefty expense. If the shop doesn't possess the tools or the know-how to complete the repair, the job must be completed by another shop or by a mobile solutions provider. Both options cost the shop time and money.

With the introduction of Autel's Re-

mote Expert feature, the shop now has the ability to obtain technical support for diagnostics, ECU programming/reprogramming/configuration, and (if necessary) with the OEM tooling, keep the entire repair in-house. This maximizes shop revenue and minimizes repair times. *TM*

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