



16 **OPERATIONS**  
STOP THE PAIN OF MULTIPLE  
DIAGNOSTIC CHARGES



## MISFIRE DETECTION STRATEGIES

Misfire diagnostics can lead to a really expensive wild goose chase, especially if the vehicle isn't actually misfiring.

38 **GET SMART ON  
BATTERY HEALTH**

We take a deeper look at how automotive repair shops can be prepared with smart tools ahead of the EV influx.

52 **DRIVEABILITY AND  
POWERTRAIN-RELATED  
ISSUES**

Driveability and diagnostics of any kind tend to bottleneck many shops. But having a structured game plan will keep the workflow productive.

# COMPLETED REPAIRS

**MOTOR**  
 DRIVEN

## WHAT'S INCLUDED?

- Anti-Theft/Keyless Entry Procedures
- Computer Relearn Procedures
- Technical Service Bulletins
- Wiring Diagrams
- Battery Replacement Procedures
- Diagnostic Trouble Codes
- Tire Pressure Monitor System
- And more.



## OPERATIONS

### 8 3 WAYS CAR REPAIR PROGRAMS WIN YOUR CUSTOMERS' TRUST

BY LAURA BUSSIS

### 12 ARE YOU MAKING THESE MARKETING MISTAKES?

Shop owners and a marketing expert share what they've found to work.

BY CHASE CLOUGH

### 16 STOP THE PAIN OF MULTIPLE DIAGNOSTIC CHARGES

You don't have to personalize the process of selling diagnostics!

BY DAVID ROGERS

### 20 WRENCH NATION JOINS THE MOTOR AGE TEAM!

Motor Age welcomes Frank Leutz, host of the Wrench Nation podcast, to our family as our newest social influencer partner.

BY MOTOR AGE STAFF

### 22 THE ROAD TO PROFITABILITY

Implement a profit model and base all your decisions on how they'll affect your profit.

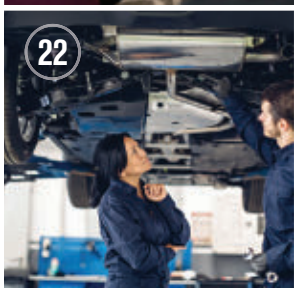
BY RICK WHITE

ASA INSIGHT

### 26 CALIFORNIA PASSES ADVANCED CLEAN CARS II

The regulations provide a path to zero-emissions by 2035.

BY MADI HAWKINS



## TECHNICAL

### 28 2022 BEST YOUNG TECH AWARD WINNER AUSTIN MATNEY

His quality of work and can-do attitude set this young tech apart from the rest.

BY AMANDA SILLIKER

### 38 GET SMART ON BATTERY HEALTH

We Take a deeper look at how automotive repair shops can be prepared with smart tools ahead of the EV influx.

BY PAVEL REZA

### 44 MISFIRE DETECTION STRATEGIES

Misfire diagnostics can lead to a really expensive wild goose chase, especially if the vehicle isn't actually misfiring.

BY BRANDON STECKLER

### 52 DRIVEABILITY AND POWERTRAIN - RELATED ISSUES

Driveability and diagnostics of any kind tend to bottleneck many shops. But having a structured game plan will keep the workflow productive.

BY "G" TRUGLIA

### 60 A FUNDAMENTAL APPROACH TO BASIC FAULT FINDING

Electrical faults fall into only a few basic categories.

Having a fundamental approach to solving them leads to efficient diagnoses.

BY CHRIS REYNOLDS

### 64 FOR AUTOMOTIVE TEACHERS, BY AUTOMOTIVE TEACHERS

Technology is coming at us all at a furious pace. Who is training the next generation and preparing them for the challenges?

BY PETE MEIER

IN EVERY ISSUE

4



**AUTOMOTIVE  
MAINTENANCE  
& REPAIR  
ASSOCIATION**

TRUST COMES STANDARD

## 4 INDUSTRY NEWS

**AMRA TO HOST MEMBERSHIP MEETING TO KICK OFF INDUSTRY WEEK IN LAS VEGAS**

**2022 SEMA SHOW EXPANDS NEW PRODUCTS SHOWCASE**

**CARB REQUIRES MANUFACTURERS TO PROVIDE SERVICE INFORMATION FOR ELECTRIC VEHICLES**

**STUDY FINDS FEWER ROADWAY FATALITIES IN STATES WITH INSPECTION PROGRAMS**

## 71 MARKETPLACE

## 71 AD INDEX

VIDEO: PRODUCT INSIGHT

### ▶ TROUBLESHOOTING ELECTRICAL PROBLEMS

In this video, Pete Meier demonstrates how this tool can perform voltage drop tests anywhere on the vehicle. The extended test leads ensure that you are always referenced to the battery that you are testing, and like all of the products in the Innova line, it's available at a price point easy on a tech's budget.



**INNOVA**



## WEB EXCLUSIVES



### SERVICE DONE RIGHT #13: MASS AIRFLOW SENSOR TESTING IS THE SENSOR LYING TO THE ECM?

The Engine Control Module is responsible for many things, but it can't do its job if the information provided to it isn't accurate. And on vehicles with Mass Airflow sensors as the primary load sensor, this happens more often than you might think.

**Delphi  
Technologies**

Want to know how to make sure the MAF sensor on your customer's car is doing its job? Check out this Service Done Right video, featuring Motor Age's own guru, Pete Meier!

[VEHICLESERVICEPROS.COM/21281101](http://VEHICLESERVICEPROS.COM/21281101)



# MOTOR AGE

**VEHICLESERVICEPROS.COM**

Endeavor Business Media, LLC  
1233 Janesville Avenue, Fort Atkinson, WI 53538. Phone: 920-563-6388

### EDITORIAL STAFF

**JAY SIGHT**  
MANAGING EDITOR  
jsicht@endeavorb2b.com

**PETE MEIER ASE**  
DIRECTOR OF TRAINING  
pmeier@endeavorb2b.com

**BRANDON STECKLER**  
TECHNICAL EDITOR  
bhsteckler@gmail.com

**RHONDA COUSIN**  
ART DIRECTOR

### CONTRIBUTORS

**LAURA BUSSIS**

**CHASE CLOUGH**

**MADI HAWKINS**

**PAVEL REZA**

**CHRIS REYNOLDS**

**DAVID ROGERS**

**AMANDA SILLIKER**

**"G" TRUGLIA**

**RICK WHITE**

PRINTED IN U.S.A.

### ENDEAVOR BUSINESS MEDIA

CEO – **CHRIS FERRELL**  
CRO/CMO – **JUNE GRIFFIN**  
COO – **PATRICK RAINS**  
CHIEF ADMINISTRATIVE AND LEGAL OFFICER –  
**TRACY KANE**  
EVP, TRANSPORTATION – **REGGIE LAWRENCE**  
VP, TECHNOLOGY – **GLENN SCHEITHAUER**  
VP, ACCOUNTING – **ANGELA MITCHELL**  
VP, FINANCE – **JESSICA KLUG**  
VP, DIGITAL BUSINESS DEVELOPMENT –  
**MONIQUE LEJA**  
VP, PRODUCTION OPERATIONS – **CURT PORDES**

### BUSINESS STAFF

**KYLIE HIRKO**  
VP/GROUP PUBLISHER  
**MICHAEL WILLIAMS**  
BUSINESS DEVELOPMENT DIRECTOR,  
MOTOR AGE TRAINING  
**LESLIE BROWN**  
CUSTOMER MARKETING MANAGER  
**SHEILA WARD**  
PRODUCTION MANAGER  
**MELISSA MENG**  
AD SERVICES MANAGER  
**TRACY SKALLMAN**  
AUDIENCE DEVELOPMENT MANAGER  
**JILLENE WILLIAMS**  
SALES COORDINATOR

### SALES STAFF

**LISA MEND**  
lmend@endeavorb2b.com  
**MICHAEL PARRA**  
mparra@endeavorb2b.com  
**PAUL ROPSKI**  
propski@endeavorb2b.com  
**CORTNI JONES**  
cjones@endeavorb2b.com  
**DIANE BRADEN**  
dbraden@endeavorb2b.com  
**MATTIE GORMAN**  
mgorman@endeavorb2b.com  
**JAMES HWANG**  
Inside Sales & Brand Manager,  
ASE Study Guides  
jhwang@endeavorb2b.com

**REPRINT SERVICES**  
reprints@endeavorb2b.com

**CUSTOMER SERVICE**  
Subscription Customer Service  
MotorAge@omeda.com  
(877)-382-9187

SUBMISSIONS:  
Motor Age welcomes unsolicited articles manuscripts, photographs, illustrations and other materials but cannot be held responsible for their safekeeping or return.

**Connectiv**  
The Business Information  
Association, a division of SIIA

MEMBER OF:



Motor Age (USPS 925566) (Print ISSN: 1520-9385, Digital ISSN: 1558-2892) is published 10 times per year, by Endeavor Business Media, LLC, 1233 Janesville Avenue, Fort Atkinson, WI 53538. Periodicals postage paid at Fort Atkinson, WI 53538 and additional mailing offices. Subscription prices: U.S. one year, \$17; U.S. two year, \$136; one year Canada, \$117; two year Canada, \$215; one year international, \$117; two year international, \$215. POSTMASTER: Send address changes to Motor Age, P.O. Box 3257, Northbrook, IL 60065-3257. Please address subscription mail to Motor Age, P.O. Box 3257, Northbrook, IL 60065-3257. Canadian G.T.S. number: R-124213133RT001.

©2022 Endeavor Business Media All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical including by photocopy, recording, or information storage and retrieval without permission in writing from the publisher. Authorization to photocopy items for internal/educational or personal use, or the internal/educational or personal use of specific clients is granted by Endeavor Business Media for libraries and other users registered with the Copyright Clearance Center, 222 Rosewood Dr. Danvers, MA 01923, 978-750-8400 fax 978-646-8700 or visit <http://www.copyright.com> online. For uses beyond those listed above, please direct your written request to Permission Dept. fax 847-564-9453.

Endeavor Business Media provides certain customer contact data (such as customers' names, addresses, phone numbers, and e-mail addresses) to third parties who wish to promote relevant products, services, and other opportunities that may be of interest to you. If you do not want Endeavor Business Media to make your contact information available to third parties for marketing purposes, simply call toll-free 877-382-9187 or email [MotorAge@omeda.com](mailto:MotorAge@omeda.com) and a customer service representative will assist you in removing your name from Endeavor Business Media's lists.

Motor Age does not verify any claims or other information appearing in any of the advertisements contained in the publication, and cannot take responsibility for any losses or other damages incurred by readers in reliance of such content. While every precaution is taken to ensure the accuracy of the ad index, its correctness cannot be guaranteed, and the publisher waives all responsibility for errors and omissions.

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

**Delphi**  
Technologies

Technology  
driven



Built on our OE engineering and testing expertise, our full-service aftermarket **steering and suspension** solution offers premium parts combined with **training** and **technical support**, making vehicles drive **cleaner**, **better**, and **further** right through their lives.



[delphiaftermarket.com](http://delphiaftermarket.com)



Delphi Technologies is a brand of BorgWarner Inc.

 **BorgWarner**



**AUTOMOTIVE  
MAINTENANCE  
& REPAIR  
ASSOCIATION**

TRUST COMES STANDARD

## EVENTS

# AMRA TO HOST MEMBERSHIP MEETING TO KICK OFF INDUSTRY WEEK IN LAS VEGAS

➔ The meeting begins at 4:30 pm on Monday, Oct. 31, and includes a cocktail reception and networking event immediately afterward.

The Automotive Maintenance and Repair Association (AMRA) will be hosting a general membership meeting on Monday, October 31, during Industry week in Las Vegas. The meeting begins at 4:30 pm and includes a cocktail reception and networking event immediately afterward. This year's meeting will be held at the Venetian, with registration currently open on the [AMRA.org](http://AMRA.org) website.


This year's theme, "Trust Comes Standard," is a strategic pillar for the organization. Insightful presentations supporting the theme will help shops to understand better the consumer landscape and the effects on the changing vehicle service industry.

"We are excited to be back for an in-person general membership meeting. Our industry faces a number of challenges in the future, and coming

together to learn about trends and insights is invaluable. We often use the phrase, 'Many Voices one Future,' and this meeting is a collection of the best voices in the industry," said Jeff Cox, president of the Automotive Maintenance and Repair Association.

Members and guests are welcome to attend and hear from association leadership to get an update on the organization's strategy. Attendees will learn about upcoming strategic initiatives that align to help the aftermarket thrive in the future.

Meeting attendees will get to socialize, network with fellow AMRA/MAP members and guests, and learn more about the association to kick off Industry Week. Sponsors for this year's meeting include Pep Boys, DRiV, Bolt On Technology, 1-800 Radiators and ALLDATA.

To register for the event, visit [amra.org](http://amra.org) and click on the calendar. 

## BREAKING NEWS

### EVENTS

# 2022 SEMA SHOW EXPANDS NEW PRODUCTS SHOWCASE

➔ Two new categories, EV and ADAS, will be added to this year's New Products Showcase.

The SEMA Show announced it will be expanding its New Products Showcase this year to now include products related to EV and ADAS, in addition to its 16 other categories.

More than 2,000 product entries are expected to be included in this year's showcase.

"Through the SEMA Show New Products Showcase, buyers, retailers, and distributors can easily discover and learn about all the hot products that they may want to carry," said Tom Gattuso, SEMA vice president of events, in a press release. "They will find details about the products, including the exhibitor's booth number. They can then connect directly with the manufacturer on the Show floor to learn more. It's no surprise that SEMA Show buyers rely on the New Products Showcase to help them stock their shelves."

Details on all the products from the showcase will also be included in the SEMA Show mobile app to give attendees a year-round resource to help them after the show, the SEMA Show reported.

Through the app, attendees can flag products of interest. Although, those in attendance will only be able to connect with the exhibiting companies for quality one-on-one discussions, demos, and presentations.

The SEMA Show is taking place Nov. 1-4 in Las Vegas. Read more: [bit.ly/3LMcJ5K](http://bit.ly/3LMcJ5K)



# THINKCAR

## WIN WITH TECHNOLOGY!



## GET THE TECH YOU NEED TO WIN!

**We invest over \$200M annually in R&D to ensure the Platinum series provides unbeatable performance!**

### MEET RICHARD PETTY

AAPEX, Nov 1, 2022  
THINKCAR Booth A433



# 43

2022 All Petty marks used under license from Petty IP,LLC.

SEE YOUR LOCAL TOOL DEALER OR DISTRIBUTOR TO EXPERIENCE THE PERFORMANCE OF THE PLATINUM SERIES!



PLATINUM S6



PLATINUM HD



PLATINUM S20



PLATINUM S10 PRO

### THINKCAR Tech, Inc.

US Tech Support Ph: 833-692-2766 | Business Hours Mon - Fri 8am - 5pm PST

# CARB REQUIRES MANUFACTURERS TO PROVIDE SERVICE INFORMATION FOR ELECTRIC VEHICLES

The California Air Resources Board (CARB) has just approved the Advanced Clean Cars II regulations. The Advanced Clean Cars II regulations are in response to Governor Gavin Newsom's executive order requiring that all new cars sold in California be zero-emission by 2035. CARB adopted the Advanced Clean Cars I regulations in 2012.

The Advanced Clean Cars II regulations include a variety of initiatives to set California on the path to zero-emissions by 2035. Most notably for independent repair shops, the Clean Car regulations require the same access and disclosure for zero-emission vehicles (ZEVs) throughout the California Service Information Regulation. This means that independent repair shops in California will be required to have access to the same service information and repair procedures from OEMs as they have with current internal combustion engine vehicles.

Additionally, the Advanced Clean Cars II regulations require standardized tooling to reprogram electronic control units (ECUs) and require standardization for some vehicle

tool data. The regulations also require zero-emission vehicles to have a standardized data connector (such as an OBD-II port) and use standardized communication protocols.

Under these regulations, OEMs will be required to make powertrain service and repair information for all zero-emission vehicles available to independent technicians. Powertrain includes all components and systems related to refueling and propulsion. This mimics what is already done for conventional vehicles for service and repair information under CCR 1969.

The Alliance for Automotive Innovation, which represents automakers and automotive suppliers that produce over 95 percent of new vehicles sold in California, voiced their support for the Advanced Clean Cars II Regulations.

Steve Douglas, vice president for Energy and Environment at the Alliance for Automotive Innovation, said: "Independent repair shops conduct 70 percent of post-warranty repairs. They are an essential partner for automakers. This does not change with the transi-

tion to an EV future. We have long supported and continue to support inclusion of EVs in the service information requirements in California and would support their inclusion in EPA's Service Information regulations, so they apply nationwide."

"It is essential that independent automotive repair shops continue to have access to the service information and repair procedures they need to effectively and safely repair vehicles," said Automotive Service Association (ASA) Chairman of the Board, Fred Hules II. "ASA is glad to see California charting a path for the rest of the nation for uninterrupted access to service information of zero-emission vehicles for independent repair shops."

Read the CARB Advanced Clean Cars II Regulations here: [bit.ly/3xQnsqc](https://bit.ly/3xQnsqc)



## STUDY FINDS FEWER ROADWAY FATALITIES IN STATES WITH INSPECTION PROGRAMS

ASA participated in a Capitol Hill briefing for a study of data from 1975 to 2018 found there were 5.5 percent fewer roadway fatalities in states with I/M programs.

The Automotive Service Association (ASA) participated in a vehicle safety inspection briefing on Capitol Hill in Washington, D.C. The briefing was hosted by CITA North America Regional Advisory Group and included a presentation of a new vehicle safety inspection study from Carnegie Mellon University.

CITA is an international organization dedicated to improving road safety and protecting the environment through vehicle safety inspection and emissions testing programs. ASA is a board member of the CITA North America Regional Advisory Group.

At the event, Dr. Scott Matthews presented the findings of the 2020 Carnegie Mellon University study on vehicle safety inspection programs in the United States. This study, which is titled "Safety I/M programs mitigate motorway fatalities: A study of the U.S. FARS dataset, 1975—2018," was funded in part by CITA.

The study evaluated the 15 U.S. states that currently require periodic safety inspections on passenger vehicles and found there are 5.5 percent fewer roadway fatalities in states that have

I/M programs on average. This translates to approximately 1,400 mitigated fatalities in 2018 due to vehicle inspection programs.

John Firm, ASA mechanical ops committee director, spoke virtually to the Capitol Hill attendees on the value of vehicle inspection and maintenance programs. Firm Automotive is located in Fort Worth, Tex, one of the 15 states that requires a periodic safety inspection for vehicles. In his remarks, Firm reiterated the importance of safety inspection programs, stating that something as simple as checking the tires or the brakes of a vehicle could keep a driver safe on the road.

Other meetings were held throughout the day to discuss the importance of vehicle safety inspection programs with Capitol Hill and U.S. Department of Transportation staff. Vehicle safety inspection programs will become increasingly important with the advent of advanced driver assist systems (ADAS) and autonomous vehicles (AVs).

Cars on the road today are equipped with advanced safety features such as automatic emergency braking, lane keep assist systems and more, making them safer than ever. However, it will be essential that these advanced systems are regularly inspected to ensure they are working properly.

Read the Carnegie Mellon study white paper here: [bit.ly/3dl7Caf](https://bit.ly/3dl7Caf); watch the recording of the Vehicle Safety Inspection Program Briefing at: [youtu.be/RnUgHllpSpl](https://youtu.be/RnUgHllpSpl)





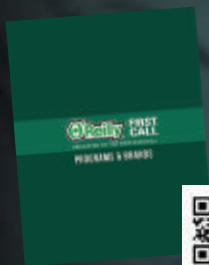


DEDICATED TO THE PROFESSIONAL

INSTALL

# PREMIUM SHOCKS & STRUTS

Let Us Be Your Parts & Equipment Supplier



<https://www.firstcallonlinecatalogs.com/OReilly-Programs-and-Brands-Dedicated-To-The-Professional/C/>



## MONROE SHOCKS & STRUTS

Monroe continues to lead the industry in developing innovative products that deliver maximum value. From entry level Monro-Matic® to premium Quick Strut® assemblies, Monroe has the replacement shocks and struts to improve handling, safety, and control on most applications.

**FIRST CALL ONLINE** MAKING IT FASTER AND EASIER THAN EVER TO ORDER PARTS



## MASTERPRO STRUT ASSEMBLIES

- Offers a high-quality, low-cost alternative to OE replacement parts
- Built with high-quality components in a fully assembled unit
- Designed to meet or exceed OEM requirements



## MONROE QUICK-STRUT ASSEMBLIES

- Save time with one complete strut assembly "ready to install"
- New coil springs
- Restore the vehicle to original height and load-carrying capacity
- New bearing plates and strut cushions



DEDICATED TO THE PROFESSIONAL

FIRSTCALLONLINE.COM

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

# 3 ways car repair programs win your customers' trust

BY LAURA BUSSIS // Contributing Editor

**D**id you know one in three drivers delay fixing their cars because they worry about discussing the repairs with a technician?

The 2021 survey by AAA revealed drivers don't want to expose how little they know about cars and what it costs to fix them. Now, that's better than the association's 2016 survey that found two in three drivers felt that way. However, we have a long way to go. And your car repair programs may be just one tool to bridge that gap.

When drivers put off repairs, they end up facing higher bills, which leads to more complaints about dealing with auto repair shops. Ultimately, that makes them reluctant to come back for repairs again.

So, how do we break that cycle?

## Bridging the gap between you and your customers

Of course, some people didn't grow up fixing their car in the driveway or studying auto shop in high school. Moreover, they don't want you to know how nervous or ill-informed they are. Despite this knowledge gap, using the right tools in your shop management system can win back their trust.

First of all, you want to tap into what's really going on before you use your car repair programs. For example, a customer's car is making a weird sound and they need you to fix it. They probably worry about getting to work or picking up their child from daycare on time. Plus, they want to know if they can afford the repair and see why it really matters.



PHOTO 45165580 © SEAN LOCKE PHOTOGRAPHY | DREAMSTIME.COM

According to Angie Barnett, CEO of the Better Business Bureau of Greater Maryland:

- 94 percent of shoppers are loyal to companies that run with transparency. They want to know where you get your products or how you treat staff.
- 73 percent of customers will pay more for products and services from companies that are transparent and ethical.
- 66 percent of consumers will switch brands for ethical companies, including 91 percent of millennial and Gen Z consumers.

Best of all, positive customer service experiences will win back 89 percent of consumers.

"Every customer interaction builds (or diminishes) trust. Just one positive customer service experience is all you need to inspire long-term customer relationships," Barnett says.

## Three ways for car repair programs to help

Above all, the AAA survey highlighted that drivers' top concerns as:

- Paying too much
- Paying for work they don't need
- Paying for poor service

On the upside, the same respondents said they found an auto repair shop with technicians they do trust.

## Is the estimate too high? Show them how you built it

According to RepairPal, "Anxiety around visiting the technician generally stems from car owners' awareness of the relative lack of knowledge." People feel ashamed to admit they don't know how to fix a car. When they come to you for a repair, that lack of technical skill puts them in a vulnerable position. They worry that they will overpay when a tech finds out they are in the dark.

---

YOUR REPUTATION RIDES ON TWO THINGS.

# YOUR SKILLS & THE PARTS YOU USE

---



You need 100% confidence in the parts you install. So go with the parts with the OE pedigree - Continental aftermarket parts. We're OE on tens of millions of vehicles on the road today. That means our aftermarket parts are engineered for perfect fit, form and function. It's a skill very few can match.

Learn more at [continental-engineparts.com/na](http://continental-engineparts.com/na)

In fact, some people will even pay too much rather than admit they don't have a clue. That's why it's vital to use car repair programs to clear things up.

Thankfully, auto shop software shows customers how you came up with the actual cost. Even better, you can attach the quotes for each part then add the number of hours the job will take. Once you send it by text or email, they can show it to a friend to check that it's fair. As a result, they understand what it takes to get their car back on the road. This level of openness earns their trust.

Likewise, when a customer hears they need a new tie rod or flange bolt, they may panic. After all, they may have never heard these terms in their lives. When shop management software shows images of the parts from a trusted source, it reassures them.

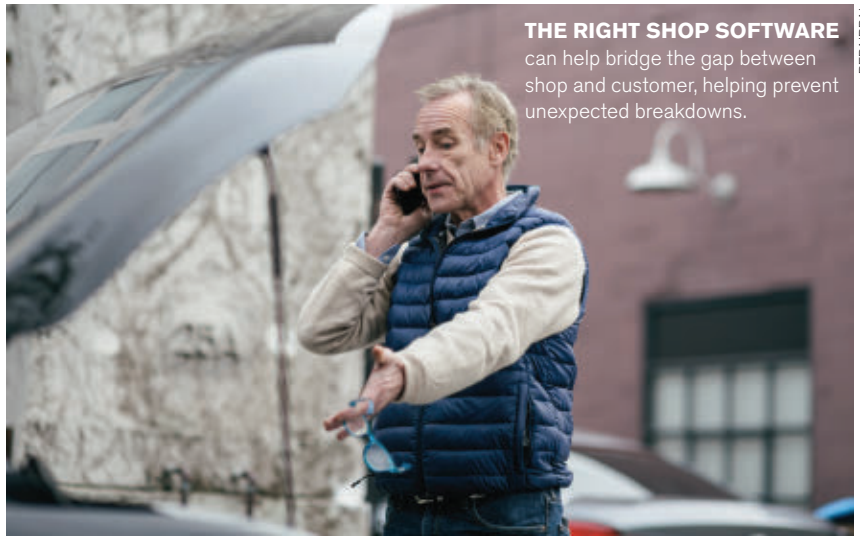
**Do they need this work? Share pictures from underneath the car**

Anyone who has ordered a hamburger and gets offered "fries with that" knows the power of the upsell. Similarly, we point out to drivers that their cars are due for oil changes or other services when they come in, but customers may see this as a sales tactic, rather than a necessity.

However, if they see the worn brake pads or the rusted exhaust clamp, they are more likely to believe you. Shooting clear photos or videos from within your shop management system and sending it to them really opens their eyes.

You could explain it to them over the phone, but it takes seconds for an image to tell the story. As a result, customers will accept that they need to make this repair for their own safety. That takes the onus off the upsell and makes it a personal priority, thanks to your automotive shop software.

At the same time, a smart shop management system feeds customers a list of upcoming service needs. This creates a



**THE RIGHT SHOP SOFTWARE** can help bridge the gap between shop and customer, helping prevent unexpected breakdowns.

REPAIRPAL

menu of options that they can choose to have completed now or later. When this is part of the message generated by auto repair software, customers may surprise you. If they see a chance to disrupt their days less often by completing two services at once, they often jump on it.

Why not be upfront and offer the customer a chance to fix their car before it falls into worse shape? We've found that Shop-Ware shops who do this get a "yes" response 89 percent of the time. That leads to an average repair order increase of 20 percent.

**Help customers understand your value with good service**

We've heard the stories of another shop offering a cheaper quote, then the customer coming back to you. Sadly, it happens more often than it should. Shops that undercut pricing for a short-term win hurt us all in the long run.

However, customers who find someone reliable to fix their cars will stay with them for the long haul. So, you cannot be shy about putting that type of data right in front of them. That way, they can see our expertise and how it pays off.

You can use an employment management system to track every interaction between staff and each customer. With DVX's Messenger, for example, every text, chat and email feeds into the

repair order so you know what each person said. Likewise, your shop management system can point out when a customer agreed to a repair if they deny it later.

As always, people are more likely to complain about a bad service than rave about a great one. As a result, people hear more about that shop that misled them than one that saved the day. When you get a good review, make sure you share it. Encourage clients to post reviews of your work, then share the five-star ratings so others can see them. Drivers trust other drivers when it comes to trying out a new shop after another one has let them down. Word of mouth is great, but a shoutout on Yelp reaches far and wide.

Once you combine all these tips, people will seek out your shop as a trusted place to repair their car. Don't let all those five-star reviews go to your head! **ZZ**



**LAURA BUSSIS** is the product marketing manager for Shop-Ware, the leading shop management system.

It offers game-changing features, such as DVX (Digital Vehicle Experience), Parts GP Optimizer, Advanced Analytics and Capacity. Learn more at [GetShopWare.com](http://GetShopWare.com) or follow them on Facebook @GetShopWare, on Twitter @GetShopWare, on LinkedIn @Shop-Ware or Instagram @getshopware.



THE FUTURE OF DIAGNOSTICS IS HERE

# MS909



9.7" SCREEN / ANDROID 7

### INTELLIGENT DIAGNOSTICS

- REPAIR ASSIST
- GUIDED DIAGNOSTICS

### TOPOLOGY MODULE MAP

- ALL SYSTEM STATUS SCREEN
- COLOR CODED FAULTS

### MAXIFLASH VCI

- WIFI / BLUETOOTH ENABLED
- NEW PROTOCOLS



### MAXISYS MS919

- 9.7" SCREEN / ANDROID 7
- INTELLIGENT DIAGNOSTICS
- FIVE-IN-ONE VCI



### MAXISYS MS909

- 12.9" SCREEN / ANDROID 7
- INTELLIGENT DIAGNOSTICS
- FIVE-IN-ONE VCI

SUPPORT: 1.855.288.3587

EMAIL: [USSUPPORT@AUTEL.COM](mailto:USSUPPORT@AUTEL.COM) | WEB: [AUTEL.COM](http://AUTEL.COM)

VIEW MARKETING MATERIAL: [ISSUU.COM/AUTEL2](http://ISSUU.COM/AUTEL2)

FOLLOW US @AUTELTOOLS



# Are you making these marketing mistakes?

Shop owners and a marketing expert share what they've found to work.

**BY CHASE CLOUGH** // Contributing Editor

**M**arketing is one of the most essential business practices any shop owner can use to his or her advantage. Below, you'll find the top nine most common marketing mistakes from a marketing expert and fellow shop owners.



**KELSEY AND BRANDAN LANCASTER**, owners of Performance Automotive Repair, host an annual customer appreciation day and barbecue, with 150 to 200 customers typically in attendance.

## Not leaving enough in your budget for marketing

Marketing is an investment. As a shop owner, you have to put enough in to see a bountiful return. Marissa Ruiz, DRIVE's digital marketing manager, says that "your marketing is an investment for a return." It's not a loss, but instead, a step toward increasing profit. Calculate your gross sales and from there determine what percentage is the correct amount to invest into your Marketing funds.

Kelsey Lancaster, co-owner of Performance Automotive Repair, said she's investing more into marketing every year. So, what is the biggest mistake she makes for marketing?

"Not spending enough!" she said. "And still to this day, I don't feel I spend enough on our marketing efforts. By divvying up enough of your profits and investing them into your marketing strategy, you can start seeing returns in no time."

## Not exploring every advertising avenue

You might be doing the same advertising you have since your shop opened, and that could be great. But using only one avenue might not be making the cut anymore. Are you only sending out mailers? Or giving coupons around the holidays? Revamping your advertis-



### MARKETING IS AN INVESTMENT.

As a shop owner, you have to put enough in to see a bountiful return.

ing and expanding to different markets can get new customers in your doors. Get in touch with a marketing professional and start placing advertisements in new places. Make sure your marketing covers both physical and online spaces so your shop's name can get in front of as many people as possible.

## Cutting marketing when it gets slow

When your shop slows, your first instinct might be to slash your marketing budget. This is actually the time to invest more in it. Marketing your shop more is what's going to get cars in your bays. As Ruiz put it, "If you need more vehicles, or to combat seasonal slows, the answer is to advertise for more vehicles." Look at what has worked best for you in the past, whether it's mailers, Google ads, or phone calls from your staff. Something has drawn a crowd to you before and can do it again.

As Lancaster put it, there's never a time not to be marketing. "Shop's doing well, lots of cars, KPIs are good? Keep marketing! The shop's slow, not enough cars, not a lot of money in the bank account? Keep marketing!"

The marketing techniques that have worked best for Lancaster are the ones that show their customers how much they are appreciated. Each year around Christmas, they send their clientele \$25-off coupons, enticing previous customers to come back for car maintenance. They also use USPS' Every Door Direct Mail services. The mailers cost \$0.41 each and bring in 15 to 20 new customers, netting them \$5k-\$10k in additional work. Their marketing practices show their community that they care, and they reap the benefits!

# QUALITY-BUILT TO LAST.

Trust Quality-Built With Every Stop.



Full-Line Application Coverage  
Brake Pads and Rotors for all Vehicle Types  
Late Model Coverage  
OE Friction Type Matched Formulations  
Copper-Free 2025 Compliant Formulations

## QUALITY-BUILT™

BRAKE PADS + ROTORS | PASTILLAS + ROTORES DEL FRENO | PLAQUETTES + DISQUES DE FREIN

powered by:



Learn More at

**aaapex**  
ahead of the curve

Booth A4638

Scan the QR code with your  
smart device to learn more  
about Quality-Built brakes.



## Lack of consistency

Does your marketing have an overall theme? Are your materials expressing the same idea? Do they have the same color palette? All of these things are an important part of branding. The way you market your business is the first impression most customers will get of your shop. So, whether you want to be seen as a homey, small-town shop -- or a sleek, professional business -- you'll need to tailor your marketing to appear the way you wish. Carefully choosing the layout, colors, and verbiage on your marketing materials will help you come across as the business you want to be. Once your advertisements are consistent, customers will have a clear idea of who will be working on their cars when they come in. You can start building trust with the clientele before they even walk through your doors.

## Not looking at the overall picture

Looking at your KPIs week-to-week or even month-to-month can damage your view of your marketing practices. Marketing is about looking at yearly trends, then deciding how to reach smaller goals from there. As Ruiz said, "I have clients who call in concerned they received fewer calls than the previous month, then jump to deciding their marketing must not be working and it needs to be cut." So, don't make any decisions immediately. Take time to look over annual data and come up with a solid game plan.

## Not being involved with your community

When you consistently interact with other local businesses in your community, your shop can become well known all over town. In showing up to or sponsoring neighborhood events, your business will start to be recognized. When they're in a pinch, they'll know they can go to the involved, community-oriented local auto shop over a big corporation. Having your name appear again and again in your community will make you stand out against other shops. Your shop can become a household name among your town's residents if you're involved enough. Word of mouth is your friend!

Lancaster and her husband and co-owner, Brandan, have an annual customer appreciation day. Around the shop's anniversary in May, they will invite their regular customers to a barbecue they host. While gathered, they smoke brisket, ribs, and pulled pork for everyone. The annual event usually draws 150 to 200 customers. Kelsey says, "It's a ton of fun; our customers and we look forward to it each year."

## Your marketing is hard to find

If you're focusing your marketing efforts in the wrong places, it can seem like marketing is not worth the time or money. Mark Bagg, owner of New Canaan Foreign Car, says his biggest mistake came from placing advertisements on the cash registers of grocery store checkouts. He wasn't getting the business he wanted and had no way of tracking its success. Now, he says he always "tracks ROI and at-

taches surveys to advertisements." He's focused on getting the most customers and information he can.

Making sure your marketing is technical and engaging is an important step. If no one can find your ads, what purpose does it serve to update and personalize them? Lancaster's advice is to "seek professional assistance to ensure your marketing is optimized, from your website to your social media- it's essential." When potential customers don't have to scour the internet to find your shop, they're much more likely to use your services.

## You don't have a unique selling proposition

A unique selling proposition (USP) is the one thing that makes your business better than the competition. Don't worry; it can be easy to figure out what your USP is! Take a look at shops that are similar to yours in your local area. Then create a list of similarities and differences between your shop and those others. How long have you and the others been open? Are you all family-owned? Once you find the differences between you and the other businesses in your area, you can find what makes you stand out. Now, you can focus your marketing toward your USP. Your shop can become known for its AAA accreditation or the fact you run a "green" shop. Customers will come to know your shop for what is special about it and you'll start to stick out in their minds.

## Not tracking your marketing moves

When you don't know which marketing channels are bringing in the most revenue, you might start funneling money into ones that aren't profitable. That's why it's important to track each advertising effort you explore. Ruiz's advice: "Track the source of your leads. Ask your customers where or how they heard of you. From there, you have additional data to use to help you determine what's profitable." Just knowing where your customer heard about your business is valuable information. Once you know which avenue is most profitable, you can start allocating more of your marketing budget in that area. Bagg said after he took all of DRIVE's marketing classes, he began tracking incoming phone calls. By figuring out why people were calling, he was able to tailor his marketing materials to their specific needs and maximize his profits.

Fixing these common mistakes is the first step toward making your marketing as profitable as possible. Get with your marketing manager and come up with a game plan to incorporate these tips, and you'll start to see your profits grow in no time. *ZZ*



**CHASE CLOUGH** of DRIVE has a wide range of marketing knowledge, including content creation across all social platforms, writing and editing. Her recent marketing positions include working at Florida State's Career Center, and she is now a master's candidate at Florida State University. Chase uses these skills in her position at DRIVE, based in Monrovia, Calif.





# MEET THE JONESES OF THE AUTO CHEMICAL NEIGHBORHOOD

## The VS7<sup>®</sup> Chemical Program from Mighty.

It's got everything going for it. The most advanced chemical formulations. Easy-to-use equipment. Strong local support with online and hands-on training. Industry-leading consumer guarantees. The Mighty VS7 Chemical Program delivers remarkable results for your customers and your business. No wonder everyone else is trying to keep up with it.

**See the results for yourself.** Visit us online or scan the QR code to receive a free sample.

*WE HAVE GREAT CHEMISTRY*  
[mightyautoparts.com/try-vs7](http://mightyautoparts.com/try-vs7)



All products backed by Limited Lifetime Protection Program

ADVANCED CHEMISTRIES | COMPLETE SUPPORT PROGRAM | LIFETIME PROTECTION PLAN

# Stop the pain of multiple diagnostic charges

You don't have to personalize the process of selling diagnostics!

BY DAVID ROGERS // Contributing Editor

**H**ave you ever had a customer come in with multiple symptoms, and all of them needed diagnostics?

The first reaction for the service advisor is often to personalize that customer's problem. He or she has a strange smell, a weird noise, and a check engine light, and your experience tells you that those issues are probably all unrelated. The only way forward is going to be diagnostics to get to the bottom of each concern.

The key problem is, of course, that parts stores and chains have devalued diagnostics in the mind of drivers. They've created a perception that they can plug in a diagnostic machine and know exactly what is wrong with the vehicle just by replacing a part.

That's an instant conflict for service advisors. They know that the customer needs hundreds of dollars of diagnostics before the repair can even begin. And they know that customer is probably going to ask if you can just do the diagnostics for free or ask you to apply the diagnostics toward their final repair bill.

It's natural to feel this pain, but it's not necessary. You don't have to personalize the customer's problems. There is a way forward where the customer gets their problem fixed right, the first time, where the shop charges for



**THE MANAGEMENT TRIANGLE** represents financial balance between the shop, the customer, and the technician. Maintaining this balance ensures financial success.

diagnostics, and where the tech is paid for their valuable time.

## The secret to depersonalizing this dilemma starts with a triangle

Imagine a triangle with three equal sides. If you're designing an office building or a bridge, this kind of equilateral triangle is critical, because the equal sides mean that stress is distributed evenly and the structure is as strong as possible.

On each side of this imaginary triangle is a label: one side says "employee,"

another says "customer," and the third says "business."

This is the management triangle, and I've used it for years to help my team and me remember to keep all three sides in balance whenever there's a decision to be made in the shop. The goal in each decision should be to grow all sides of the triangle evenly. In engineering or construction, a triangle with uneven sides can't handle as much stress and is more likely to crumble, and it's no different in management.

If the goal is to grow all sides of the management triangle evenly, who ben-

# Trusted by thousands of professional technicians everyday

- Industry leading coverage with 400+ SKU covering vehicle applications 1982 through 2023
- Program offered in both Sensor Only and Full Assembly
- 100% programmed and tested to OE specifications in fit, form, and function
- Manufactured with the highest quality materials designed to hold up under any condition



All "sensor only" MAF's are supplied with Torx® bit and corresponding security screws.



QUALITY • COVERAGE • SUPPORT

efits when the shop does not charge the customer fairly for all the needed diagnostics?

When the shop doesn't charge (or doesn't charge enough) for diagnostics but asks the technician to perform them anyway, the technician loses because he or she is not paid for his or her valuable expertise. If the business pays the technician for his or her time without charging the customer enough, a different side of the triangle suffers. And if the shop doesn't charge for diagnostics because the plan is to throw parts at the problem based on what the diagnostic tool says, then it's the "customer" leg of the triangle that suffers.

No matter how you slice it, these outcomes are bad -- for shop efficiency, for the customer, for the tech, and for the shop. The only outcome that benefits each side of the management triangle equally is one where the shop charges the customer for diagnostic time and pays the technician.

Of course, knowing that you need to charge for diagnostics and actually selling diagnostics are two very different things. If you've been uncomfortable selling diagnostic time until now, what's the best way to get started?

**The key is education**

Job one in selling diagnostics is to set your shop apart from the customer's experience elsewhere. Don't assume that he or she understands the full problem. In the customer's heart, he or she may hope that the smell and the noise and the check engine light are all connected.

That means the customer needs to know your goal is to fix their problem right, right away, and with as few parts as possible. He or she can either spend time now and a few dollars on labor, or he or she can spend a lot of dollars on parts and a lot more dollars on labor so that your shop can guess your way through the process until you land on the right solution.

Posturing here is critical, because the

customer doesn't want to know how bad you've got it. It doesn't matter how busy you are or how much of a pain it is to diagnose issues like this. Not only does the customer not want to know these things, he or she shouldn't know, because you're not buying their problem.

The business transaction you're discussing isn't one where he or she agrees to pay you money and you agree to accept their problem. You're not promising an answer in exchange for a fee. You didn't design or manufacture that vehicle, and you didn't purchase it or drive it, but you are here to work with them to get to the bottom of the problem.

And that is the crux of the matter, of course. The customer's biggest concern is that he or she will end up paying something for nothing -- especially when there are multiple diagnostics needed. That's probably not far from the concern of most service advisors, that diagnostics will not uncover a solution and the customer will be upset.

This is why posturing is so critical, and why word-pictures are so important.

Instead of telling the customer that he or she is approving a series of tests and letting them picture what that means, compare it to trips to the doctor. Sometimes, the doc can shine a flashlight in your ears and throat and give you a prescription, and other times he or she needs to order more complex tests to understand what your symptoms mean. This puts you in the position of guide and protector. It also changes your primary goal to one of investigation.

This is where check-in forms and driveability checklists become critical. The better a job that the advisor can do at this point of asking questions about the intermittency and reproducibility of the issues, the faster the technician will be able to dial in and the more likely it is that the diagnostic time you sell will bear fruit. If your team asks the right questions every time, the customer, shop, and employees all benefit.



**The application of the management triangle goes far beyond selling diagnostics**

Other critical areas of the shop where keeping all sides in balance include how the team is incentivized. Is everyone working together to care for the customer and grow the shop? And what about your shop management solutions? Is the whole team more efficient and productive because of this software?

Start by drawing an actual management triangle and keeping it in sight on your desk. Remembering to keep the shop, customer, and employee in balance is much easier if you have the visual reminder in your eyeline during the day.

Above all, don't compromise. The easy thing is to give in and let the parts stores and chains dictate the value of diagnostics. But the right thing -- for everyone involved -- is to make sure the customer understands, values, and approves diagnostics so that the shop and technician are fairly compensated, and the customer can receive the right solution, right away, and get back on the road safely and quickly. *ZZ*



**DAVID ROGERS** is the COO of Keller Bros., an award-winning repair shop in Littleton, Colo. Twenty-five years after David took

over management of the shop, it continues to set sales and profit records because of perfected processes and systems. These same systems and processes are at the core of Auto Profit Masters, which David founded in 1999 to help fellow shop owners eliminate inefficiencies and maximize profits. Whether you need marketing that delivers results, incentive pay plans, training CDs, business coaching, or the same shop management system used by Keller Bros -- Shop4D -- to maximize your team's production, find the solutions you need at <https://autoprofitmasters.com/triangle>.

# BendPak®

YOU'RE INVITED

## COME VISIT US!

SAVE BIG DURING THE SHOW

NOV 1<sup>ST</sup> - 4<sup>TH</sup>, 2022

# SEMA

SHOW



LAS VEGAS  
CONVENTION CENTER

### SEE LIVE DEMOS!

## WE'LL BE AT 2 CONVENIENT LOCATIONS

SEMA and BendPak are back again, and we're coming in loaded with an amazing display of world-class equipment. Get up close and personal with some of our top brands, like **QuickJack** and **Autostacker** and of course, **legendary BendPak lifts**. When you need a break from the heat, stop by our **Cool Boss** exhibit and chill out with our new **COOLBLAST** and **COOLBREEZE** Series! We couldn't fit it all in one booth, so be sure to look for us out front by the racetrack, and upstairs in the south hall. See you there!

## WIN PRIZES

Inside Booth #37117  
South Hall Upper

Outside Booth #81030  
Silver Lot



### CHECK OUT OUR NEWEST PRODUCT!

ERGO-RS

Adjustable-height rolling work seat



**COOL BOSS™** **QUICKJACK™** **AUTOSTACKER™** **ergochair™**

1-800-253-2363 ■ [bendpak.com/SEMA](http://bendpak.com/SEMA)

© 2022 BendPak Inc. BendPak is a registered trademark.

**BendPak®**

# Wrench Nation joins the Motor Age team!

Motor Age welcomes Frank Leutz, host of the Wrench Nation podcast, to our family as our newest social influencer partner.

**BY MOTOR AGE STAFF**

**B**orn in Frankfurt, Germany, and growing up in Washington Heights in New York City, Frank Leutz became an accomplished trombonist with multiple appearances at Carnegie Hall, performing with greats Dizzy Gillespie, Tito Puente, Dave Valentine, Branford Marsalis, Lionel Hampton, and as a jazz/salsa musician with the McDonald's Tri-State Jazz band.

After high school, he chose to travel the world, serving in the Navy until 1990, when he got married and decided to enter the automotive industry. After learning the ropes as a technician, he ventured out on his own, starting his first automotive


shop in 1996 with \$4,000, a used hoist, floor jack, and lots of naive determination. Six years later, he profited through the sale of that business, and in 2004, opened Desert Car Care of Chandler, in Chandler, Ariz.

Desert Car Care expanded to a second location in 2009 and third in 2012. Both were sold in 2013 to focus on the Chandler operation, which grew to become a nationally recognized and award-winning seven-bay, top one percent in national gross revenue automotive repair shop.

Leutz took his leadership abilities to serve as president of the Phoenix Chapter of the Automotive Service Association from 2013-2017. In 2016, he was elected, and continues to serve, on the National ASA Mechanical Operations Committee, representing over 5,000 independent garage owners across the country.

That same year, he launched Wrench Nation, a national platform to educate on all things automotive through the award winning Wrench Nation Car Talk Radio Show that he hosts weekly on Wednesday from 4-5 p.m. MST on 88.7 FM The Pulse. The live show is then repurposed as a podcast and distributed through additional radio stations and podcast distribution channels with approximately 10,000 monthly downloads and guest appearances by Magnus Walker, NHRA Champ Robert Hight, Craig Jackson, Cody Walker, Dave Kindig, Dennis Gage, and many more colorful automotive industry talents!

Leutz continues to be a sought-after car care expert for Phoenix metro TV networks to educate the public on car care tips and national automotive news, as an industry expert on various panels, and he presents at automotive conferences, such as Ratchet + Wrench, Automotive Service Association (ASA) National, and Automotive Aftermarket Products Expo (AAPEX).

Leutz said, "My journey will never be complete, as there are many discoveries and ventures of helping the human spirit and sharing the great bounties of life's experiences with many, and always remembering that, 'Success is not final, and failure is not fatal...It is the courage that counts.'" 



The Automotive Management Institute (AMi) is pleased to announce the development and launch of a new professional designation focused on the technician in a leadership role: **AMi Accredited Shop Foreman.**

Mentors in the shop environment often receive technical training, but little in the way of training develop other skills. To be successful as a leader, they have to pick up the rest as they go. The shop foreman accreditation fills the gap with soft-skill courses from accredited industry training providers.

This new designation requires multiple categories of training, including shop management basics; coaching, mentoring, team building, and five new courses focused on the shop foreman role.

**Questions or Support:**  
[supportingsuccess@amionline.org](mailto:supportingsuccess@amionline.org)

# HARNESSES THE POWER

INTRODUCING THE MOST  
INTELLIGENT YET AFFORDABLE  
DIAGNOSTIC TOOLS EVER UNLEASHED!



## OTOFIX IM1

- KEY PROGRAMMER
- DIAGNOSTICS TABLET
- SERVICE RESETS

## OTOFIX D1

- BIDIRECTIONAL FUNCTIONALITY
- DIAGNOSTICS TABLET
- SERVICE RESETS

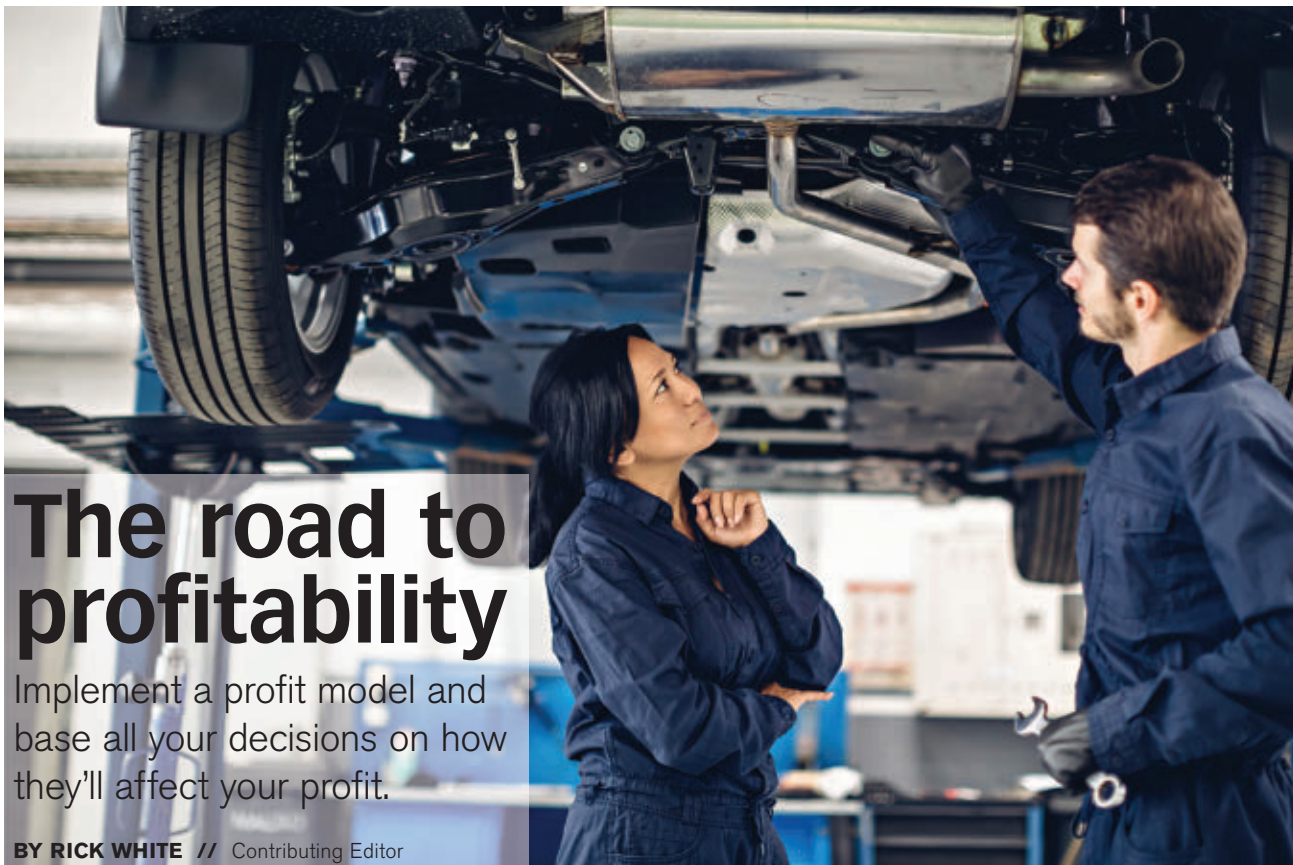
## OTOFIX BT1

- BATTERY TESTING
- ELECTRICAL SYSTEM ANALYSIS
- DIAGNOSTICS & SERVICE RESETS

# OTOFIX™

WWW.OTOFIXTECH.US ○ @OTOFIXTOOLS





## The road to profitability

Implement a profit model and base all your decisions on how they'll affect your profit.

BY RICK WHITE // Contributing Editor

want to start this month with a confession. I have a definite agenda for this article, which I believe will become evident as you read it.

If I were to ask you what you opened your shop to do, what would your answer be? I know you're probably thinking, "What are you sniffing, Rick? I opened my shop to fix cars!" And this, my friend, is where the problem in our industry starts. Let's dive into the focus every business needs to have to be successful.

Management guru Peter Drucker said, "The purpose of any business is to create and keep a customer." This is true whether you're a plumber, a chiropractor, a doctor, a butcher, or a candlestick maker. Let's face it: this makes sense because a business with no customers is just a hobby!

Economist Milton Friedman argued that the goal of any business is to generate a profit. Profit is NOT a dirty word. I've heard profit defined as the applause your customers give you for a job well done. Profits

allow for equipment purchases, hiring top talent, retaining the talent you have, giving back to the community, and a lifestyle of your choosing for you and your family.

Profit is the difference between owning a business or creating a super hard job. As a coach, nothing is sadder to me than seeing business owners working their butts off 70 to 90 hours a week with no profit to show for their effort. They end up being compensated for an amount they would never accept working somewhere else. Many shop owners get fixated on growth, but a sale without profit is simply more work. The antidote to just working is to have a profit model and base all your decisions on how they'll affect your profit.

The key to business success comprises two ingredients: raving fans and profit. I hope you've noticed that not once have I mentioned fixing cars. That's because fixing cars is the "vehicle" (pun intended) you've chosen to create and keep a customer while generating a profit!

### Increasing profitability doesn't mean fixing more cars

But because you've focused on fixing cars, you mistakenly believe that all you need to be more profitable is to fix more cars. And nothing could be further from the truth. Adding more cars to your day creates an environment entirely focused on activity.

When you're activity based:

You have a lower average repair order because as you add more cars to your schedule, your team has less time to work on each one.

You will experience lower profits because lower average tickets mean less profit per invoice.

You will have a bottleneck at the front counter because your advisors can't keep up with the number of vehicles.

You will have ambivalent customers due to a transactional focus because your team can't invest the time with each person building and cultivating a relationship that matters.

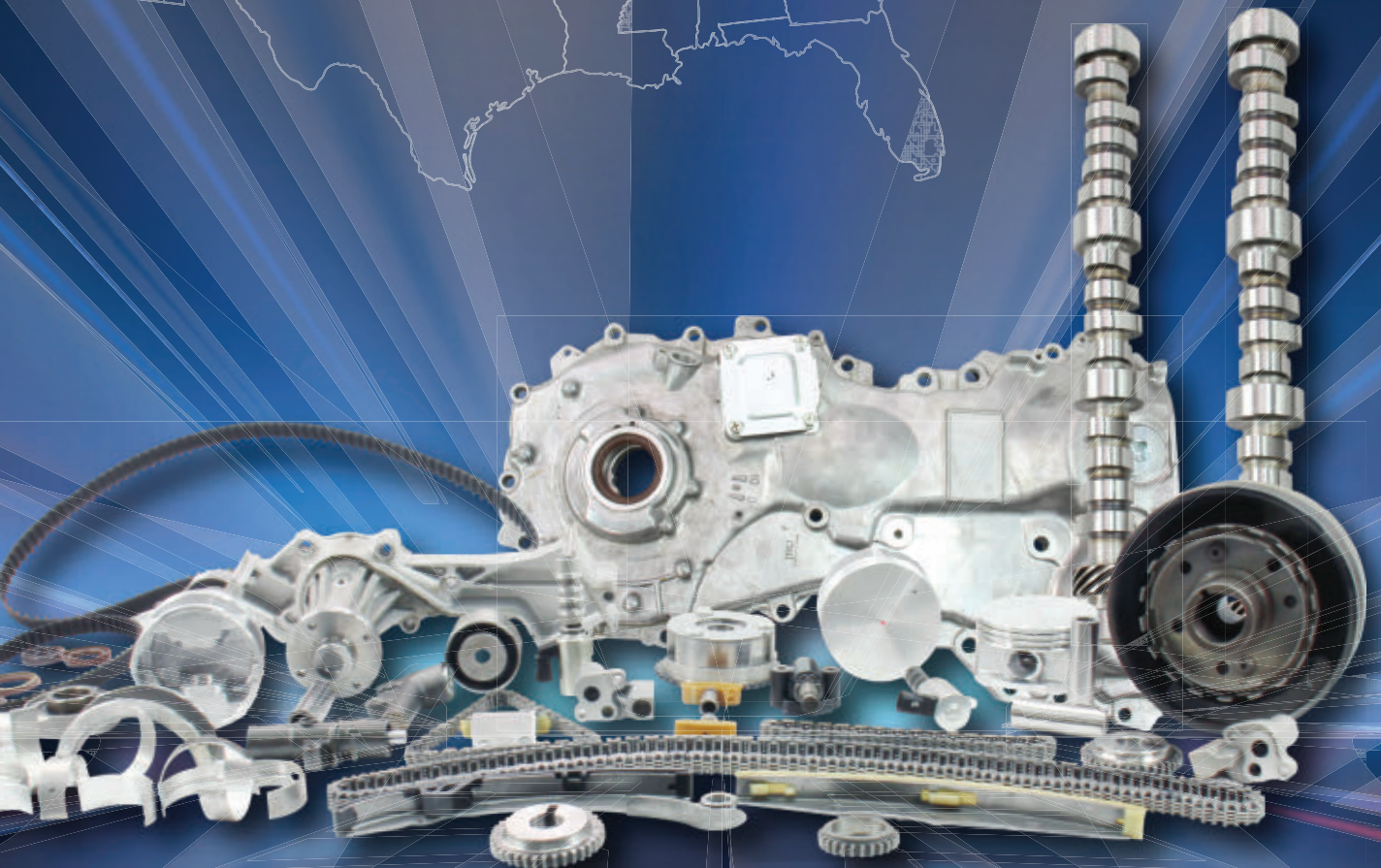


# DNJ<sup>®</sup>

## ENGINE COMPONENTS



# FULL LINE SUPPLIER OF INTERNAL ENGINE PARTS



[enginecomponents.com](http://enginecomponents.com)



You will have unhappy customers because you make promises you can't keep caused by the chaos of activity and inevitable snags and delays.

Your team will be wound tighter than a guitar string due to the workload and expectations you have for them.

And as profits shrink, you frantically

grasp for more and more cars. This cycle continues in a downward spiral, with you getting more frustrated and bitter as time goes on.

Before you lock your doors for keeps, I want to show you a solution to your increasing frustration and decreasing bank balance. That solution is to SLOW

DOWN. That's right, I said it. SLOW DOWN. The secret is to do more with less. Let me show you.

When you slow down, you can invest more time with your client getting to know them, their buying motive, their current concerns, how they're using the vehicle today, and what their plans are for their vehicle. You can focus on showing care, concern, creativity, confidence, and certainty. You can identify their problem and position yourself as their solution. In other words, you can create a client instead of having a customer. What do I mean by a client instead of a customer? I'm glad you asked.

**Climbing the 'Loyalty Ladder'**

I want to introduce you to "The Loyalty Ladder." On the lowest step, you have a citizen. A citizen is someone who doesn't know you exist. A candidate is the next step in climbing the Loyalty Ladder. A candidate is someone who knows who you are but hasn't done business with you (yet). Continuing up the ladder, the next step is a consumer. A consumer is someone who's done business with you once. Consider them a guest, and they're trying you on for size. If they like their visit and come back, they've just climbed to the next rung and become a customer. A customer is someone who has decided to come back again. As you get more comfortable with each other, they ascend the ladder to their next perch to become a client. A client is someone you have a deeper understanding of their needs, wants, and goals, and they see you as a trusted advisor. And finally, with much intention, your client climbs to the top of the Loyalty Ladder and becomes a champion. A champion loves what you do for them and does everything they can to help you succeed, including recommending others.

For me, this is what it means to create and keep a customer. It means actively creating champions. And the ingredient



**Get a comprehensive vehicle health picture with Autodiagnos™ Pro.**

Live data feeds make the difference.

**Analyze, diagnose, and repair faster and more accurately with the ability to record and playback live data feeds.**

- Accurate data in list, graph and gauge formats
- Fast - DTCs reported in 20-30 seconds on average
- Access Identifix®, Mitchell 1®, ALLDATA®, and others, right from the scan tool (*separate subscription required*)
- Based on 100% OE data and OEM platform
- USA designed, developed, manufactured and supported

**Subscription based model - no large hardware investment! Use your PC/tablet or ours.**

Learn more: [www.AutodiagnosPro.com](http://www.AutodiagnosPro.com)



Autodiagnos - A Trademark of the Continental Corporation

“**THE SECRET IS TO DO MORE WITH LESS.**”

that fuels their climb up the Loyalty Ladder is trust. I could go deeper here, but that's another article.

**Shift perspectives from ‘fix a broken car’ to ‘helping keep them on the road.’**

Slowing down also allows you and your team to shift from a “fix a broken car” perspective to a “helping them keep it on the road” perspective. Instead of just fixing their vehicle and getting them back on the road, focus on partnering with your client and keeping their vehicle on the road safe, reliable, and as efficient as possible. This means concentrating on the complete vehicle, finding issues before they cause a breakdown or a need for a surprise visit outside of their scheduled visits, and helping your client maximize the investment in their vehicle by recommending maintenance services. This focus enables you to maximize the opportunity you already have in your bays without adding more cars.

A key indicator of how well you're doing at this shift in perspective is called Sold or Billed Hours per Repair Order. A typical repair shop with no management training will average 1.3 to 1.7 hours of sold or billed labor per repair order. A general repair shop with training will average 3.0 to 3.5 sold or billed hours per repair order. A European repair shop with training will average 4.0 to 5.0 sold or billed hours per repair order. When you think about the age of the vehicle that you're working on and an average of two visits per year, these targets are completely attainable in a moral, ethical, and legal way.

If you are a shop owner frustrated at how much you're working and how little you're achieving, I hope now you can see that by slowing down, you can cre-

ate a better environment for your team and the people you serve. If you'd like a calculator showing you where you are now and where you could be by managing your Sold or Billed Hours/RO metric, go to [www.180biz.com/profit](http://www.180biz.com/profit) and download an Excel spreadsheet to help you dream and grow. **ZZ**



**RICK WHITE** is a business-turnaround and exponential growth expert who helps auto repair shop owners go from struggling

to stay open to being recognized as the go-to shops in their market. He helps business owners with average shops transform their shop into the shop of the year in the industry.



**OEM TOOLS**  
FAST IN CLASS

**FAST. EASY. CLEAN.**

**PNEUMATIC AND MANUAL FLUID EXTRACTORS**

- Removes Many Fluid Types: Engine Oil, Transmission Fluid, Coolant, Power Steering Fluid, Water
- Automatic Shut-Off Valve Prevents Overflow
- One Piece Leak Proof Reservoir
- 5 Ft. Main Suction Flexible Hose and 2 Dipstick Adaptors



#24389  
Manual Function  
1.4 Gallon  
5.3 Liter



#24936  
Manual Function  
2.1 Gallon  
8 Liter



#24938  
Pneumatic & Manual Function  
2.5 Gallon  
9.5 Liter



#24937  
Pneumatic & Manual Function  
1.5 Gallon  
6 Liter

Scan QR code or search [bit.ly/COVEREDOct22](http://bit.ly/COVEREDOct22) to get deals on all OEMTOOL Fluid Extractors



# California passes Advanced Clean Cars II

BY MADI HAWKINS // Contributing Editor

**O**n Aug. 26, the California Air Resources Board (CARB) approved the Advanced Clean Cars II regulations. These regulations are in response to Governor Gavin Newsom's 2020 executive order that requires all new cars sold in California to be zero-emissions by 2035. California is the first state in the nation to make such sweeping steps toward a zero-emission vehicle future, but other democrat-led states, such as New York and Oregon, are expected to follow suit soon.

Electric vehicle sales are higher in California than anywhere else in the United States—making up 16 percent of total vehicle sales to date in 2022. Comparatively, electric vehicles make up only about 6 percent of total vehicle sales across the United States. However, EV sales are climbing nationwide, due in part to pro-electric vehicle policies from the Biden Administration and state governments.

This summer, the U.S. Congress passed the Inflation Reduction Act (IRA), which includes \$369 billion in funding for emissions-reducing policies ranging from large-scale clean energy technology manufacturing investments to electric vehicle tax credits. The IRA includes a tax credit of up to \$7,500 for personal electric vehicles. The credit amount depends on a variety of factors, such as whether the vehicle battery meets manufacturing standards, vehicle MSRP price, individual household income and Made-In-America provisions.

On the state level, California is leading the way in advancing electric vehicles with the Advanced Clean Cars II regulations. The Advanced Clean Cars II regulations include a variety of initiatives to set California on the path to zero-emissions by 2035. Most notably for independent repair shops, the Clean Car regulations require the same access and disclosure for zero-emission vehicles (ZEVs) as established in the California Service Information Regulation. This means that independent repair shops in California will be required to have access to the same service information and repair procedures from OEMs as they have with current internal combustion engine vehicles.

Additionally, the Advanced Clean Cars II regulations require standardized tooling to reprogram electronic control units (ECUs) and require standardization for some vehicle tool data. The regulations also require zero-emission vehicles to have a standardized

data connector (such as an OBD-II port) and use standardized communication protocols.

Under these regulations, OEMs will be required to make “powertrain” service and repair information for all zero-emission vehicles available to independent technicians. Powertrain includes all components and systems related to refueling and propulsion.

This mimics what is already done for conventional vehicles for service and repair information under CCR 1969.

The Alliance for Automotive Innovation, which represents automakers and automotive suppliers that produce over 95 percent of new vehicles sold in California, voiced their support for the Advanced Clean Cars II Regulations.

Steve Douglas, Vice President for Energy and Environment at the Alliance for Automotive Innovation states: “Independent repair shops conduct 70 percent of post warranty repairs; they are an essential partner for automakers. This does not change with the transition to an EV future; we have long supported and continue to support inclusion

of EVs in the service information requirements in California and would support their inclusion in EPA's Service Information regulations, so they apply nationwide.”

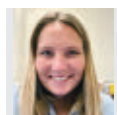
Overall, there is still a long way to go for wide-scale electric vehicle adoption in the United States. A recent study by Energy Innovation, a climate policy think-tank, found that “it can take many years to realize deep sectoral reductions [in the vehicle marketplace], even with high shares of clean vehicle deployment. This highlights the importance of strong Zero-Emission Vehicle (ZEV) incentives in the next decade, as waiting runs the risk of missing climate goals due to slow stock turnover.”

The Advanced Clean Cars II Regulations are a huge first step in the process to electrifying the American vehicle fleet, and including EVs in the service information requirements in California, and in other states that choose to follow in California's footsteps, is vitally important to all independent repair shops. **ZZ**

“THE ADVANCED CLEAN CARS II REGULATIONS INCLUDE A VARIETY OF INITIATIVES TO SET CALIFORNIA ON THE PATH TO ZERO-EMISSIONS BY 2035.”

JOIN AT

ASAsShop.org



**MADI HAWKINS** works as a Washington D.C. representative of the Automotive Service Association. She has a B.A. of Public Policy Studies from Vanderbilt University.  
[mhawkins@reddingfirm.com](mailto:mhawkins@reddingfirm.com)



# RAYBESTOS IS TURNING 120 YEARS OLD!

With a long-standing history as an industry leader, Raybestos® The Best in Brakes® provides a full line of automotive aftermarket braking components covering brake pads, rotors, calipers, hydraulics and hardware.

**Trusted by Professionals  
Since 1902**

[www.raybestos.com](http://www.raybestos.com)

**TECHNICAL**



**2022 BEST YOUNG  
TECH AWARD WINNER**

# AUSTIN MATNEY

**HIS QUALITY OF WORK AND CAN-DO ATTITUDE  
SET THIS YOUNG TECH APART FROM THE REST.**

**BY AMANDA SILLIKER // Contributing Editor**

# THE MOST HANDS-ON TRAINING AVAILABLE **ONLINE**



Meet the new standard for training with Virtual Classroom from CTI+WTI. Access a live, interactive experience just like your team is in front of the instructors, at a time and pace that fits your schedule.



Start today at [my.advancepro.com/shoptraining](https://my.advancepro.com/shoptraining).

Congratulations to Austin Matney  
Equipment Mechanic II  
Ventura, California



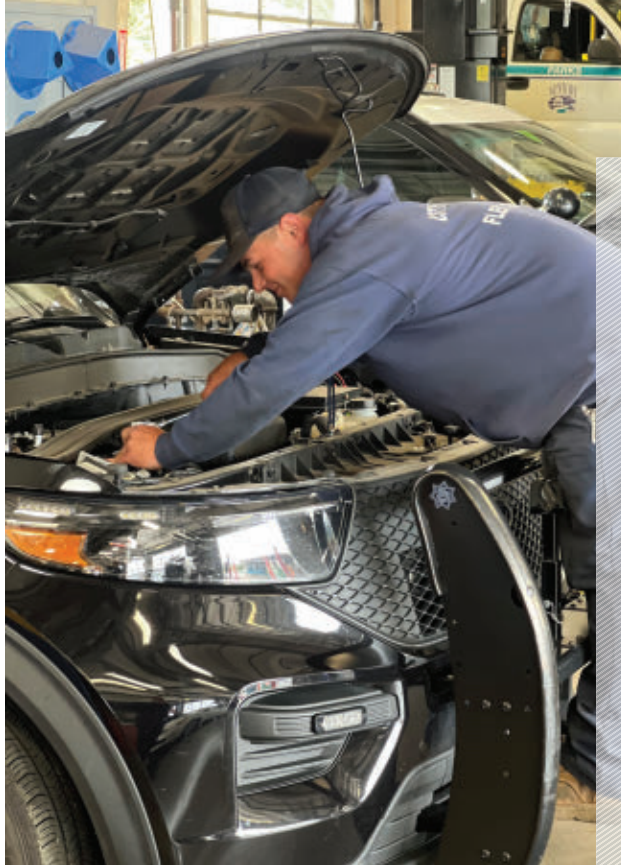
**A**ustin Matney has been turning wrenches for as long as he can remember. When he was a little kid, he was always trying to “fix” his bike or skateboard and later helped his dad work on ATVs and UTVs. At age 15, he started working part-time for his now father-in-law at his mobile semi-truck repair business.

“I would do just odds and ends stuff for him after school, trying to learn, and I couldn’t get enough of it,” he says.

Then at 17, he got a full-time job working for his now father-in-law’s brother who had an auto repair shop near his hometown in Camarillo, Calif. He worked there during the day and still worked after hours on heavier duty repairs with his father-in-law. After doing this for five years, Matney applied at the City of Ventura in California, where he works now as an equipment mechanic II. (He was promoted two years ahead of schedule). It was his supervisor, Frank Palmer, fleet services supervisor, who nominated Matney for the Motor Age and PTEN Best Young Tech Award because he has been incredibly impressed by this young man since the day he interviewed for the job.

“He blew me away,” Palmer says. “As a 22-year-old, his maturity, knowledge, and awesome attitude are very impressive.”

Matney, now 23, started out doing simple preventive maintenance on basic fleet equipment but quickly displayed his skills. The fleet of 454 pieces and six technicians went from 12 percent preventive maintenance compliance to 98 percent in Matney’s first six months on the job, and they completed 1,007 backlogged repairs. His throughput increased 54 percent since he started at the city about a year and a half ago.



### **AUSTIN MATNEY’S TOP 5 FAVORITE TOOLS:**

- 1” impact wrench by Ingersoll Rand
- 1/2” ratchet by Snap-on
- 1/2” electric impact wrench and 3/8” electric ratchet by Milwaukee Tool
- Sockets and wrenches by Snap-on and GEARWRENCH
- Snap ring pliers by Snap-on

“We all knew what we had to do,” Matney explains. “There was a big list of what was behind, so we all got on the same page and upped our workload to a different level than what we were at before,” Matney explains. “Sometimes we would skip breaks to make sure the jobs get done and just putting our heads down and getting through it; working at a lot faster pace than normal, but not without reducing the quality of work.”

### **Stepping up to the challenge**

Over the last six months, Matney has been running the heavy side of Palmer’s shop, and then he was moved over to Fire Apparatus Preventative Maintenance and Repair. This spot is normally reserved for Palmer’s top technician, but Matney stepped up to the challenge “never grumbling or complaining, just showing results.”

For example, Matney has “singlehandedly led the charge” on keeping the city’s one and only ladder truck up and running, Palmer says. This includes several “NASCAR-style” preventive maintenance and repairs in order to get this



# WHAT'S INSIDE OUR OE REPLACEMENT PLUG



**CORROSION-RESISTANT  
NICKEL-PLATED SHELL**



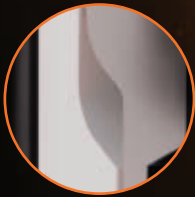
**PROPRIETARY,  
PLATINUM SIDEWIRE  
TECHNOLOGY  
FOR INCREASED  
DURABILITY**



**COPPER CORE FOR  
RELIABLE STARTS**



**LASER-WELDED  
FINEWIRE CENTER  
ELECTRODE**



**HIGH-ALUMINA  
CERAMIC INSULATOR FOR  
INCREASED STRENGTH**



Iridium Ultra® is engineered to meet or exceed OE standards in late model engines. With a laser-welded finewire center electrode, the most advanced plug from Autolite® delivers optimal fuel efficiency, acceleration and focused ignitability.

**Autolite**  
IGNITING YOUR PASSION™



Come see us at AAPEX Booth  
A3638 and SEMA Booth 24565

Find your OE replacement spark plug at [autolite.com](http://autolite.com)

©2022 Fram Group IP LLC

important piece of equipment back on the road as quickly as possible.

When the truck needed a transmission replacement, Matney gave Palmer the confidence as a fleet supervisor to let his team do it rather than sending it out to an outside vendor. The team completed the job in eight days versus the nine weeks they were quoted from a vendor.

“I decided to trust my mechanical knowledge, and the guys around me,” Matney says. “I knew as long as we worked together and pushed through it, we could get it done.”

Also, Matney did a full engine swap on an older truck by himself with minimal guidance while also reprogramming the unit utilizing the new Ford diagnostic software. He thoroughly enjoys tackling challenges in this line of work and loves problem-solving.

Matney always wanted to work on fire trucks and really enjoys learning and understanding how they work, in addition to providing a valuable service to his community.

“Helping to make sure our public service workers and emergency vehicles are good on the road and able for their operators to do their jobs — that’s what I am the most proud of about working here,” Matney says.

### Work quality

According to Palmer, Matney’s quality of work is that of a seasoned technician. He is a smart, methodical technician that takes his time to ensure his maintenance and repairs are completed properly. Matney has had zero units come back for rework in the past 180 days.

“He continually strives to be the best at his craft,” Palmer says. “I have been in the fleet business for almost three full decades, and he has exceeded all of my expectations in his ability to complete repairs right the first time.”

Matney says he is “almost OCD” about double and triple



checking his work to prevent comebacks.

“It’s replaying the process through in my head,” he explains. “Making sure I have every line hooked up, every bolt tightened, no matter if it takes the extra 20 or 30 minutes or so, just making sure that when it leaves our shop it’s in the best shape it can be.”

### Attitude

Matney’s “can-do attitude” really sets him apart on the team. Palmer says he is often chosen over more senior technicians to complete complex repairs because of his impressive diagnostic skills, technical prowess, and positive attitude.

“Since I was born, my dad has always instilled a good work ethic in me,” Matney says. “Whether it was sports, or school, or any other aspect in life, just giving it 100 percent all the time, and even if things get tough, or you face some adversity, just keep pushing through.”

His father-in-law had a big influence here as well by always encouraging him to take a step back and look at the job with a clear head.

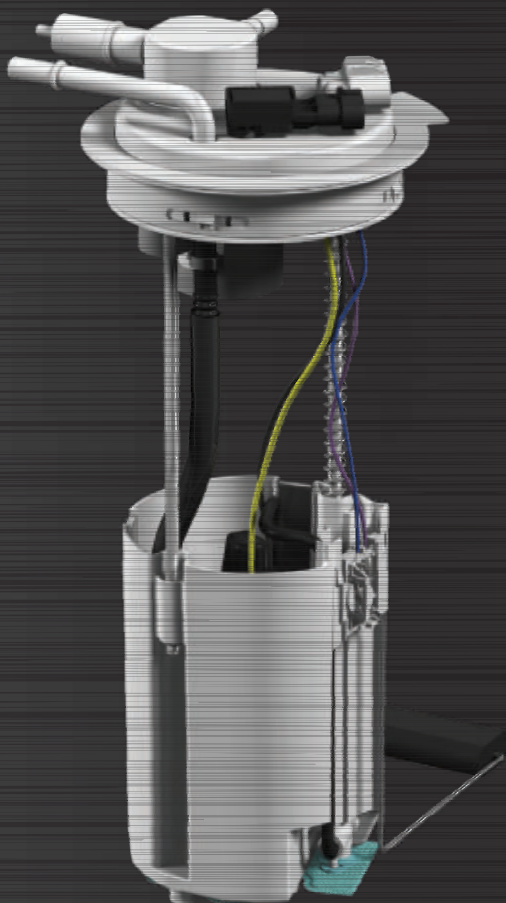
### RUNNERS-UP

Be on the lookout, starting December 2022, for the first online exclusive interview featuring one of the talented top nine runners-up for this year’s Best Young Tech Award. Throughout the year, PTEN and Motor Age editors will be chatting with the top nine to get the inside scoop on how these techs have come to thrive in the industry. The top nine include the following:

- |                        |                     |
|------------------------|---------------------|
| 1. Josh Whiteman       | 6. Jessica Areizaga |
| 2. Brandon Laguire     | 7. Hazem Tugan      |
| 3. Cody Rennison       | 8. Devon Jones      |
| 4. Brandon Ludwikowski | 9. Ryan Jackels     |
| 5. Jonathan Wasilewski |                     |



# THE PUMPS YOU CAN DEPEND ON



You select the best quality products you know will perform. With the same Engineered Quality™ of Carter Fuel Pumps, Carter brings you a full line of always new water pumps. Carter engineered pumps provide you peace of mind with quality, performance and warranty.



[www.CarterEngineered.com](http://www.CarterEngineered.com)

Come see us at AAPEX Booth A3638

## TECHNICAL

“It’s important to think things through instead of getting worked up and possibly messing up the job you’re working on,” Matney says. “Being a mechanic, you can face jobs that just get into your head mentally.”

### Well-rounded

Matney can be assigned anything in the fleet and has already completed repairs on various types of equipment, from lawnmowers, light, medium, and heavy vehicles to first responder emergency vehicles.

He works hard on his administrative duties and has mastered the work order system that was brand new to him before starting at the city. Now, he writes the best work orders in the entire fleet, Palmer says.

Matney is the type of team member that when he sees an improvement that needs to happen, he takes the initiative. Most recently, he identified shortcomings in a field maintenance vehicle, so he took it upon himself to conduct a full tool inventory, re-organization, and upfit with the right parts and tools that were already located in the shop.

“This will save countless hours of travel for the team during after hour emergency callouts,” Palmer explains.

Once Matney learns a new procedure, technique, or repair, he is quick to share with his team members. This includes the new tire alignment machine and commercial tire balancing machine. Recently, he identified over a dozen commercial tires that were out of DOT standards and dismantled the wheel/rim assemblies in the matter of an afternoon, ensuring they were ready for disposal and to not be used again.

Ultimately, Palmer says Matney is the cornerstone of the new legacy of the fleet at the city — since 66 percent of technicians recently retired — and he is a breath of fresh air.

“He is the poster child from going from the past days of being a mechanic to being a modern-day technician.” *ZZ*



### GRAND PRIZE

As the winner of the Best Young Tech Award, Austin Matney received the following prize pack:

- Roundtrip flight and lodging for two nights for the AAPEX/SEMA shows in November in Las Vegas
- A trip for two to Vision 2023 and a one-year subscription to the Virtual Training Academy from Carquest Technical Institute and WorldPac Training Institute
- The Autel MaxiSYS MS906TS scan tool

## Marquee Sponsors



## Supporting Sponsors





# THE COMPLETE PROTECTION PACKAGE

FRAM® OIL, ENGINE AIR & CABIN AIR FILTERS



Today's drivers depend on total vehicle solutions. No shop is ever fully equipped without FRAM® oil, engine air and cabin air filters to give your customers superior protection for the road ahead.

See the full line of trusted filtration products at [FRAM.com](http://FRAM.com).

# FRAM®

FRAM.COM

Trusted since 1934

# WHEN FAILURE IS NOT AN OPTION



## *Duralast*<sup>®</sup> PROVING GROUNDS

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

EXPLORE WHY AT [DURALASTPARTS.COM/PROVINGGROUNDS](https://www.duralastparts.com/provinggrounds)



Follow MotorTrend on Facebook and Instagram  
for **Stories from SEMA** presented by DURALAST



# MORE TECHNICIANS CHOOSE DURALAST PARTS\*



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

# GET SMART ON BATTERY



WE TAKE A DEEPER LOOK AT HOW AUTOMOTIVE REPAIR SHOPS CAN BE PREPARED WITH SMART TOOLS AHEAD OF THE EV INFLUX.

BY PAVEL REZA // Contributing Editor



# HEALTH

**I**n traditional internal combustion engine (ICE) vehicles, the engine is the heart of the car. In hybrid, EV, BEV and PHEV, the battery is the heart of the car. The primary focal point of a vehicle has shifted with the introduction of EVs to the market – and how we define the health of a car battery has changed, too.

We define the health of a car battery by viewing its overall power and performance. As the electrical pulse of the vehicle, it's important to be in tune with battery health and stay updated with the evolving industry standards for maintenance. The industry is currently experiencing the rapid digitization of auto repair shops, using specialized software and tools to accurately diagnose all issues in a vehicle. With the industry moving in this direction, there's a growing need for smart tools in the shop to optimize data access, communication, and time- and cost-effectiveness as vehicles become increasingly connected.

From smart multimeters to smart chargers, shop owners need to familiarize themselves with these “smart” tools to keep up with the battery maintenance needs of “smarter” vehicles – especially with the rapid growth of the electric vehicle (EV) market. According to the financial data firm Experian, EV registrations shot up by 60 percent in the first quarter of 2022, accounting for a record 4.6 percent of all new vehicle registrations in the U.S. With this impending influx of EVs hitting the market, technicians, now more

than ever, need to be familiar with smart tools. The importance of battery diagnostics will also continue to grow, as the battery is the core component of an EV and accounts for 30 to 40 percent of the EV cost. Although not all technicians may perform maintenance on EV batteries just yet, there are steps they can take to prepare for the future of vehicle servicing.

## Diagnosing battery health

Technicians will be most familiar with checking the battery health of an ICE vehicle. This checkup includes reviewing the cold cranking amps and reserve capacity using a digital multimeter when connected to the battery terminals. ICE vehicles are now built with battery health updates on the dash to keep the driver informed when the car needs maintenance.

When it comes to EVs, we refer to checking the battery's state of health (SOH). An EV battery's SOH is measured in kilowatt-hours, which is the same unit used to measure the energy found in a home or apartment. The powerful lithium-ion battery in an EV holds several cell pockets housed in the vehicle's undercarriage. As a result, maintenance of an EV battery tends to be more complex with several moving parts mixed in – with the added danger of higher voltage. Luckily, EVs paved the way for dashboard testing, which will inform the driver of battery malfunctions in real-time.

Diagnosing a car battery malfunction in a timely manner will help avoid major issues for the car overall. For a typical vehicle, it is recommended to inspect the battery at

least twice per year or every 6,000 miles. This is where EV battery maintenance will vary. Most EV batteries will last somewhere between 10 to 20 years before they need to be replaced. Lithium-ion batteries are built to be longer-lasting and often come with the option for lengthy warranties. Despite their durability, EV batteries should still be checked at least once every year with traditional routine maintenance.

### What can impact a car's battery health?

Before diagnosing battery health, it's important to understand how these varying batteries are designed and what external and internal impacts may affect their lifespan. Using battery testers, we can analyze the battery's voltage, amperage, and status to determine the battery's ability to perform basic tasks such as starting in cold temperatures or maintaining a full charge.

Usually technicians will encounter conventional lead-acid batteries and, on occasion, the more advanced AGM battery. Factors like extreme temperatures, dirt and corrosion, staying up to date on maintenance, loose hardware, and the use of exterior and interior lights will impact the car battery's ability to perform over time.

Now, with more EVs hitting the market, technicians will continue to encounter lithium-ion batteries in their shops. Much like traditional batteries, the external and internal impacts on a lithium-ion battery are the same. Extreme temperatures will impact an EV's battery lifespan. For this reason, EVs have a built-in thermal battery management system which protects the battery from overheating. Excessive speeding can also greatly impact the battery health of an EV and the battery's allotted cooling time after driving – we recommend about a half-hour after completing a trip. Most importantly, the ideal "state of charge" for EVs is from 20 to 80 percent and only 100 percent for long-distance driving. Keeping the charge

**THIS MULTIMETER IS CAT III** 1,000V and hybrid-compatible to safely diagnose high-voltage circuits found in hybrid vehicles. PC software and a cable are included so users can use their computer as a data logger and display detailed diagnoses.

to 100 percent or close to zero percent will degrade the battery faster and cause it to lose capacity.

### Smart tools for smart diagnostics

Like the smart home system you may find in a modern home, smart shop tools are making it easier for technicians to communicate with their peers and keep track of workflow. Smart tools on the market range from a variety of products such as smart multimeters, smart chargers, to overall smart instruments which perform all functions of battery maintenance. Although designed to be intuitive, technicians need proper training to become familiar with smart tools as EVs rely on these tools.

Smart chargers can provide many automated options that are much more sophisticated than traditional tools. They can offer multiple charging modes from normal to fast and are programmed to deliver different outputs for different conditions of the battery.

Similarly, a smart multimeter is an advanced tool that can support testing of a vehicle's battery and accurately produce data on the battery power, current, and voltage. These tools usually come equipped with applications as well, allowing multiple technicians in one shop to get updated on the status of a battery via their smartphone to synchronize tasks better.

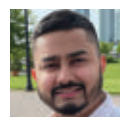
In the future, we can imagine it being standard practice for shops to house smart EV charging stations that can allow for the efficient charging of EVs staying in the shop for extended periods of time. Shops will soon become familiar with the latest software



updates for various EVs to maintain the car and its battery properly.

### It starts with training

For technician training beyond smart tool usage, understanding system operations and safety precautions for EVs will be more critical than ever before. EVs can produce five or more different circuit voltages, ranging from 12V to 650V, and feature dozens of interconnected modules. The complexity of the EV system has brought to light the need for proper technician training and safety precautions, as well as emphasizing the need for advanced tools. The best thing shop owners can do now to prepare their teams for the future of vehicle servicing is to invest in training to empower technicians as the industry makes the shift. **TM**



**PAVEL REZA** is a Bosch U.S.A. product manager (filters and batteries). Reza completed his undergrad in Automotive Management at

SUNY Morrisville, N.Y., and later received his MBA in marketing from Mercy College. He has 13 years of automotive experience and enjoys being part of the automotive industry because of his ability to help others through trustworthy advice, providing resources, and getting people to their destinations safe and sound. You can reach him at [pavel.reza@us.bosch.com](mailto:pavel.reza@us.bosch.com).

# THE CLEAREST CHOICE IN WIPER BLADES™

Offering comprehensive coverage for passenger cars and commercial vehicles, ANCO® wiper blades are engineered with the latest technology to ensure maximum driving visibility.

Learn more about the entire ANCO line at  
[www.ancowipers.com](http://www.ancowipers.com)



# How do *you* plan to service EV battery packs?

The BendPak EV2400SL is a push-around full-rise scissor lift table that is perfectly suited for EV battery pack replacement. With its compact design, this space-saving scissor lift can be easily transported anywhere in the workplace, making it ideal for multi-bay facilities or workplaces with confined areas. To learn more visit [www.bendpak.com/EVLIFT](http://www.bendpak.com/EVLIFT).

**NEW**



40" 60"

Full-Length  
Utility Trays

Twin Hydraulic  
Cylinders

12-Volt Deep  
Cycle Battery

Oversized  
Urethane Casters



Hand Pendant Control



Optional Adapters



Battery-Powered Mobility

BENDPAK MODEL  
EV2400SL  
Ev Battery Pack and  
Powertrain Lifting System

# WORK MEETS COMFORT



## ROLLING CREEPER SEAT CONVERTS FROM HIGH TO LOW

UP TO **6** LOCKING HEIGHTS

The **ergochair™** is the adjustable height rolling work seat which will make performing awkward work tasks ergonomically easier and safer. This comfortable creeper seat offers a full range of mobility, increased productivity, and reduced fatigue. To Learn more visit [bendpak.com/ergochair](http://bendpak.com/ergochair)



TRANSFORMS COMFORTABLY FROM CREEPER TO UPRIGHT SEAT



1-800-253-2363 • [BENDPAK.COM](http://BENDPAK.COM)

©2022 BendPak Inc. All rights reserved.

 **ergochair™**

# MISFIRE DETECTION STRATEGIES

MISFIRE DIAGNOSTICS CAN LEAD TO A REALLY EXPENSIVE WILD GOOSE CHASE, ESPECIALLY IF THE VEHICLE ISN'T ACTUALLY MISFIRING.

BY BRANDON STECKLER // Technical Editor

**W**e have all likely been there before. Faced with a vehicle exhibiting what the Engine Controller believes is a misfire. Some of us were lucky to realize that the ECU had misunderstood before the parts cannon was fired too many times.

Troubleshooting the root cause of misfires should be an easy task, considering most gasoline internal combustion engines require only three factors to carry out a successful combustion event:

- *Adequate ignition discharge (and at the proper time)*
- *Proper Air/Fuel ratio*
- *Cylinder mechanical integrity (compression and breathability)*

So, why is it so many techs struggle to solve the problem? Or worse, why are so many parts replaced unnecessarily? The answer likely lies with a lack of understanding of how the misfire is detected in the vehicle they are addressing.

## The flavors of misfires

Contrary to popular belief, a misfire is not necessarily a cylinder lacking a combustion event. True, a lacking combustion event does indeed cause a misfire. But it is the slowing of the crankshaft that is the definition of a misfire. Anytime a cylinder fires and combustion take place, the nitrogen inside the air charge is heated by the combustion event. The heat causes the nitrogen gas to expand, and the pressure exhibited on top of the piston helps to propel it down and causes the crankshaft rotational velocity to increase.

If there is a lack of adequate fuel supply, a combustion event will either cease to occur or it will not be as intense of an event as intended. Both possible scenarios will cause a slowing of the crankshaft and likely be flagged as a misfire.

In a scenario when no (or inadequate) ignition supply is available within the combustion chamber, the A/F (Air/Fuel) mixture will fail to ignite properly or at all. Again, this situation will indeed cause a slowing of the crankshaft and



misfires will likely be flagged by the ECU.

Thirdly, when a cylinder lacks integrity, it could be from one of two different causes. First, if the cylinder cannot breathe, it cannot fill adequately with the proper A/F charge. This could lead to low compression (nothing to squeeze) or even an A/F density issue (cylinder didn't scavenge properly and inert exhaust gases are taking up real estate in the combustion chamber, displacing the A/F mixture, like the EGR effect).

The second symptom of a lack of cylinder integrity would be a cylinder's inability to seal properly (a leak caused by a poorly sealing valve, compromised head gasket sealing surface, scored cylinder wall, or damaged piston rings). This type of fault can lead to a flame-out condition (**Figure 1**).

The reason this occurs is that a cylinder with integrity can properly harness and squeeze its contents. This means none of the A/F charge is displaced, just compressed. However, when a leak is present, as the piston approaches the



**THE IGNITION EVENT** is being captured on a DSO simultaneously as shop air is blown across a firing spark plug. This simulates what occurs in the cylinder during a compression leak.

top-dead-center (TDC) of the compression stroke, a portion of that A/F charge is displaced and forced out the leak point. The A/F charge moves within the combustion chamber and this movement disrupts the combustion event (like blowing out a candle on a birthday cake).

1  
BRANDON STECKLER

A similar event occurs with the frequent cold-idle misfires we tend to experience with GDI engines. The carbon at the intake valve ports disrupts the airflow and the air charge “tumbles” into the cylinder differently than intended and originally designed (**Figure 2**). This disruption displaces the air and fuel molecules within the combustion chamber, creating turbulence in the combustion event. The overall contribution to the crankshaft rotation is lacking significantly enough to cause misfires/driveability symptoms.

**Why the struggle?**

As mentioned above, a misfire diagnosis shouldn't be so difficult, but that doesn't mean it isn't. It's natural to see a MIL, scan for DTCs or monitor active misfire data, and assume a misfire was detected when the Engine Controller has indicated so. From what I've witnessed over the past several years it's my opinion that a lack of knowledge in the department of system strategy is the main culprit.

The assumption by many is that misfire detection is accomplished simply by monitoring the changes in crankshaft rotational velocity (more on this shortly). The fact of the matter is that there are a handful of strategies used to detect misfires. Below are a few examples:

- CKP sensor signal frequency variations
- Spark ionization
- AF sensor signal variation
- Spark kilovolt (kV) amplitude

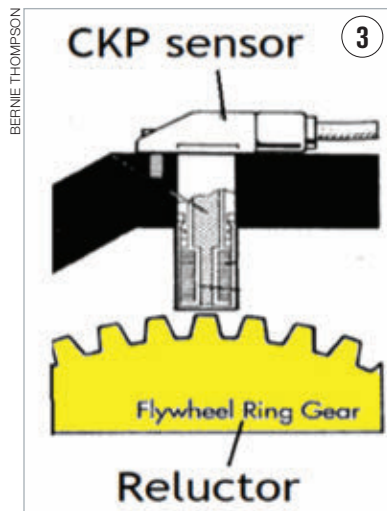
Any one of these strategies could be at play when it comes to misfire detection. In fact, some vehicles will implement more than one strategy, depending on vehicle operating conditions (idle vs. highway/cruise speed).

**CKP sensor signal frequency**

This strategy is most used. As the crankshaft rotates, its tone wheel (containing strategically spaced notches) rotates past



**VALVE CARBON DEPOSITS** in GDI engines can cause the air to tumble into the combustion chamber and disrupt the combustion process, which generates misfires.



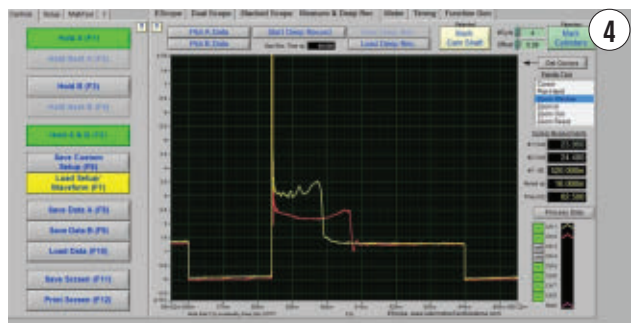
**A CKP SENSOR AND TONE WHEEL**, used to detect engine rpm but also for misfire detection, as changes in frequency represent changes in crankshaft rotational velocity.

the CKP sensor (**Figure 3**). This causes the sensor to output a change in signal voltage, either represented by a sine wave or square wave (depending on sensor design). These changes in signal amplitude are what the engine controller is monitoring. It is keeping count of how often a pulse occurs (pulses per second,) also known as frequency. As the crankshaft slows, so, too, does the frequency. The pulses become more spaced apart. This is what the engine controller is monitoring to determine a misfire has occurred.

**Spark ionization**

Spark Ionization misfire detection strategy goes back several years. It's based upon the principles and physics of ignition system operation. With a basic understanding, one will realize that any condition that occurs within the combustion chamber will affect the environment in which the spark is discharged. The spark event is very sensitive and reactive to the environment in which it is fired.

Within the very high-energy plasma (which is what we know as a spark event), a highly conductive path between the two spark plug electrodes is established. This allows the spark to travel across the gap with little resistance. The cause



**THE RED TRACE REPRESENTS** a normal event, and the yellow trace represents a misfire occurring. Changes in the environment in which the spark is firing will alter the resistance in that environment and affect the amount of energy being consumed. This is represented here in yellow by the shorter horizontal burn line.

BERNIE THOMPSON

BRANDON STECKLER



of this highly conductive plasma channel is due not only to the tremendous amount of energy created by the ignition coil (step-up transformer) but also to the cylinder contents (the A/F mixture).

A spark is a finite event. This means there is only a set amount of energy an ignition coil can store and discharge. Energy is required to discharge a spark and overcome all combined sources of electrical resistance within the path of the spark. Changing factors like spark plug gap, cylinder compression, A/F ratio, and cylinder contents (like oil or antifreeze) or even changes in resistance from spark plug wires or weak ignition coil, the conditions in which the spark was fired will change. This will directly affect the intensity and duration of the spark event. Here is an example of a normal spark event compared to one occurring in a misfiring cylinder, due to a compression leak (**Figure 4**).

**AF sensor signal variation**

Technology is brilliant and the speed at which the data streams communicate sets us up for success, compared to the days of old. With the speed involved in this technology, the response of the heated exhaust gas oxygen sensors (or A/F sensors), and the ECU’s ability to process and display it is tremendous.

This speed and accuracy of the sensors now give the engine controller the ability to detect variations and A/F imbalance from cylinder to cylinder. As a result, this technology allows us to determine which cylinder may be “misfiring” (via engine data) even before a misfire is flagged (**Figure 5**).

This can serve as a very valuable clue, especially when troubleshooting misfires. The fact that a misfire occurs can and does influence the A/F ratio and how the A/F sensor sees it. As a result, changes in fuel trim can be visible. This is particularly handy when dealing with a v-type engine or one with twin bank fuel control (bank 1/bank 2), which allows for bank-to-bank comparative measure.

**5**

Parameter	Value	Unit
Engine Speed Cylinder #6	5119	rpm
Average Engine Speed of All Cylinders	5136	rpm
A/F Sensor Determination (Worst Value) Bank 1	0.01	
A/F Sensor Determination (Worst Value) Bank 2	0.09	
Engine Speed Fluctuation Average (Worst Value) Cylinder #1	0.25	
Engine Speed Fluctuation Average (Worst Value) Cylinder #2	0.23	
Engine Speed Fluctuation Average (Worst Value) Cylinder #3	0.32	
Engine Speed Fluctuation Average (Worst Value) Cylinder #4	0.21	
Engine Speed Fluctuation Average (Worst Value) Cylinder #5	0.21	
Engine Speed Fluctuation Average (Worst Value) Cylinder #6	0.17	
A/F Sensor Determination (Worst Value) (Port) Bank 1	0.09	
A/F Sensor Determination (Worst Value) (Port) Bank 2	0.08	
Engine Speed Fluctuation Average (Worst Value) (Port) Cylinder #1	0.13	
Engine Speed Fluctuation Average (Worst Value) (Port) Cylinder #2	0.13	
Engine Speed Fluctuation Average (Worst Value) (Port) Cylinder #3	0.16	
Engine Speed Fluctuation Average (Worst Value) (Port) Cylinder #4	0.13	
Engine Speed Fluctuation Average (Worst Value) (Port) Cylinder #5	0.13	
Engine Speed Fluctuation Average (Worst Value) (Port) Cylinder #6	0.13	

**TODAYS DATA STREAMS SUPPORT** many helpful PIDs if you know what to look for. These PIDs represent variations in A/F imbalance from cylinder to cylinder. A great precursor to detectable misfires.

STEVE ANDERSON - LEXUS DIAGNOSTIC SPECIALIST

**AUTEL**

# REMOTE EXPERT

REMOTE SERVICES. EASY COMMUNICATION. INTELLIGENT OPERATION.

SHOP TECHS REMOTELY CONNECT WITH AN EXPERT

## MODULE PROGRAMMING

**SAVE TIME & MONEY**  
**ONLINE & ALWAYS READY**

WATCH VIDEO NOW

**STEP 1**

Connect to the Vehicle OBDII Port with OBDII Cable

**STEP 2**

MaxiFLASH VCI or VCI is Connected Via USB to a Tablet

**STEP 3**

Diagnostic Tool: Can Be MS909, MS919 or Ultra

**STEP 4**

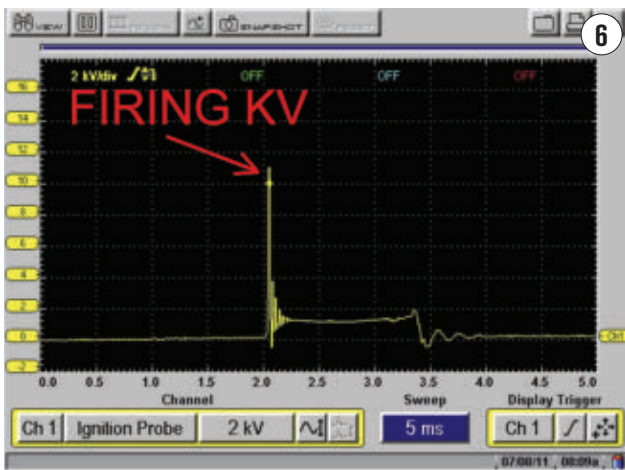
Hard-wired Internet Connection Via Cat 5 Cable (Ethernet)

**STEP 5**

Experts Use OEM Hardware & Software Connected to a Programming Converter Box

CLOUD.AUTEL.COM/EXPERT

**SUPPORT: 1.855.288.3587**  
**EMAIL: USSUPPORT@AUTEL.COM | WEB: AUTEL.COM**  
**VIEW MARKETING MATERIAL: ISSUU.COM/AUTEL2**  
**FOLLOW US @AUTELTOOLS**



BRANDON STECKLER

**THE FIRING KV** represents the energy demand from the ignition system to initiate the spark. The overall secondary resistances in the system determine firing kv and is monitored/used in some misfire diagnostic strategies.

### Spark kilovolt (kv) amplitude

Very similar to the characteristics described above in the “Spark Ionization” strategy is the spark kv amplitude detection strategy. This strategy works from the same principles, however, the detection strategy is nonetheless sophisticated but simple and brilliant.

When a spark event initiates, it’s the firing kv that is visible as the tall vertical event (**Figure 6**). When the coil fails to discharge, or the firing kv is significantly diminished, the detection circuit will see it, just as an ignition scope would display it. It’s the software in the Engine Controller that is designed to recognize a sufficient spark firing kv from a deficiency.

### Detection strategy in action

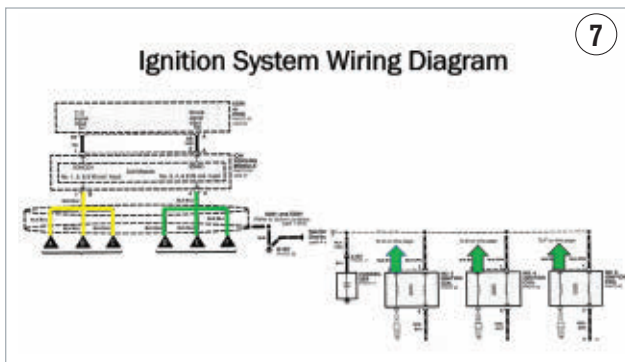
Below is an example of preliminary research performed, implementing the proper tools for system evaluation and capture of a fault, along with the root cause of the perceived misfire.

A 2000 Isuzu Rodeo, with 180k miles on the odometer, presented with a MIL illuminated. The DTCs were scanned and a single P0303 “Cylinder #3 misfire detected” was stored. After interrogating the customer, there were no other driveability complaints noted. If not for the MIL, the customer wouldn’t have even realized a fault existed.

Speaking further with the customer revealed there had recently been a driveability concern. The vehicle was taken to a local and reputable shop for correction, although the customer couldn’t recall what repairs were performed.

### Preliminary investigation

The PCM believes that the #3 cylinder is misfiring. Knowing the oxygen content of the exhaust gas will rise during a misfire,



**THIS WIRING DIAGRAM** of the ignition system and CQ signals demonstrates how the system functions and is used to build a diagnostic game plan.

I attempted to snoop this out in scan data via fuel trim. Elevated fuel trim will be the result of detected oxygen from a misfire (The oxygen that isn’t consumed because combustion didn’t occur). However, the status of the feedback system was in an Open-Loop Default, making fuel trim an unreliable tool for misfire detection.

The question becomes, “Why does the PCM believe cylinder #3 is misfiring?” Other valid questions may be, “How does this vehicle’s PCM detect a misfire?” and, “What components make up the misfire detection strategy?” However, one of the most important questions to ask after deriving answers from the previous ones is, “How can we test the detection strategy for accuracy?”

With a little bit of research, it was quite easy to locate information about this vehicle’s system description and operation of the misfire detection strategy and the necessary wiring diagrams associated with the system. This system functions quite differently (**Figure 7**). The PCM monitors what is known as Combustion Quality signals (CQ signals).

There is one CQ signal reporting to the PCM on two individual parallel circuits, one for each bank of the V6 engine’s coils. These signals are induced by the actual discharge of the spark from the COP ignition coils. The detection pick-up for the CQ signals is located inside each of the COP coil’s integrated circuits.

As a spark from each coil is discharged, a shared circuit (one from each bank of three coils), in turn, reports each of the coils’ CQ signals to the PCM. If the PCM determines one of the CQ signals is not quite like the other, it can only assume there is something wrong with the quality of the ignition event and flags that cylinder as “misfiring.” Once the suspect cylinder is identified — and under the appropriate load/rpm conditions — the PCM will begin to flash the MIL, and a cylinder-specific DTC is flagged in the PCM memory.

### The game plan

This job requires a multi-trace lab scope to capture the fault and confirm cylinder #3 is responsible. I chose to monitor



Expect More. Expect TYC.

## QUALITY, SELECTION, CONVENIENCE

From Headlights to HVAC to Electrical parts, TYC has you covered. With a commitment to quality products that are parallel to the Original in terms of Fit, Form and Function, TYC automotive products provide incredible value for you and your customers.



AUTOMOTIVE LIGHTS



MIRRORS



CONDENSERS



COOLING FAN ASSEMBLIES



CABIN AIR FILTERS



STARTERS



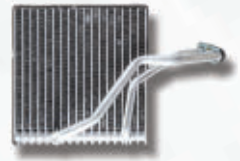
ALTERNATORS



RADIATORS



BLOWER ASSEMBLIES



EVAPORATORS



WINDOW REGULATORS



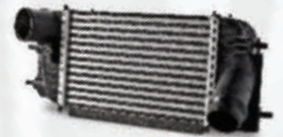
FUEL PUMPS



HEATER CORES



TRANSMISSION OIL COOLERS

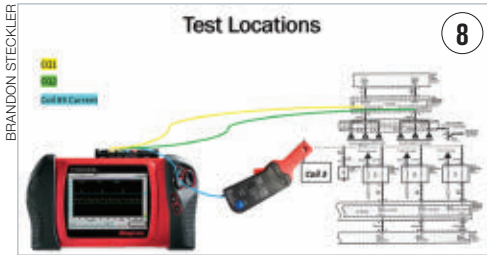


CHARGE AIR COOLERS

## FIND YOUR ONE-STOP SHOP

For more information about our replacement automotive parts and to order TYC parts, please contact Tri-State Enterprises. You can also look up TYC parts in our convenient e-catalog located at [www.TYCUSA.com](http://www.TYCUSA.com)

**AAPEX**  
**Booth #A4445**



**8** **THESE ARE THE TEST LOCATIONS** used to troubleshoot the cause of the DTC P0303.

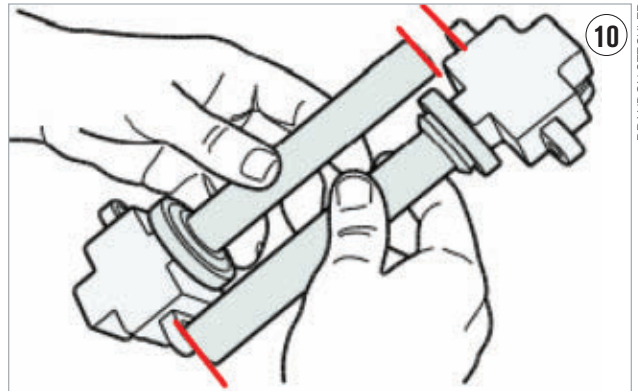
three pieces of data. These three will tell the entire story about what happened, “who’s” responsible, and how the other coils look in comparison. All I need to know ahead of time is the cylinder positioning, so I can properly identify coil #3.

- On channel #1 (in YELLOW) I will be capturing the CQ signals for Bank #1 cylinders.
- On channel #2 (in GREEN) I will be capturing the CQ signals for Bank #2 cylinders.
- On channel #3 (in BLUE) I will be capturing the coil current trace for cylinder #3 (suspect cylinder).

Viewing the multi-trace capture on the lab scope, the BLUE coil ramps represent when Coil #3 discharged (**Figures 8+9**). Between the two BLUE coil ramps are six distinct CQ signals, and all have been encircled. The RED circles represent the CQ events for coil #3 (suspect cylinder) and the BLUE circles represent those CQ signals from the other cylinders. The entire lower portion of the CQ signals is missing from our suspect cylinder #3.

This is the reason for the flashing MIL and P0303. Of course, the root cause is yet to be determined, however, we have the justification to invest more time in this arena and pursue the root cause with further testing.

Realizing the detection circuitry is housed within the ignition coil, the ignition system must be inspected carefully as there may simply be an issue with a coil, not necessarily a true ignition event fault. Using tools we have at our disposal, the goal is to monitor the actual ignition events,



**10** **THE COMPARISON OF THE COILS** shows two different lengths. The CQ detection circuit proximity has changed relative to the spark plug position. This caused a perceived reduction of event intensity, causing the PCM to detect a misfire that wasn't truly occurring.

as they are the input to the coils responsible for generating the CQ signals.

However, before getting my hands dirty, and upon further investigation, a TSB was located pertaining to the same fault we have been experiencing. It's been discovered that one of the 6 coils has been deliberately made to be 7mm shorter than the rest of them. This is to accommodate its positioning in the tight space beneath the brake master cylinder.

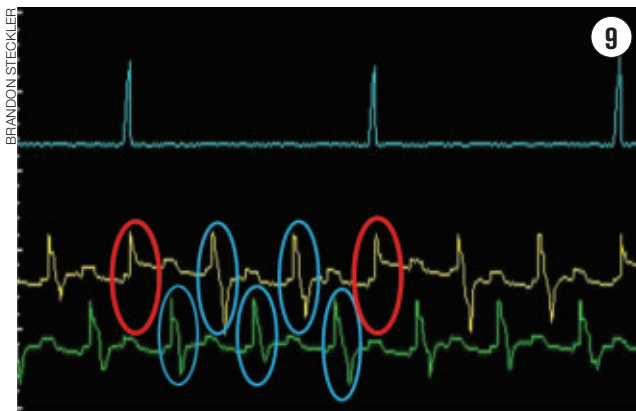
**Logical deduction**

Think about this carefully: If this coil is placed anywhere other than in the cylinder #6 position, the integrated detection circuit will be further (in proximity) from the spark plug. The resulting induced signature will be altered due to the unintentional air gap. What are the chances the shorter, coil #6 is hovering over cylinder #3's spark plug? Rather than invest more time in testing, a preliminary inspection of the coil placement seems much more efficient now. Let's find out!

As can be seen from the picture above, there is the length of the shorter #6 coil as compared to one of the other 5 longer coils (**Figure 10**). The problem is this shorter coil is not over #6 (as it should be) but it is over #3 (our suspect cylinder). This occurred unknowingly during the recent repair noted above.

So, the engine had no misfires whatsoever, but the Engine Controller certainly believed so. Misfire detection strategies of today are brilliant, but they have their flaws. For instance, something as simple as a worn axle CV Joint or even a damaged tire can skew a CKP signal enough to flag misfires.

This is nothing you haven't heard me mention before in previous articles. Understand the system strategy, reference wiring diagrams, employ the appropriate testing tools, and have a sound knowledge of what they can and cannot do. If you've got those bases covered, the rest is simply putting it all into practice. 🛠️



**9** **THE EVENTS WITHIN THE RED CIRCLES** show a missing portion of the CQ signal. This is the reason the PCM believes a misfire is occurring.

# RAISING THE

# AP SERIES™

# STANDARDS OF EXCELLENCE

*NEW 360-Degree Automatic Swing Arm Restraint System  
Provides the Ultimate In Safety and Vehicle Fall Protection*



BendPak Model  
**10AP**  
Two-Post Lift



Certified to meet the  
standards of ANSI/ALI  
ALCTV: 2017



**Bi-Metric Swing Arms**

Our 10AP Series offers the convenience of wide or narrow installation wrapped up into one configurable package. This durable, safe, and reliable car lift features an expandable top beam and BI-METRIC™ arms to suit virtually every vehicle lifting requirement – symmetric or asymmetric. The 2-in-1 design gives operators the option of loading vehicles either symmetrically (centerline of vehicle at column) or asymmetrically (centerline of vehicle behind column). The simple, yet highly sophisticated is sure to keep operating costs low and productivity high. Check out the full line of 10AP lift series at [bendpak.com](http://bendpak.com) or call us at **1-800-253-2363**.

1-800-253-2363 • [BENDPAK.COM](http://BENDPAK.COM)

©2022 BendPak Inc. All rights reserved.

**BP BendPak®**

# DRIVEABILITY AND POWERTRAIN - RELATED ISSUES

DRIVEABILITY AND DIAGNOSTICS OF ANY KIND TEND TO BOTTLENECK MANY SHOPS. BUT HAVING A STRUCTURED GAME PLAN WILL KEEP THE WORKFLOW PRODUCTIVE.

BY "G" TRUGLIA // Contributing Editor

**B**elow are four case studies that were a challenge to us...but challenges help us grow stronger and become more knowledgeable. We had the right tools, supportive information, and technical support on hand. But it was the great attitudes of the technicians that made it all work out in the end.

## 2007 Ford Mustang MIL illuminated

Our first vehicle had 90,960 on the odometer. It came in with an illuminated MIL and two DTCs:

- P0171 (*System Too Lean, Bank 1*)
- P0174 (*System Too Lean, Bank 2*)

We interviewed the vehicle owner to make sure we knew what his concern was and followed that with a good visual inspection. The inspection uncovered an aftermarket intake air tube and air filter. These both can be suspect when dealing with a lean mixture.

After reviewing scan data PIDs on the *ATS eScanELITE*, we reviewed the freeze frame data. It showed:

- *Bank 1 LTFT 17 percent*

- *Bank 2 16 percent (recorded at idle)*
- *MAF=5.5 gps (grams per second)*

The MAF value seemed to be in the correct range for this 4.6L engine. However, knowing it's a Ford, I thought that we had better check the MAF sensor by obtaining volumetric efficiency readings (**Figure 1**). That was a good call, as you can see by the test data.

Moving on, we ran the STFT and LTFT test that confirmed that the MAF numbers were a low of +22 percent and a high of +54 percent on the fuel trim chart (**Figure 2**). That test confirmed we had a problem with the MAF system. You may be wondering how this test can be performed if the shop you're working in does not own an EScan. Not a problem; you must work a bit harder and use any scan tool (in generic scan mode) that will allow the user to confirm this issue. Start by checking DTCs followed by looking at freeze frame PIDs. Most of the time, viewing the high fuel trim reading on a generic scan tool (other than eScan) will not provide you with a defined failure of the MAF.

The eScan makes our job easier when working on drive-



PHOTO CREDIT: 240643605 © DMYTRO VARAVIN DREAMSTIME.COM

ability and/or check engine light problems. The test for fuel trim on eScan allows us to view the fuel trim numbers. The high values exhibited (from the bottom to the top of the chart) are always a good indication that the MAF can be the issue.

The next step on a generic scan tool would be to graph the Calculated Load

PID and to make sure that the test reading can obtain 90-percent load (at sea level but adjusted for elevation) as you press the pedal to the metal. Always make sure that the road in front of you is clear and safe (nothing worse than crashing into something. After all, we want you to stay in one piece). A one-car length is all you need to complete the test and view results along with another length to repeat the test. The eScan makes testing a breeze, but if you do not have one, you have to work with the tool you have. Remember, you can run the tests on any scan tool in generic mode by using the steps I outlined above.

The problem on the Mustang was not the usual MAF sensor issue, but rather something that was a related item. We tried cleaning the MAF sensor (as a first step) but did not see any improvement, so we RTFI (read the fricking information) and found that some aftermarket intake air tubes can cause an issue that mimics a MAF sensor problem. We called the dealer to order a new OE intake tube and were told that it was no longer in production or available.

The next step was a Google search, which came up short, so we called LKQ (a salvage yard), found a used OE intake duct, and installed it. The engine was now running the way it should, with the MAF values back to normal. The only procedure we had left to complete was

to reset the adaptive fuel trim before shipping the vehicle.

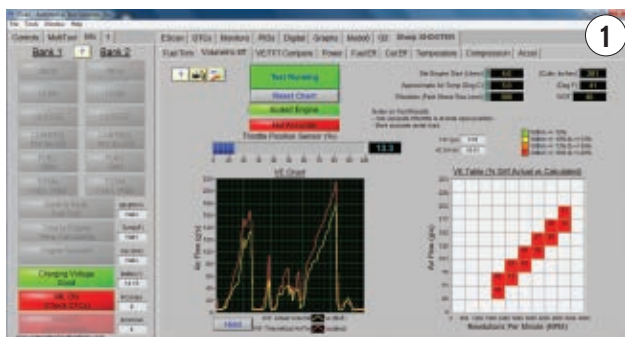
**2013 Audi A4, repeated MIL after dealer-service**

The next vehicle was one of our new customers. He arrived with his 74,111-mile vehicle. He told us that he had regularly serviced the vehicle (at the Audi dealer) from when it was new. The Audi owner told us he was no longer happy with the dealer service. Since his recent vehicle service, the check engine light was now illuminated.

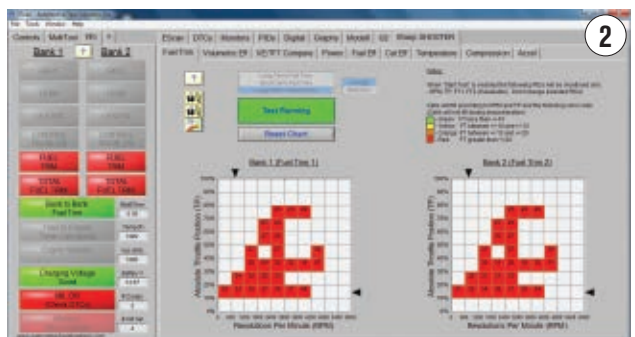
After more than a couple of trips back to the dealer (along with more money spent), the check engine light came back on. The dealer replaced the spark plugs and ignition coils (along with some other service items) before returning the vehicle to the owner. The MIL returned shortly after those repairs and the Audi owner returned to the dealer. He was advised to leave the vehicle once again.

The fed-up owner decided to search for a different repair facility to diagnose and service his vehicle. The dealer's mistake cost them a good customer that turned out to be a *win* for us. When we received the vehicle, we explained to the vehicle owner that we would have to perform a diagnosis before we would recommend any service or repair anything.

After a good visual inspection, we followed up with a search for TSBs. It yielded two important bulletins. One bulletin was on gasoline quality and carbon buildup



**MAF SIGNAL** is not matching the theoretical airflow, indicating that the signal is not reported correctly. This could be a signal fault or engine breathing issue, but more data will need to be collected to determine.



**THE FUEL TRIM** is very elevated, regardless of operating condition. This could be a clue that the MAF signal is incorrect for what the engine is actually breathing.

(which is very common) (**Figure 3**). I have written about carbon build-up issues on Audis and VWs in other *Motor Age* articles where we came across misfire problems on cold engines.

On our problem vehicle, we waited for the engine to cool down before we installed a video scope into the engine. We examined the condition of the valves and pistons. The valves and cylinders did not look carboned-up enough to cause the misfire problems that this engine produced.

We reviewed the information from the scan data on the following DTCs:

- P0301 - (Cylinder 1 Misfire)
- P0302 - (Cylinder 2 Misfire)
- P0303 - (Cylinder 3 Misfire)
- P0304 - (Cylinder 4 Misfire)
- P0171 - (System too Lean)

Knowing the DTCs assisted us in developing a plan to repair this Audi. We understood that a misfire can be caused by many things (such as spark, fuel, engine-mechanical, carbon build-up, a cracked flex plate, crank sensor, and a few other things). We just needed to narrow it down to the correct problem.

Franklin (the technician) ruled out the previously mentioned and looked at the second bulletin. It stated misfires P0300,



**THIS TSB INDICATES** a potential cause for driveability faults may be linked to gasoline quality and/or induction system carbon build-up.

P0301 to P0304 can be associated with ignition coil issues. Since the coils were already replaced with OEM coils (along with the spark plugs), we had to move on.

The next thing we found is something we always check for, crankcase pressure. ALLDATA had a community article that referenced a P0171 problem. It was associated with crankcase pressure issues (aka, the breather / PCV system). We used our manometer to check the crankcase pressure and found it was out of specification.

With the manometer connected, we viewed a crankcase pressure reading of 125 mbar (way over the specification of 97mbar). Franklin connected the smoke machine and noticed the flow meter ball was way up the top of the flow scale, indicating a large leak somewhere.

There was no smoke visible from the top view of the engine, so we lifted the vehicle and found the smoke coming out of the engine/transmission inspection cover (**Figure 4**). The excessive crankcase pressure was caused by a clogged breather / PCV system and resulted in a blown-out rear main seal. We explained to the Audi owner that we had to drop the transmission and then remove/install the rear main oil seal. The job would also entail changing the breather / PCV components to fix the root cause of the fault and make sure the engine was able to breathe properly.

We received the OK from the vehicle owner, along with getting approval for

replacement of the rear brakes, starter, shifter cable, flywheel bolts (that were a one-time use), and a driver's side mirror. We installed all the needed parts. We retested the breather/PCV system using the manometer to make sure the engine was operating as designed.

After clearing the DTCs and test-driving the vehicle, we confirmed all the monitors were "ready," along with no suspect Mode 6 data, pending DTCs. We now acquired a good customer since we repaired the root cause of his concern of the rough-running engine. We built the vehicle owner's confidence level through good communication, including showing him scan tool screenshots and pictures of the problem before making any repairs. We followed that up with the after-repair scan tool screenshots when the vehicle was completed. Using digital inspection can be a very important tool for your shop.

### 2011 Nissan Pathfinder, MIL illuminated

Our third problem vehicle had 177,225 miles and came in with a P0101 (Mass Air Flow Sensor Range/Performance), along with an illuminated MIL and performance issue. We connected our eScan to diagnose the vehicle and check the freeze frame data carefully.

The data stream for this 4.0L indicated the MAF sensor was only reporting 3.59 grams per second of airflow at idle. We fol-



**THE PRESENCE OF SMOKE** in the bell housing is indicative of a rear main crankshaft seal leak, as smoke is being introduced to the crankcase/PCV system.



# SOLVE YOUR TECHNICIAN SHORTAGE DO MORE WITH LESS

Work LIVE with IVS 360™  
Dealer Master Techs



## Demand for Automotive Technicians Far Exceeds Supply

Between replacement positions due to retirement, transfers and turnover, plus new job growth, the automotive repair industry must fill an estimated 79,000 technician jobs in 2022. However, technical schools and training programs will only graduate an estimated 31,400 this year (40% of demand). That's a serious skilled labor shortage that may be negatively impacting your business.

## Do MORE With Less with DrivePro™ Remote Unlimited + IVS 360™ Support

Respond to staff shortages through unlimited access to the IVS 360™ remote support platform featuring 100+ brand-specific Dealer Master Techs. They utilize patented DrivePro™ Remote technology to connect directly to the vehicle using OE and aftermarket tools to diagnose and complete the toughest jobs for all U.S. Domestic, Asian and European brand vehicles.

Count on IVSRepair™ for complete built-in, licensed multi-brand diagnostic software for scanning, live data, bi-directional controls, self-tests and ADAS functions. Additionally, get Autologic Legacy European Software. Plus, you will get IVSRAP™ for hassle-free Remote Assisted Programming on a pay-per-use basis.

## Stop Sending Work To The Dealer and Start Adding Billable Hours


Despite the technician shortage, we've found that automotive repair shops who use our remote programming and diagnostic support platform add up to five billable hours per week by not subletting work and by expanding their vehicle brand coverage to grow their share of market. They further increase profitability by not paying for expensive factory software licenses.

## Address Labor Uncertainty with a Sure Thing – IVS 360™ Support – Available Only Through DrivePro™ Remote Unlimited

Source: 2021 Tech Supply & Demand, TechForce Foundation

# SCAN FOR SEMA SPECIAL



 Learn More

# Meet us at SEMA Booth 31095



**OPUS**

IVS™

**GET THE POWER TO REPAIR™**

opusivs.com

sales@opusivs.com

\*Scan QR code for details. Terms and conditions apply.

844-OPUS IVS  
(844-678-7487)

lowed that up by running the volumetric efficiency test to see where the MAF reading was under loaded conditions. Test results confirmed the MAF is not reporting properly (**Figure 5**).

The next step was to use CRC MAF cleaner to see if there was an improvement. Because there was no difference after cleaning, my technician, Bill, took into consideration the mileage of the vehicle and ordered a new Hitachi MAF sensor then installed it. After the new MAF was installed, the codes cleared, and the vehicle was taken on a test drive. That resulted in 3 emissions monitors not being able to run to completion.

Bill looked up the monitor run criteria and then took it for another couple of test drives. The monitors still would not run to completion. Bill moved on to research information in ALLDATA, ProDemand, and Identifix, and found TSB NTB12-051k (regarding PCM reprogramming for MAF code).

Now, it was time to contact the vehicle owner and explain the issue. The

vehicle owner was OK with the repair and agreed to proceed with the programming. Since Bill was tight on time, he decided to use the Opus RAP2 box to reprogram the vehicle. The RAP2 is a great tool to have around, especially on a Nissan (they can be a bit of a pain to program, and tend to take a long time, in most cases).

An Opus Nissan tech instructed Bill to connect a battery maintainer and follow some minor instructions before he took over remotely to program the PCM. After hours of programming, another test drive was performed that was not successful. Bill's next step was to perform a hard reset. This is done by turning the ignition key off, followed by removing the battery cable end from the battery post. Then, connect a 1 ohm - 10-watt resistor (in series) to bring down all the capacitors in the computers.

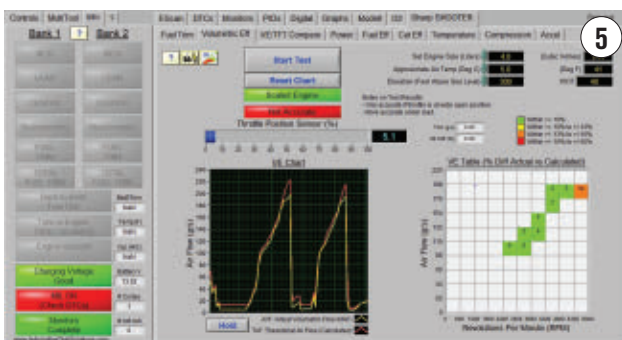
This was followed up by cleaning the throttle plate and a test drive that resulted in an illuminated MIL but four out of the five monitors "Ready."

Bill was beside himself (since the MIL was off before programming and no DTCs were present prior), so he called Opus tech support. The Opus tech recommended not using any other brand MAF sensor other than the OEM dealer part. Bill told the tech support agent the MAF was an OE Hitachi, the same brand as the one installed currently on the engine (that we purchased from an aftermarket supplier). The tech had Bill check the part number off the old sensor and compare it to the one that was in the vehicle; they were not an exact match.

We followed the Opus tech's recommendation and took a ride to the dealer to purchase the Nissan Hitachi MAF. It had a few numbers different than the OE Nissan one we purchased. After the new dealer-MAF was installed, all the monitors were now "Ready" and there was no MIL illuminated. The fuel trim and volumetric efficiency tests both passed with flying colors (**Figure 6+7**). Sometimes strange things occur on certain vehicles (as in this case) when only the OEM dealer part will work. The help from Opus saved the day on this Pathfinder.

**2012 Chrysler Town and Country, overheating warning/MIL**

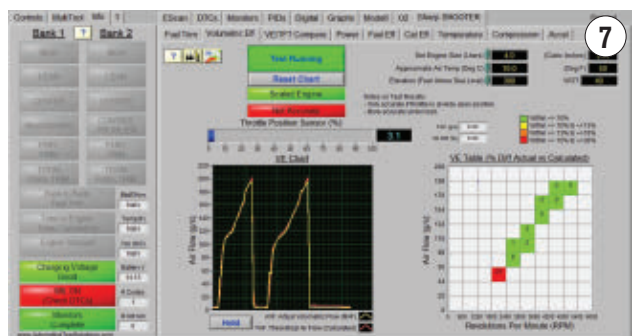
The last vehicle in this article that came in had 62,990 miles on it and a complaint of the temperature gauge reading high/check engine light on. After connecting the Zeus scan tool, we were able



**THE MAF VALUES FALL OFF** of the theoretical values at higher rpms. Indicating that the MAF signal is not correct for the operating conditions.



**PROPER FUEL TRIM DISPLAYED HERE** indicates the fuel being delivered to the cylinders is correct for the operating conditions, throughout the entire rpm/load range.



**THE MAF VALUES MATCH** the theoretical values, indicating that the vehicle is now fixed.

# SEMA

## SHOW



***WHERE CONNECTIONS ARE BUILT***

NOVEMBER 1-4, 2022  
LAS VEGAS CONVENTION CENTER

---

REGISTER TO ATTEND AT  
[SEMASHOW.COM](http://SEMASHOW.COM)



to view more than just one DTC on the vehicle scan report. The DTCs that were reported were:

- P0480 (Cooling Fan 1 Control Circuit/Open)
- C212A-16 (Antilock Brakes System voltage below threshold)
- P0692 (Cooling Fan 1 Control Circuit High)

Bill looked up service information in MotoLogic to review how the circuit works and what color wires went from the PCM to the component. With the scan tool connected, we looked at the data to see if the fan was being commanded on (**Figure 8**). As you can see, the cooling fan was not receiving the correct command. Both the engine and transmission were at the recommended

temperature for the fans to operate.

I always suggest in my classes to go to the load in the circuit and see if it works (so you can rule out the load as the issue). With the wires disconnected from the fans, we connected the Power Probe Hook, and applied voltage/ground to see if the fans would come on; they did. So, that ruled out the loads as being the issue.

We checked and found all necessary voltage supplies, grounds, and continuity in the load circuit were OK. We hooked up the eScope to all the terminals of the low cooling fan relay and warmed the engine up.

The test indicated that there was no signal received (from the command relay) to turn the fans on. This left us

with the only logical conclusion that the TIPM circuit board was bad. We ordered a Dorman/NAPA TIPM and installed it. We cleared the DTCs then warmed the engine up from a cold start to make sure the fans worked as designed. With the vehicle repaired we called the customer and sent the cool vehicle on its way.

Efficient and accurate diagnostics comes from a combination of factors. Having the correct tools and knowing how to implement them, in combination with the correct service information, will get you very far, but certainly not without an understanding of how the systems are designed to work and what to anticipate. *ZZ*



**THE PIDS DISPLAYING ADEQUATE TEMPERATURE to operate the fans, but no command being give. This offers insight to a computer related fault.**



**JERRY TRUGLIA**, is an automotive instructor and author whose work with the U.S. Environmental Protection Agency,

Society of Automotive Engineers, National Automotive Service Task Force, Council of Advanced Automotive Trainers, *Motor Age* and *Motor Age Training*, *PTEN*, 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.

United States Postal Service Statement of Ownership, Management, and Circulation (Requester Publications Only)			
1. Publication Title: MOTOR AGE			
2. Publication Number: 925-560			
3. Filing Date: 9/8/2022			
4. Issue Frequency: January/February, March, April, May, June, July, August, September, October, November/December			
5. Number of Issues Published Annually: 10			
6. Annual Subscription Price: Free to Qualified			
7. Complete Mailing Address of Known Office of Publication (Not Printer): Endeavor Business Media, LLC, 1233 Janesville Ave, Fort Atkinson, WI 53538 Contact Person: Tracy Skallman; Telephone: (818) 600-7156			
8. Complete Mailing Address of Headquarters or General Business Office of Publisher (Not Printer): Endeavor Business Media, LLC, 30 Burton Hills Blvd., Ste. 185, Nashville, TN 37215			
9. Full Names and Complete Mailing Addresses of Publisher, Editor, and Managing Editor - Publisher: Kylie Hirko, VP/Group Publisher, Endeavor Business Media, LLC, 1233 Janesville Ave, Fort Atkinson, WI 53538 ; Editor: Brandon Steckler, Technical Editor, Endeavor Business Media, LLC, 1233 Janesville Ave, Fort Atkinson, WI 53538 ; Managing Editor: Jay Sicht, Managing Editor, Endeavor Business Media, LLC, 1233 Janesville Ave, Fort Atkinson, WI 53538			
10. Owner - Full name and complete mailing address: Endeavor Media Holdings I LLC, 905 Tower Place, Nashville, TN 37215; Endeavor Media Holdings II LLC, 905 Tower Place, Nashville, TN 37205; Resolute Capital partners Fund IV LP, 20 Burton Hills Blvd, Suite 430, Nashville, TN 37215; RCP Endeavor, Inc, 20 Burton Hills Blvd, Suite 430, Nashville, TN 37215; Northbrook Mezzanine Fund II LP, 312 Walnut Street, Suite 2310, Cincinnati, OH 45202; Invegar Holdings, LP, 44235 Hillsboro Pike, Nashville, TN 37215; Everside Fund II LP, 155 East 44th St, Suite 2101 - 10 Grand Central, New York, NY 10017; Everside Endeavor F1 Blocker, LLC, 155 East 44th St, Suite 2101 - 10 Grand Central, New York, NY 10017; Everside Endeavor International Blocker, LLC, 155 East 44th St, Suite 2101 - 10 Grand Central, New York, NY 10017; Everside Endeavor F1 Blocker, LLC, 155 East 44th St, Suite 2101 - 10 Grand Central, New York, NY 10017; SunCap Endeavor Blocker, LLC, 155 East 44th St, Suite 2101 - 10 Grand Central, New York, NY 10017			
11. Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages or Other Securities: None			
12. Tax Status (For completion by nonprofit organizations authorized to mail at nonprofit rates) (Check one) The purpose, function, and nonprofit status of this organization and the exempt status for federal income tax purposes: N/A			
13. Publication Title: MOTOR AGE	Average No. Copies Each Issue During Preceding 12 Months	No. Copies of Single Issue Published Nearest to Filing Date	
14. Issue Date for Circulation Data: August 2022			
15. Extent and Nature of Circulation			
a. Total Number of Copies (Net press run)	99,196	98,505	
b. Legitimate Paid and/or Requested Distribution (By Mail and Outside the Mail)			
(1) Outside County Paid/Requested Mail Subscriptions stated on PS Form 3541 (Include direct written request from recipient, telemarketing and Internet requests from recipient, paid subscriptions including nominal rate subscriptions, employer requests, advertiser's proof copies, and exchange copies.)			
	74,164	72,429	
(2) In-County Paid/Requested Mail Subscriptions stated on PS Form 3541 (Include direct written request from recipient, telemarketing and Internet requests from recipient, paid subscriptions including nominal rate subscriptions, employer requests, advertiser's proof copies, and exchange copies.)			
	0	0	
(3) Sales Through Dealers and Carriers, Street Vendors, Counter Sales, and Other Paid or Requested Distribution Outside USPS®			
		5	3
(4) Requested Copies Distributed by Other Mail Classes Through the USPS (e.g. First-Class Mail®)			
c. Total Paid and/or Requested Distribution (Sum of 15b (1), (2), (3), and (4))			
		74,169	72,432
d. Nonrequested Distribution (By Mail and Outside the Mail)			
(1) Outside County Nonrequested Copies Stated on PS Form 3541 (include Sample copies, Requests Over 3 years old, Requests induced by a Premium, Bulk Sales and Requests including Association Requests, Names obtained from Business Directories, Lists, and other sources)			
		23,406	24,903
(2) In-County Nonrequested Copies Stated on PS Form 3541 (include Sample copies, Requests Over 3 years old, Requests induced by a Premium, Bulk Sales and Requests including Association Requests, Names obtained from Business Directories, Lists, and other sources)			
		0	0
(3) Nonrequested Copies Distributed Through the USPS by Other Classes of Mail (e.g. First-Class Mail, Nonrequester Copies mailed in excess of 10% limit mailed at Standard Mail® or Package Services Rates)			
		0	0
(4) Nonrequested Copies Distributed Outside the Mail (Include Pickup Stands, Trade Shows, Showrooms and Other Sources)			
		596	370
e. Total Nonrequested Distribution (Sum of 15d (1), (2), (3), and (4))			
		24,002	25,273
f. Total Distribution (Sum of 15c and 15e)			
		98,170	97,705
g. Copies not Distributed			
		1,047	800
h. Total (Sum of 15f and g)			
		99,218	98,505
i. Percent Paid and/or Requested Circulation (15c divided by 15f times 100)			
		75.55%	74.13%
16. Electronic Copy Circulation			
a. Requested and Paid Electronic Copies			
		-	-
b. Total Requested and Paid Print Copies (Line 15c) + Requested/Paid Electronic Copies (Line 16a)			
		74,169	72,432
c. Total Requested Copy Distribution (Line 15f) + Requested/Paid Electronic Copies (Line 16a)			
		98,170	97,705
d. Percent Paid and/or Requested Circulation (Both Print & Electronic Copies) (16b divided by 16c x 100)			
		75.55%	74.13%
x. I certify that 50% of all my distribution copies (electronic and print) are legitimate requests or paid copies:			
17. Publication of Statement of Ownership for a Requester Publication is required and will be printed in the issue of this publication. Oct-22			
18. Date: 9/8/22			
Tracy Skallman, Audience Development Manager			
I certify that all information furnished on this form is true and complete. I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions (including fines and imprisonment) and/or civil sanctions (including civil penalties).			

**2022 GREAT PRIZE GIVEAWAY**

**TIME IS RUNNING OUT!**

★ Win these prizes at [VehicleServicePros.com/GPG](http://VehicleServicePros.com/GPG) ★

Entries close October 31st



**AirCat Tool Giveaway**

Prize value: \$500



**Autel ITS600 Sensor Kit**

Prize value: \$965



**BOSCH SMT 500 Smoke Machine Leak Tester with built-in Air Compressor**

Prize value: \$1,972



**COAST Bright Light Bundle**

Prize value: \$715



**Gray 7-THF Vehicle Support Stands**

Prize value: \$500



**OEMTOOLS Oil Service Prize Pack**

Prize value: \$649.96



**Induction Innovations Mini-Ductor Venom HP + Coil Kit**

Prize value: \$736.50



**KTOOL Deluxe Mechanics Tool Set**

Prize value: \$3,600



**Lang Tools Made in USA Specialty Tools**

Prize value: \$550



**Launch Millennium MAX Scan Tool**

Prize value: \$799



**XTools USA Nitro LT & Auto Keys**

Prize value: \$2,250



**Oasis Scientific ME-610i Borescope**

Prize value: \$900



**Opus IVS Mongoose-Plus J2534 Device**

Prize value: \$495



**OTC Ball Joint Connected Adapter Professional Kit**

Prize value: \$2,140



**ProMAXX Ford 3.5 EcoBoost Exhaust Manifold Repair Kit**

Prize value: \$613.25



**ToolAid Electrical Diagnostic and Repair Pack**

Prize value: \$615



**StreamLight 2022 Worklights Prize**

Prize value: \$750



**TEXA Nano S, IDC5 Car and Tablet**

Prize value: \$4,495



**ThinkCar Platinum S8**

Prize value: \$1,249

BROUGHT TO YOU BY:

**PTEN**  
PROFESSIONAL TOOL & EQUIPMENT NEWS

**MOTOR AGE**

**ABRN**  
AUTO BODY REPAIR NETWORK

**VEHICLESERVICEPROS**.COM

# A FUNDAMENTAL APPROACH TO BASIC FAULT FINDING

**ELECTRICAL FAULTS FALL INTO ONLY A FEW BASIC CATEGORIES. HAVING A FUNDAMENTAL APPROACH TO SOLVING THEM LEADS TO EFFICIENT DIAGNOSES.**

BY CHRIS REYNOLDS // Contributing Editor

**VEHICLE INFORMATION**

**2014 LEXUS GS350**

112,246 miles  
3.5L V-6  
RWD Automatic

**COMPLAINT:**

"Crank/no-start after the vehicle collided with a snowbank"

**W**e often encounter an unfamiliar vehicle or system. But it's not our familiarity that allows for efficiency and accuracy. It's the solid base of knowledge we've developed that does so.

Think about this question: *How many times have you relied on someone else to fix a fundamental problem?* If you say never, I am glad, but I must encourage you to accept the reality of our industry. I have a limited reservation in asking others in the field for assistance when performing services or diagnostics with which I lack familiarity. Open communication in this field is extremely important and creates professional growth to assist both individual and communal performance.

In this case, an overly apparent fault created confusion for the technician assigned to this vehicle. As a result, I acted as his resource to successfully understand, diagnose, and repair the vehicle. I feel obligated to assist those who ask me for assistance in odd instances and use these experiences to justify my professional occupation by developing presentable cases for implementation in future course materials.

A broad variety of technicians practice in the automotive service industry. Sometimes they fall into a world of crude mechanical work and are content. Others may explore the most advanced technologies with personalized understanding and still be hungry for more. As a technician educator, it is my job and passion to prepare anyone who walks into our doors for the broad array of



CHRIS REYNOLDS

**UPON ARRIVING AT THE REPAIR SITE,** I found a pile of old spark plugs, a disconnected air inlet boot, and some interesting harness modifications.

service occupations our industry offers. I cannot guarantee what the students learn (in a brief one to two years of study) will be beneficial if they do not see the opportunity the industry provides when they exit. I also cannot guarantee my students (upon graduation) will be provided the opportunity to explore service and/or diagnostic methods that enhance their previous learning experiences in academia. This is one of the many reasons I find myself assisting others in diagnosing problems that seem complicated but are found to be extremely fundamental (**Figure 1**).

Case in point: I was asked to help a technician/former student in our region analyze a 112,000-mile 2014 Lexus GS350 sedan. It had a no-start complaint. To be specific, this only happened after our most recent snowstorm (STL metro region) encouraged snow to inconveniently make its way into the underhood area of the vehicle while the driver was operating it in early 2022.

This vehicle was towed to the technician's residence and sat for two days before I was able to assist. I had a few questions related to

the vehicle's service history, symptoms experienced, and if visible damage was present. I also inquired about services performed since the technician received the vehicle. The vehicle was a recent auction purchase, had five of six spark plugs replaced, a new battery installed, and a MIL illuminated.

As basic as it may seem, I consistently apply the following critical steps when diagnosing faults with a drivability or emissions concern:

**Step 1: Verify the complaint**

This process is sensory and relies on physical interaction with the vehicle. To verify this complaint, I cranked the engine over and verified a “crank, no-start” was truly present. Oftentimes, conducting a visual inspection can provide focused results, as was the case in this instance. In observing non-OEM wiring attached to ignition coil #1's factory harness, I developed an immediate concern that the ignition system's obvious alteration *may* be related to the present no-start condition.

**Step 2: Gather DTCs**

Gathering DTCs is a valid practice that enhances our experience as technicians. Considering the multi-modality of OBD-II, it is extremely important to understand how issues identified by control modules are captured, stored, and then reported as faults that impact critical systems of operation in engine controls. DTC's P0351-P0356 were found in the PCM of this Lexus. These DTCs are described loosely as “Ignition A-F Primary/Secondary Circuit”.

**Step 3: Review service information for platform fault commonalities**

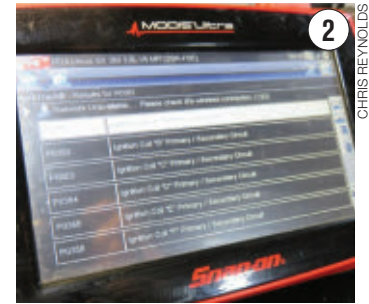
While it was not likely that TSBs nor recalls were going to quickly identify the fault conditions on this vehicle, technicians must be aware that both pieces found within service information are oftentimes critical for success. TSBs are generated by OEMs in response to frequently identified failures uncovered by technicians that act as a resource during terms of warranty coverage (and beyond). These are shared to reduce the time invested for diagnostic and service procedures to resolve sometimes confusing or unfamiliar system complaints and/or conditions.

On the other hand, recalls are implemented in response to emissions control and/or vehicle safety concerns. Both are excellent resources to review in the instance a driveability, emissions, or safety concern is provided by the consumer. In the case of the Lexus, zero campaigns were listed related to the presence of common ignition circuit DTCs.

**Step 3: Dissect the DTCs**

Reviewing service information to find conditions for running and setting the DTCs is a necessary step to understanding what conditions objectively encourage fault presence in stored data.

For a P0351-P0356 to be identified and stored, the only cause can be the PCM not receiving “IGF” signals while the engine is running. As I wasn't extremely familiar with Toyota/Lexus' common ignition control systems, I used the next step to provide myself and the technician with an understanding of this system (Figure 2).



CHRIS REYNOLDS

**DTCs TYPICALLY PROVIDE US** with a sufficient diagnostic starting point.

**Step 4: Understand the system of concern**

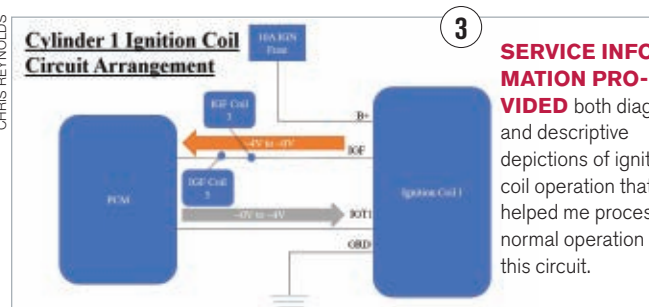
Collecting diagrams, procedures, and illustrative service information act as a major resource in the understanding system(s) or component theory. In reviewing the diagnostic sequence for the present DTCs, I found Toyota/Lexus provides a clean, descriptive summary of their ignition controls that included illustrations, diagrams, measurable values, and the sequence of operation.

From a broad perspective, this Lexus ignition system uses critical parts for ignition control such as CKP, VVT, a diverse array of other fundamental inputs (i.e., ECT, TPS), the PCM, the vehicle's power/ground source, and six coils (loads) for successful ignition. As this array of parts can seem intimidating in the diagnostic process, it provides major points of data and/or measurement to build a valid procedure.

In a summative perspective, each ignition coil must be provided switched B+, constant ground, an ignition trigger signal (IGT) from the PCM and output a feedback signal (IGF) to verify operation as a way to satisfy the PCM. Essentially, the PCM wants to know if the request for ignition was honored by the coil. Service information provided some specified values for B+, IGT, IGF, and ground measurements. IGF *and* IGT values were inferred based on OEM-provided waveforms found in service information (Figure 3).

**Step 5: Gather measurable data and infer faults**

As noted in service information, KOEO/KOER, B+ *must* be provided to terminal 1. The OEM notes that to test the terminal 4 ground circuit (Key OFF), utilize a DMM's ohms setting to meas-



CHRIS REYNOLDS

**SERVICE INFORMATION PROVIDED** both diagrams and descriptive depictions of ignition coil operation that helped me process the normal operation of this circuit.

ure live resistance between terminal 4 and body ground with the ignition coil disconnected. The specified resistance value is less than 1 ohm.

In KOER, the IGT (trigger terminal of the ignition coil) is received from the vehicle's ECM to communicate primary charge/secondary output requests *and* IGF (feedback) verifies the request from the PCM was internally honored by the Ignition Coil assembly. The IGT signal is unique to each coil on this vehicle in that it is only shared with the ECM. It is pulsed high (~4V) and rests at 0V. When IGT drops low to 0V, secondary ignition occurs.

The IGF, however, is shared amongst 3 cylinders per bank, therefore labeled as IGF1 and IGF2. The IGF is pulled low from ~5V to ~.5V to let the ECM know the trigger request has been honored. IGF1 is linked to cylinders 1,3, and 5 on the passenger side bank, while IGF2 is linked to cylinders 2,4,6 on the driver side bank. Service information provided all the necessary information to understand the sequence of operation.

Now knowing how the circuit operates, I concluded ignition coil 1 would be the most convenient and effective point to measure voltage and continuity based on location. When measuring voltage during a crank request at terminal 1 of coil 1, I found 0V present. This came as no surprise due to the unexplainable piece of wire crudely tapped into coil 1's power supply circuit, which was contacting body ground. We immediately removed this non-original wire from the harness to eliminate any further damage it could cause. Using the circuit diagram, I located the 10A ignition fuse common to all ignition coils and found it open (Figure 4+5).

Finding this visible problem created a few basic questions:

- Do I just replace the fuse?
- What tools can I use to quickly isolate the cause(s) beyond the

*obvious fault?*

To prevent potential future damage, I placed the IPA Fuse Saver in the IGN fuse slot with a breaker rated at 10A. In performing a wiggle test, the breaker did not trip, indicating the immediate fault of a short-to-ground was absent. I have used this tool for nearly a decade to reduce my cost in diagnosing higher amperage circuit faults (i.e., preventing the commonly blown fuses in circuit diagnosis). The Fuse Saver tool is equipped with multiple current-limiting circuit breakers (ratings). I also purchased this kit with a *BuzzAlert*, which creates an audible output if the installed breaker trips while connected to the main circuit (Figure 6).

### Step 6: Repair and Verification



After locating the obvious short-to-ground fault, I had the technician remove the non-OEM wires and then repair and seal the harness. In wanting to verify our routine was valid, I then wanted to collect raw data using an oscilloscope to witness normalized operation for future reference (Figure 7).

We connected a Pico 4425A to ignition coil 1's terminals:

- Channel A was linked to Terminal 1 to measure live and active load voltage
- Channel B was connected to terminal 2 to collect IGF output
- Channel C was connected to terminal 3 for IGT output
- Channel 4 was connected to a secondary paddle probe to collect an illustrative capture that proved both theory and assumptions were reasonable.

If the technician I assisted in this diagnostic process encounters Toyota/Lexus vehicles of the same era with this ignition system, I am comfortable in knowing his experience from this case study will guide him down a more structured diagnostic path. Sharing our knowledge of circuit theory, methods of measurement, navigating service information, and capturing live data provided an objective conclusion for this fault. *TL*



**CHRIS REYNOLDS** is an ASE Master Technician, ASE-Education Foundation evaluation team leader, and an associate professor of automotive technology at Lewis & Clark Community College in Godfrey, Illinois. He is currently in his second year of study toward a Doctor of Education in Educational Practice degree at the University of Missouri – St. Louis. He enjoys time with his wife and three children and advocating for the needs of the automotive service industry and the field of technical education.



**4** WHILE LOCATING AN EASY POINT of access for measurable coil readings, I found a non-OEM modification to two wires on Ignition Coil 1. These two wires were for coil power supply and coil round supply.



**5** INSPECTING THE UNDER-HOOD FUSE BLOCK confirmed my suspicion was correct. The 10A Ignition supply fuse used by all six coils was now open due to excessive amperage.



**6** THE IPA FUSE SAVER KIT contains numerous fuse dimension terminals, a variety of circuit breaker inserts, and a Fuse Alert which will provide an audible sound if the selected breaker insert trips. This tool prevents costly fuse replacements in circuit diagnostic routines where excessive amperage is the culprit.





# CONGRATULATIONS!

*PTEN* and *Motor Age* would like to recognize  
**AUSTIN MATNEY**  
our 2022 Best Young Tech Award winner.

THANKS AGAIN TO OUR SPONSORS:



## AUTO TECHS IN TRAINING

Stay up to date and in the know throughout your career  
with essential resources from [VehicleServicePros.com](http://VehicleServicePros.com).

Visit [VehicleServicePros.com/youngtechs](http://VehicleServicePros.com/youngtechs) to learn more!



**VEHICLESERVICEPROS**.com

**TECHNICAL**

# FOR AUTOMOTIVE TEACHERS,

**TECHNOLOGY IS COMING AT US ALL AT A FURIOUS PACE. WHO IS TRAINING THE NEXT GENERATION AND PREPARING THEM FOR THE CHALLENGES?**

**BY PETE MEIER** // Director of Training

I'm sitting in a quiet conference room at the Cincinnati Marriott at River Center in Covington, Ky., just across the Ohio River from Cincinnati proper. Why am I here? I'm attending the 2022 NACAT (North American Council Of Automotive Teachers) conference, and if you're an educator, you should have been here, too!

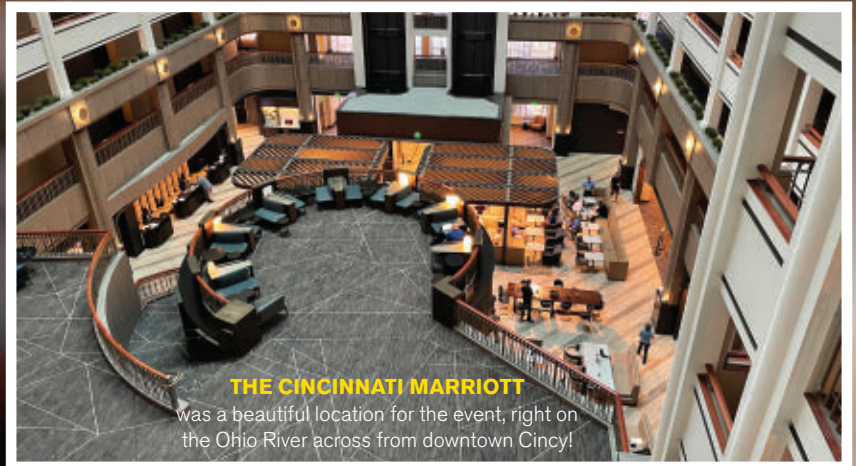
NACAT is the only industry association that is specifically focused on those responsible for training our next generation of technicians and is run by those doing the same. Their tagline is, "For automotive teachers, by automotive teachers." As the name implies, educators involved in high school and post-secondary programs from across the United States and Canada are included and eligible for membership. And while there are numerous benefits to being a member, the one that has to be at the top of the list is attending the annual conference.

Although training in the latest vehicle technologies is certainly important to the men and women preparing their students for careers in the industry, the primary purpose of the conference

is to assist members on developing their professional skillsets as educators. This includes mastering the necessary classroom skills and on the business of education – interacting with administration, potential employers of their students, and more.

Another factor that makes NACAT a unique experience is the family atmosphere surrounding the event. Yes, I mean how other members make you feel right at home, but more than that, many of the attendees bring their families and everyone is welcome at the group activities held over the course of the four-day event. A tradition at the conference is the annual Valve Cover Races, a pinewood derby-style event featuring entries made from a variety of automotive valve covers and limited only by the imagination of the builder. This year, the races started off with the kids in attendance, including visiting Girl Scouts who attended as guests of ATech Training, the host sponsor of this year's event. And the winner of this informal competition was a little two- or three-year-old by the name of Wesley, who, admittedly, needed a little help setting up his entry on the track!

BY



**THE CINCINNATI MARRIOTT**

was a beautiful location for the event, right on the Ohio River across from downtown Cincy!

# AUTOMOTIVE TEACHERS

## A New Era?

NACAT, like many other industry organizations, has had its up and downs. This year's conference also welcomed in a new business manager, Heather Sebben, to help lead NACAT to new heights. This young lady has motor oil in her blood, as a drag racer (starting at age eight!) and in working with her father at the family shop. She admits when her father asked her to take over the management of the business, her skillset was a bit lacking. So, she sought help and ended up at what was at that time ASA Midwest, where she met someone we all know, Sheri Hamilton. That meeting led to working first part-time and later full-time with Hamilton, who mentored Sebben and helped pre-



pare her for this new role.

And the efforts are already showing. A new logo heralds in a new era for NACAT, and the conference's successes are only one part of the whole. Visit the newly redesigned website, and you'll find that becoming a member has been made as easy as it can be. And resources for existing members have been expanded, including the ability to see and identify other NACAT members near you to en-

**WHILE REMAINING CURRENT** on automotive technology, the primary purpose of NACAT is to help members grow as educators.

courage collaboration and networking. Additional resources are planned to include both technical and management training resources, as well as an area to exchange ideas on curriculum development and implementation.

As I wrote, "For automotive teachers, by automotive teachers". If that's you, you need to learn more about how NACAT can help you take your programs to the next level. Log on to [www.NACAT.org](http://www.NACAT.org)

today, and plan on attending the 2023 conference. I'll be there!

### NACAT Awards

On the final evening of the 2022 conference, members and guests sat down for one last meal together. As part of the evening's activities, individual awards and recognitions were announced.

First on the agenda were two awards presented every year by Mitchell1. This year, Mike Alberry, product manager for Mitchell1's ProDemand service information service, made the presentations. First was the presentation of the company's annual student scholarship that recognizes one U.S. or Canadian high school senior or college student for outstanding achievement in automotive technology/auto shop repair scholastics. The winning student, Daniel Zielinski, received a \$2,500 scholarship, a check for \$500, and roundtrip airfare and accommodations for the winner and a guest to attend the NACAT conference.

Mitchell1 also recognizes an Educator of the Year. Metropolitan Community College (Kansas City, Mo.) automotive technology instructor and Ford ASSET coordinator David Patience was announced as this year's recipient. Patience, whose automotive career spans 37 years, including 19 at MCC, earned the honor by achieving the highest score of all the

educators in the U.S. and Canada who took the most recent National Institute for Automotive Service Excellence (ASE) certification tests.

The Educator of the Year award includes a one-year subscription for MCC to Mitchell1 online service manuals (about a \$1,200 savings for the college), plus \$500 and an expenses-paid trip for Patience and his wife to attend the conference and awards banquet.

Next was the presentation of the Larry Cotten Memorial scholarship. The scholarship honors the legacy of Larry Cotten, the first president of the council. Cotten retired from Tarrant County College in 2005 after teaching there for 30 years. Additionally, in 1982, Cotten worked for I-CAR for a year. Cotten passed away in 2005. His family established this scholarship as way to support the next generation of collision repairers. This year's recipient is Elisaa McAdams, a graduating senior from New Horizons Education Center in Newport News, Va. She was accepted into Lincoln Tech in Nashville, Tenn., as a collision repair student. Thanks to the scholarship, McAdams has received \$1,000 for use in her automotive education career.

The NACAT Award of Appreciation was presented to ATech Training, this year's host and Gold sponsor. ATech Training, Inc. was founded in 1984 to develop products that aid instructors in



**HEATHER SEBBEN (RIGHT)**, under the mentorship of Sheri Hamilton (left), is the new business manager for NACAT and has already begun to make a difference!

presenting automotive repair topics. Led by CEO Laura Lyons, ATech has become a world leader in the design and development of world class "trainers" and courseware for automotive OEM, secondary and community college automotive programs, as well as military and other technical training schools.

Two outgoing NACAT Board members, Jim Voth and Jason Bronsther, were honored for their efforts in keeping NACAT moving forward and meeting their objectives of serving automotive educators in the U.S. and Canada. NACAT News editor James Curry was also honored as a friend of NACAT for his efforts and contributions to the organization.

Bronsther was also honored as NACAT's 2022 MVP for Outstanding Service. I think it's important to understand that he and the other board members are not paid staff but educators that volunteer their time to serve their fellow educators. Anyone who has taught in the public school system knows how much time it demands just to run your own classes! So on behalf of those in the aftermarket benefiting from your efforts, thank you, NACAT, and all those who make it what it is.

***Are you an educator? Then learn how you can not only benefit from what NACAT has to offer, but also to learn how you can make a difference in the direction this industry takes, visit the NACAT website at [www.NACAT.org](http://www.NACAT.org). See you in Houston, Tex., in 2023! 🚗***



**LOCAL GIRL SCOUTS** came to the family night as guests of host ATech Training. The traditional valve cover races held each year really caught their attention!

SAVE

\$40

WHEN YOU REGISTER USING  
CODE **40OFFVIP** TODAY

# 2022 TRAINING EVENT



**MOTOR AGE**  
TRAINING

**PTEN**  
PROFESSIONAL TRAINING NETWORK

**MOTOR AGE**

**ABRN**  
AUTO BODY REPAIR NETWORK

**VEHICLESERVICEPROS**

OCT. 15, 2022 - EMBASSY SUITES - ROSEMONT, ILLINOIS

# ACCELERATE

A MOTOR AGE TRAINING EVENT

**REGISTER TODAY** AT [WWW.ACCELERATE-CONFERENCE.COM](http://WWW.ACCELERATE-CONFERENCE.COM)

PREMIER SPONSOR:

**AUTEL**

SIGNATURE SPONSOR:

*Milwaukee*

PRIMARY SPONSORS:

**REPAIR  
PAL**

**AutoLeap**



## DIRECT INTEGRATION WITH ADVANCEPRO

The latest Tekmetric Shop Management System update offers a direct integration with Advance Auto Parts' AdvancePro, allowing Tekmetric users to order parts through their existing AdvancePro account. Through the integration, Advance Auto Parts and Tekmetric provide easy access to affordable, quality products. In one screen, shop owners can receive real-time updates on available parts and quantities, track shipping, and utilize paperless invoices. When purchasing parts, the system automatically utilizes a shop's existing labor guide and parts matrix. For shops that have previously used AdvancePro, the integration looks exactly like the existing system – with the added capability of integrating purchases into Tekmetric for an all-in-one experience.

[TEKMETRIC.COM](http://TEKMETRIC.COM)



SPONSORED

## REMOVES QUICK CONNECT WITH SNAP/SIDE LOCK COUPLERS

The Cal-Van Tools Adjustable Jaw Fuel Line Pliers, No. 68800, are designed to disconnect fuel, EVAP and breather, push-style quick connect fittings. Can also be used on some electrical connectors. Features a spring-loaded handle with a 2-3/8" maximum jaw spread in the straight position and a 1" maximum spread in the 90-degree position. The 2" long, tapered jaws rotate 180 degrees and have 1/8" contact points. The pliers are suited for use on multiple vehicles.

[VEHICLESERVICEPROS.COM/21280159](http://VEHICLESERVICEPROS.COM/21280159)



## FITMENTS FOR VIRTUALLY EVERY VEHICLE ON THE ROAD

Centric Parts is a leading manufacturer and supplier of replacement brake components for import and domestic vehicles. Centric's reputation for quality is the result of years of hard work from a stellar team of engineers and product specialists and a manufacturing process that is second to none. Centric friction and rotors cover virtually every vehicle on the road and are the premium quality brake products that technicians need to do the job right the first time.

[CENTRICPARTS.COM](http://CENTRICPARTS.COM)

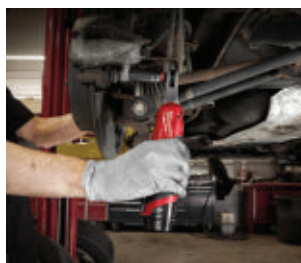


SPONSORED

## DELIVER THE FASTEST SPEEDS FOR INCREASED PRODUCTIVITY

Milwaukee Tool's 1/4" and 3/8" M12 FUEL High Speed Ratchets deliver best-in-class productivity with 35 ft-lbs of torque and 450 rpm, the fastest speeds in the industry for installing and removing fasteners, according to the company. As with all M12 FUEL products, the new tools feature three Milwaukee-exclusive innovations — the Powerstate brushless motor, Redlithium battery pack, and Redlink Plus Intelligence hardware and software — to deliver unmatched performance, durability, and run-time.

[MILWAUKEETOOLS.COM](http://MILWAUKEETOOLS.COM)



SPONSORED

## MEASURES VOLTAGE, MICROAMPS, RESISTANCE, AND MORE

The UEi Test Instruments Wireless TRMS Clamp Meter with 3-Phase and Imbalance Motor Tests, No. DL599, measures capacitance, voltage, microamps, circuit continuity, resistance, and temperature via K-Type thermocouples. It can test 3-Phase motor rotation, unbalanced load, mini-splits, circuits in Molex plugs, and diode malfunctions. The DL599 features auto volts and amp selection, a built-in magnet with hanging strap, auto/manual ranging, input jack lock, test lead storage, an over molded grip, auto calibration, auto power off, and a low battery indicator. Includes free app, silicone test leads, back probe leads, alligator clips, two thermocouples, four batteries, pouch, and a manual.

[VEHICLESERVICEPROS.COM/21281683](http://VEHICLESERVICEPROS.COM/21281683)



## COMPLETE BRAKING COVERAGE

The Raybestos Element3 premium line of brake products starts with The Best in Brakes and adds enhanced product features to deliver exceptional performance and longer life. The Element3 line establishes Raybestos as a leading innovator in the automotive aftermarket industry with a full selection of premium brake components for complete braking coverage, including EHT Enhanced Hybrid Technology friction formulations, coated rotors, new plated brake calipers, OE-matched hydraulics and shoes.

[RAYBESTOS.COM](http://RAYBESTOS.COM)

SPONSORED



## DESIGNED WITH A NEW CONNECTION INTERFACE

Pico Technology's PicoScopes, Nos. 4425A and 4225A, are diagnostic oscilloscopes designed to provide an efficient, noninvasive method to accurately identify a wide range of vehicle faults. The two- and four-channel models deliver the same performance and analytic capabilities as their predecessors while introducing the potential for a new generation of intelligent accessories and usability enhancements. Designed with a new connection interface, the PicoBNC+, these scopes take an active role in powering and automating accessory configuration to help service professionals avoid errors and become productive faster.

[VEHICLESERVICEPROS.COM/21139759](http://VEHICLESERVICEPROS.COM/21139759)



## A COMPLETE ADAS PROGRAM FROM STANDARD

Standard's complete ADAS program includes over 550 part numbers covering more than 800 million part replacement opportunities. Blind Spot Detection Sensors, Cruise Control Distance Sensors, Lane Departure System Cameras, Park Assist Sensors, Park Assist Cameras and Steering Angle Sensors highlight Standard's broad offering. Parts are available for gas, EV and hybrid vehicles, import and domestic.

[STANDARDADAS.COM](http://STANDARDADAS.COM)

SPONSORED

## THE FUTURE IS NOW

The DieHard family has expanded to include DieHard EV, the first aftermarket 12-volt EV battery specifically designed for the high demands of hybrid and electric vehicles. The 12-volt battery in hybrid and electric vehicles works with the high-voltage battery to deliver power and support for safe operation. DieHard EV is optimized to provide consistent performance and the right amount of energy when it's needed. The DieHard stocking program keeps in stock the batteries shops use most and offers flexible payment options.

[MY.ADVANCEPRO.COM/DIEHARD](http://MY.ADVANCEPRO.COM/DIEHARD)



SPONSORED

## DESIGNED TO GRIP STRIPPED, FROZEN, AND DAMAGED SCREWS

The Gearwrench Bolt Biter Screw Extractors are designed to grip stripped, seized, and damaged screws. The extractors use patented tapered sides to sit easily and safely into damaged screws, providing powerful and consistent extraction. The bidirectional design makes it easy to remove fasteners from the extractor after use and allows fasteners to be retightened. The extractors are made from high-strength steel, have a black oxide coating for corrosion resistance, and have high-visibility laser markings for easy size identification. They are compatible with fastener sizes from 1/4" to 5/8" and M5 to M16. Available in a 4-piece set, No. 84787, or a 10-piece set, No. 84786 (includes five sizes of extraction drill bits for removal needs).

[VEHICLESERVICEPROS.COM/21274008](http://VEHICLESERVICEPROS.COM/21274008)



## FOR ELECTRIC AND HYBRID VEHICLES

The EV Battery + Coolant Leak Detector from Redline Detection is designed to test the integrity of battery enclosures in electric and hybrid vehicles. Durable and compact, the unit connects to the battery enclosure on or off the vehicle, giving audible and visual progress and precise pass/fail indication, specific to that battery and vehicle type, when testing is complete. Data logging and reports can be accessed remotely, and the machine is programmable for future battery configurations.

[VEHICLESERVICEPROS.COM/21244985](http://VEHICLESERVICEPROS.COM/21244985)

## DIAGNOSES HIGH VOLTAGE SYSTEMS AND BATTERY PACKS

The Autel MaxiSYS MSUltra EV and MS909 EV both offer comprehensive vehicle coverage for U.S., European, and Asian electric, gas, diesel, and hybrid vehicles. Both tablets are equipped with the EVDiag Box to comprehensively diagnose high-voltage systems and battery packs. The tablets provide direct access to fault locations within the high-voltage system and clear and concise OEM-compliant instructions to ensure optimal battery maintenance.

[VEHICLESERVICEPROS.COM/21273750](http://VEHICLESERVICEPROS.COM/21273750)



## AUTOMOTIVE ELECTRIC SERVICE TOOL KIT

The Cementex Automotive Electric Service Tool Kit, No. ITS-12B-AES, is an ideal base of insulated tools for use with hybrid and electric vehicles (EVs) as well as troubleshooting and repair to EV charging stations. Stored in a standard toolbox, this tool kit includes double-insulated diagonal cut, needle nose, slip joint, crimping, and water pump pliers, as well as a variety of double-insulated cushion grip screwdrivers. Cementex double-insulated tools are made in the U.S.A., tested to 10,000 VAC, rated for 1,000 VAC/1,500 VDC when working on energized parts, and marked with the (double-triangle) international safety symbol. These tool combinations can be customized to fit a customer's needs.

[VEHICLESERVICEPROS.COM/21280975](http://VEHICLESERVICEPROS.COM/21280975)



## DELIVER FOR YOUR CUSTOMERS

The Original Exhaust Systems (OES) line distributed exclusively by Autopart International is more than just equal to OE quality, according to the company; it is a direct fit for OE equipment that is true to size and shape, helping ensure a proper fit and ease of installation, saving on repair times and getting vehicles back on the road faster.

OES exhaust products are built for durability, long life and noise reduction. They are manufactured from aluminized steel, both inside and outside, to prevent rust and have double-wrapped shells for increased longevity and resistance to road hazards.

OES catalytic converters are designed for a direct fit to OE and use EPA-compliant catalyst substrates featuring advanced catalyst washcoat technology. OES exhausts are backed by a limited lifetime warranty and OES catalytic converters with a 5-year/25,000-mile warranty.

[AUTOPARTINTL.COM](http://AUTOPARTINTL.COM)

SPONSORED

## MOTOWEB SHOP WEBSITES

With customers increasingly on the go and on mobile devices, you need to establish an online presence that sets your shop apart. Worldpac's MotoWeb is an easy, effective and affordable solution to that challenge, offering a professionally designed website for your shop and allowing your customers to engage online at their convenience. A website from MotoWeb makes it easy for customers to see what services your shop offers, access their personalized online garage, get exclusive coupons and book their next appointment. Call 1-855-770-MOTO (6686) or visit us online to request a demonstration.

[MY.ADVANCEPRO.COM/MOTOWEB](http://MY.ADVANCEPRO.COM/MOTOWEB)



SPONSORED

## REACTIONLESS RATCHET ELIMINATES KICK BACK

The 1211MAX Series High Speed Ratchet from Ingersoll Rand features 80 lb-ft of nut-busting torque and produces 625 rpm of free speed—speeds three times faster than its previous generation. The twin hammer reactionless impact mechanism protects the operator's knuckles and fingers from kick back while completing the job. Once it has reached its torque limit, the operator can add a last touch of torque manually using the tool's true ratcheting mechanism. It weighs just over 3 lbs. An ergonomic design with a compact, straight-line composite handle and contoured trigger maximizes comfort, control, and accessibility. Available in 3/8" or 1/2" drive models.

[VEHICLESERVICEPROS.COM/21279802](http://VEHICLESERVICEPROS.COM/21279802)



## SAFELY TRANSPORTS DISABLED VEHICLES

The Body Buggy Chassis Roller from Dent Fix Equipment is designed to quickly and safely transport disabled vehicles, allowing shops to easily move a vehicle from a lift with the powertrain removed when waiting on parts, inspections, or other delays. After a simple five-minute installation, the unit essentially becomes part of the vehicle, negating the need to employ any unstable or dangerous lift points. The device can be installed on the front or rear of most any vehicle using the cradle or sub-frame mounting points and hardware. Available in 4' and 5' sizes.

[VEHICLESERVICEPROS.COM/21275301](http://VEHICLESERVICEPROS.COM/21275301)



## BREAKS LOOSE STUBBORN CRANK BOLTS

The OEMTOOLS Heavy Duty 9mm Crank Bolt Socket, No. 25290, is designed to easily break loose stubborn crank bolts. Constructed with heat-treated, durable chrome molybdenum steel, the heavy duty impact sockets have more mass for high-torque applications. The socket has a 1/2" drive.

[VEHICLESERVICEPROS.COM/21277572](http://VEHICLESERVICEPROS.COM/21277572)





**BRINGS A NEW TRAINING EXPERIENCE**

Virtual Classroom from Carquest Technical Institute (CTI) and Worldpac Training Institute (WTI) brings a new training experience to the aftermarket with live, instructor-led, interactive technical training in a virtual setting.

Technicians, service writers, and shop owners have a front-row seat watching industry experts provide live demonstrations featuring tool screens, service information, animations, and live streaming video demonstrations delivered from the CTI+WTI Research and Development Center in Raleigh, N.C. and other instructor locations throughout North America. Attendees can ask questions and interact with multiple instructors during these sessions, allowing for a more engaging learning experience than standard virtual training formats.

Virtual Classroom helps technicians increase their skills diagnosing, servicing and repairing today's high-tech vehicles in a format that uses technology in a new way—one that is innovative and engaging and offers the aftermarket a new standard to meet their training needs.

[VEHICLESERVICEPROS.COM/21269966](http://VEHICLESERVICEPROS.COM/21269966)



**DELIVERS 1,200 CRANKING AMPS**

The Weego 120 Jump Starter delivers 1,200 cranking amps and features a bypass button that allows users to jump a completely dead battery. It's rated for all gas engines and diesel engines up to 15L. With the included 30" detachable clamps, users can access remote batteries and posts more easily. The Weego 120 can also detect low voltage and provide support to raise and maintain the voltage of a vehicle's 12V battery to a level safe for jump starting. It also doubles as a portable power source for recharging USB devices and 12V tools.

[VEHICLESERVICEPROS.COM/21280180](http://VEHICLESERVICEPROS.COM/21280180)



**TURN YOUR TOOL IDEA INTO MONEY**

**LISLE CORPORATION CURRENTLY PAYS ROYALTIES TO OVER 100 INDIVIDUALS.**

Lisle has been in business for over 115 years and for over 50 years has been working with individuals on an award or royalty basis. If you have an original tool idea which others may need, we have a procedure to evaluate your idea.



*Respond now to request an idea disclosure packet, or fill out a form online:*  
[www.lislecorp.com/idea-program](http://www.lislecorp.com/idea-program)

P.O. Box 89 • Clarinda, IA 51632-0089  
712-542-5101 • Fax 712-542-6591

**HIT THE FAST LANE OF THE AUTOMOTIVE INDUSTRY**

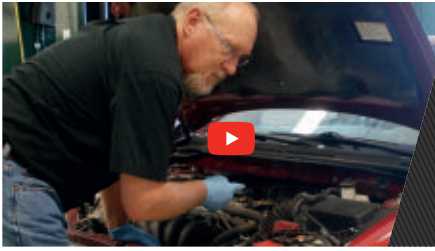
**for Web Exclusives and Advertising Opportunities  
Go to our Website**

[www.VehicleServicePros.com](http://www.VehicleServicePros.com)

**AD INDEX**

**AD INDEX**

ADVERTISER	PAGE #	ADVERTISER	PAGE #	ADVERTISER	PAGE #
ACCELERATE CONFERENCE	65	CONTINENTAL	9	MOTORCAR PARTS OF AMERICA	13
ADVANCE AUTO PARTS	29, C3	CONTINENTAL CORP.	24	O'REILLY AUTO PARTS	7
ANCO	39	DELPHI TECHNOLOGIES AFTERMARKET	3	OPUS IVS	55
AUTEL US INC.	11, 21, 45	FRAM GROUP	35	RAYBESTOS	27
AUTOLITE	31	GOLDEN LION CORPORATION	23	SEMA	57
AUTOMOTIVE MGMT. INSTITUTE	20	GREAT NECK SAW MFG.	25	THINKCAR	5
AUTOZONE	36-37	GREAT PRIZE GIVEAWAY	59	TYC GENERA	47
BENDPAK	19, 42, 51	LAUNCH TECH (USA) INC.	C2	WALKER PRODUCTS	17
BEST YOUNG TECH AWARD	63	LISLE CORPORATION	71	WORLDPAK	C4
CARTER	33	MIGHTY DISTRIBUTING SYSTEM ATL	15		



# MOTOR AGE THE TRAINER



## THE TRAINER #130: DIAGNOSING DTCS – DON'T FORGET THIS IMPORTANT STEP!

EVER FIND YOURSELF TRYING TO DIAGNOSE A CHECK ENGINE LIGHT COMPLAINT AND YOU JUST DON'T SEEM TO BE GETTING ANY CLOSER TO THE CAUSE, EVEN AFTER HOURS OF WORK?

PETE MEIER // Director of Training

Ever find yourself trying to diagnose a Check Engine light complaint and you just don't seem to be getting any closer to the cause, even after hours of work? Maybe it's because you didn't include a very important step in your diagnostic process early on.

You're doing everything right in the diagnosis. You've identified the DTCS causing the Check Engine light to come on, you've read up on what each means, what the criteria the ECM uses to set the codes and you've also read up on the system operation so you fully understand how it works and how to test it.

But even after hours of trying, you don't seem to be getting any closer to the causes.

If not, you may have missed a critical step – one you should take in every troubleshooting task you are assigned.

What is that missing step? It's checking for any related Technical Service Bulletins, or TSBs, that the manufacturer may have issued. Sometimes, it's a new part that is used to resolve a common problem, but most times – in fact, up to 70 percent of the time when it comes to engine management – it's a matter of re-



programming the controller. And if that's the case, you can diagnose all day and never find anything wrong!

So don't waste your time – make a check of TSBs one of the first steps you take when tackling even the simplest of DTCS.

Well, that's all well and good, Pete – what if there is a TSB that calls for reprogramming? What do I do then?

There are options - watch this month's edition of The Trainer to learn more! [TA](#)

SPONSORED BY

# AUTEL®



SIGN UP FOR YOUR SUBSCRIPTION TODAY AT [CONNECT.MOTORAGETRaining.COM](https://connect.motoragetraining.com)



# DELIVERING EV RELIABILITY

The DieHard family now includes DieHard EV, the first aftermarket 12-volt EV battery specifically designed for the high demands of hybrid and electric vehicles.

No matter the type of vehicle, keep the batteries your shop uses most in stock with the battery stocking program and enjoy flexible payment options.

TO FIND OUT MORE VISIT [MY.ADVANCEPRO.COM/DIEHARD](https://my.advancepro.com/diehard) 



VALIDATED

CONTRIBUTES TO A  
CIRCULAR ECONOMY

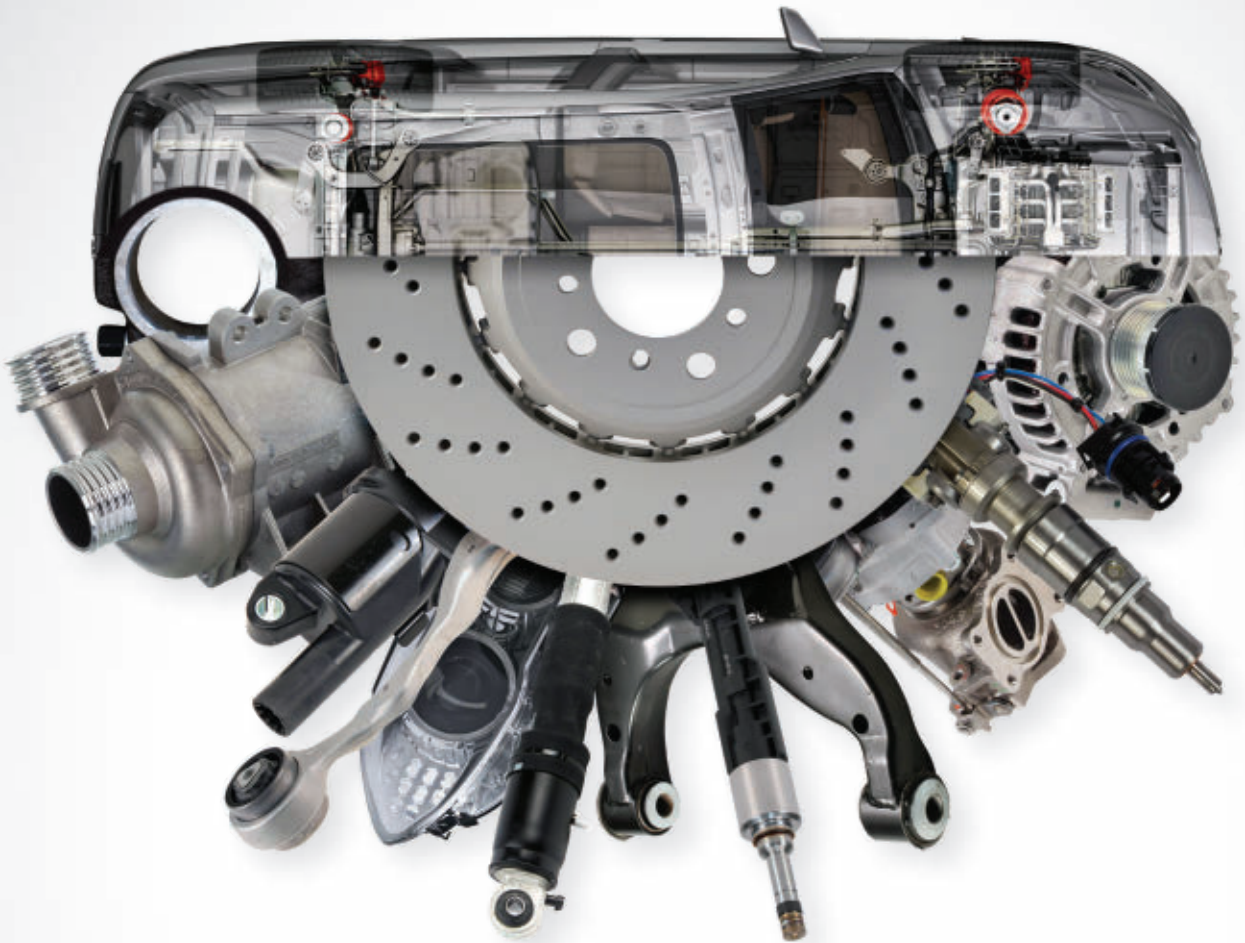
- DIEHARD AGM BATTERIES CONTAIN A MINIMUM OF 94% POST-CONSUMER RECYCLED POLYPROPYLENE AND LEAD CONTENT USING A CLOSED-CYCLE MASS BALANCE SYSTEM.

[UL.COM/ECV](https://ul.com/ecv)



# YOU'RE COVERED

Worldpac stocks OEM parts for every situation.



**WORLD PAC**

[worldpac.com](http://worldpac.com) | [worldpac.ca](http://worldpac.ca)  
Access quality parts, technical training  
and business solutions all in one place.

