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An overheated engine can be caused by anything that reduces the cooling system's ability to absorb, transport and dissipate heat. Watch this episode of "Service Done Right" with Pete Meier so you can keep these factors in mind when troubleshooting any overheat concern.

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Service Done Right #12: Correcting Engine Overheating Concerns



MOTOR AGE

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

EDITORIAL STAFF

AMANDA SILLIKER
EDITORIAL DIRECTOR
asilliker@endeavorb2b.com

JAY SIGHT
MANAGING EDITOR
jsicht@endeavorb2b.com

PETE MEIER ASE
DIRECTOR OF TRAINING
pmeier@endeavorb2b.com

BRANDON STECKLER
TECHNICAL EDITOR
bsteckler@gmail.com

RHONDA COUSIN
ART DIRECTOR

CONTRIBUTORS

JOHN ANELLO

GEORGE ARRAITS

ROSS COLKET

MIKE HALEY

JENNIFER LANG

DENNIS MICHAEL

MICHAEL SMYTH

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VP, DIGITAL BUSINESS DEVELOPMENT —

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VP, PRODUCTION OPERATIONS — **CURT PORDES**

BUSINESS STAFF

KYLIE HIRKO

VP/GROUP PUBLISHER

MICHAEL WILLINS

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

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AASP-MISSOURI MEMBERS VOTE TO MERGE WITH MIDWEST AUTO CARE ALLIANCE

In a unanimous vote, the members of AASP-MO (Alliance of Automotive Service Providers of Missouri) have elected to merge with the Midwest Auto Care Alliance. Effective Nov. 1, AASP-MO will close its doors, and members will become part of the MWACA organization. MWACA will add the Gateway Collision Chapter to its long list of active chapters in the Midwest, as well as merge the organization's two St. Louis mechanical chapters.

AASP-MO and MWACA have worked together over the years to educate the Missouri State Legislature on various industry-related issues. Their joint work included working to prevent the elimination of Missouri's vehicle safety inspection legislation.

Seeing the benefits of merging to make the numerous benefits, services, and programs available to AASP-MO members, Ron Reiling, AAM (current AASP-MO executive director) reached out to Sheri Hamilton, executive director for Auto Care Alliance and the Midwest Auto Care Alliance, to discuss the possibility of joining forces once more, but this time on a permanent basis.


Reiling, with his 23 years of experience as AASP-MO's executive director and over 50 years in the industry, will be joining MWACA as the St. Louis area liaison and legislative lobbyist and will monitor the legislative activities that affect the industry. Ron will continue to work closely with the Gateway Collision and St. Louis Mechanical Chapters. He will also represent MWACA on the many secondary and postsecondary school advisory boards and industry committees for both mechanical and collision.

MWACA and its national parent organization, the Auto Care Alliance, continue to grow daily, with this merger being an excellent example of its growth and future opportunities.  



ELECTRIC VEHICLES

THE IMPACT OF ELECTRIC AND HYBRID VEHICLE REPAIRS ON INDEPENDENT REPAIR SHOPS

 Study reveals impact of BEV and HEV repairs on independent repair shops. IMR Inc. interviewed 500 independent repair shops between June 1 and June 30 in order to update its findings from 2021 on how battery electric and hybrid vehicle service is impacting independent repair shops in the U.S.

The findings include information on:

- Investment in tools/equipment and training for BEVs and HEVs
- Marketing practices for these service capabilities
- Shops' views on when they expect BEVs and HEVs to impact their business


In 2021, when shops were asked if they expected BEVs/HEVs to impact their business within the next ten years, 55.1 percent responded "yes." In comparison, the new findings state that 41.9 percent of shops expect BEVs/HEVs to impact them within the next two years.

Additionally, the new findings indicate that a portion of business for 55 percent of independent repair

shops comes from servicing battery electric vehicles. Since 2021, repair shops are seeing a 0.8 percent increase in BEV and a 0.3 percent decrease in HEV service numbers. This has resulted in an average of 3.9 percent of total business coming from BEVs and HEVs, which makes up about 5.9 percent of shop business overall.

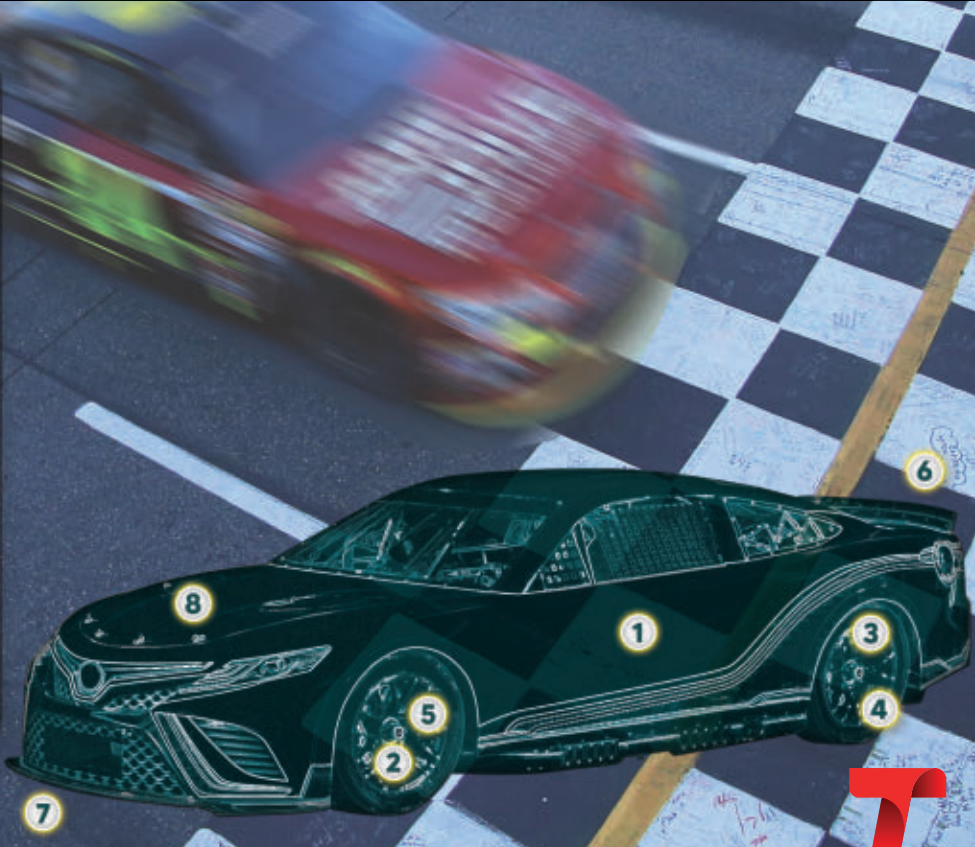
Shops with eight or more are still receiving more BEV/HEV business (5.4 percent BEH, 7.7 percent HEV) than shops with one to three bays (3 percent BEV, 4.3 percent BEV). Also, in terms of marketing their service capabilities for BEVs/HEVs, only 15.2 percent of small shops engage in this while 43.2 percent of larger shops do.

As BEVs/HEVs become more popular among consumers, 42.4 percent of repair shops have invested in tools/equipment to service BEVs/HEVs and 41.2 percent have invested in training for their technicians compared to last year when only 27.5 percent invested in tools/equipment and 30.5 percent invested in training.

To view the full updated report from IMR, go to bit.ly/3QJVgwI. 

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SEMA ANNOUNCES NEW AUTOMOTIVE INFLUENCER OF THE YEAR AWARD

➔ To recognize content creators and social media influencers who have significantly impacted the automotive industry, Specialty Equipment Market Association (SEMA) has created its new Automotive Influencer of the Year award.

This award will be presented at the 2022 SEMA Show Industry Awards Banquet to honor an influencer who has built an engaged audience and uses his or her platform to positively impact car enthusiasts of all ages, SEMA announced in a recent press release.

“So many automotive influencers have built up a tremendous voice to help promote, shape, and protect the automotive industry,” said SEMA Chairman James Lawrence. “Each of them has the ability to share their stories and connect with their fans in a unique and impactful way. They also generate tons of excitement and enthusiasm for the automotive industry. They are a big part of being an automotive enthusiast today, and it’s time we recognized them for their contributions.”



Finalists will be selected based on their presence and influence across social media channels, including YouTube, Instagram, Facebook, and TikTok.

The top five finalists will be announced in September and then honored on-stage at the 2022 SEMA Show Industry Awards Banquet in November.

“Automotive influencers embody the passion that makes being a car person so special,” continued Lawrence. “The content they create is a great representation of what car culture is all about.”

Finalists and the winner will be

based on their creativity of original, entertaining, and informative automotive media content.

Qualifications also include a loyal and substantial following of passionate and engaged automotive enthusiasts and having used a social media platform to promote positive automotive content that has benefited the automotive aftermarket and culture, SEMA noted.

To submit a recommendation or for more information on the award, go to bit.ly/3AHNWMB. 

WOMEN IN THE AUTOMOTIVE AFTERMARKET

ALL-FEMALE VEHICLE BUILD SHINES LIGHT ON WOMEN IN THE AFTERMARKET

➔ The Ford Bronco for the 2022 SEMA Businesswomen’s Network (SBN) All-Female Vehicle Build recently arrived at the SEMA Garage in Diamond Bar, Calif., marking the beginning of a new project to generate excitement and shine a light on the women in the aftermarket industry. The build began the week of July 18 and will be completed in late October, just before the SEMA Show in Las Vegas.

The project is in partnership with Ford’s Bronco brand, which donated the 4-door Ford Bronco Wildtrak. The


campaign seeks to highlight successful women in the automotive industry while also attracting and supporting more women to pursue careers in the field.

SBN volunteers have begun disassembling the vehicle and are working on modified suspension, wheel and tires. The vehicle departed for the SEMA Garage in Detroit on Aug. 8, where final accessories will be installed, including enhanced electrical, lighting, exhaust, intake and an exterior wrap.

This campaign marks the 10-year anniversary of SBN’s first award-win-



ning All-Female build and is a highly anticipated build for the upcoming SEMA Show.

For more information, visit sema.org/sbn or contact Nicole Bradle at nicoleb@sema.org. 

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BOSCH



Is your business ready for a COO?

THE COO WILL WORK to ensure all departments are working together and communication is clear at all levels and become the leader of the CEO's vision.

At some point, you need to pull away from the day-to-day operation of the business. Who will be the person to provide you with that opportunity?

BY MIKE HALEY // Contributing Editor

Let's face it, you didn't start this business only to give yourself a job that has all the responsibility and accountability with no end in sight. A true entrepreneur starts a business with the end in mind. With that in mind, I'm sure you didn't open or take over a repair service center thinking you will work in it until the day you die. Now that I've got you thinking that at some point you need to pull away from the day-to-day operation of the business, when is the time to do that and who will be the person who can provide you with that opportunity?

You must grow with the times

In a business organizational chart, the Chief Executive Officer (CEO) is the owner or is the officer hired to grow the business. They are not the manager, lead tech, service manager, or chef and bottle washer. The purpose of the CEO is to grow the business each year. This means forecasting

and plotting the course and direction the company is going to take to grow and stay relevant. We have all seen or even been a part of businesses that closed because they refused to change and grow with the demand of the consumer.

The perfect example of this is Blockbuster Video. I remember almost every Friday night going down to my neighborhood store and hoping they had the latest release in stock for me to rent. I even remember hanging out at the return counter hoping someone was returning the video I wanted. When internet and cable service grew, a small start-up company called Netflix was born. This business asked Blockbuster if they would like to merge and grow the movie rental business. Blockbuster thought there was no need to change, and Netflix would never become the premier movie rental company it has become. Be careful. If you don't have a true CEO growing the business, you can very easily become a Blockbuster.

Why your business needs a COO

Now that we know what the role of the CEO is, who oversees the operation of our business? That person is called a COO, a chief operating officer. We at ATI also call this a second-in-command. The COO's function is to ensure the CEO's plan is executed in all aspects of the business. This individual is on the same page as the CEO and has a clear understanding of what the CEO wants to accomplish. The COO's experience and competencies enable him or her to impact every part of the business. This person has business intelligence to anticipate problems and create solutions.

The COO can understand complex issues and create action plans. Most importantly, he or she ensures the sales goals are met and the expenses are managed. Managers will lead the staff and manage processes. The COO will work on a level above this to ensure all the departments are working together and communication

is clear at all levels. He or she will become the leader of the CEO's vision.

Sounds good so far, right? Just go out and find a smart person and put him or her in charge. If it were only that easy. We need to first set up our business to receive such a person and position. This will not work in a true mom-and-pop operation. The owner will need to grow the business to a level that will support the position's salary demand and have the resources to be successful. It should also have enough staff that a COO can have an impact on the business. Many times, we bring in someone we hope can fill our shoes and run us out of the shop as fast as possible, only to be disappointed they were not successful, and we are brought kicking and screaming back to the day-to-day operation.

To get out of that merry-go-round, we need to ensure the business is in a condition for which the COO can take the steering wheel and drive. This means developing processes and procedures so he or she can measure the performance of the team. Most importantly, he or she needs to know the company's core values and culture. He or she needs a high-definition picture in 4k of where the business currently is and where the CEO wants it to go. Then he or she obviously needs the autonomy and tools to get there.

When to look for a COO

When does the owner know it's time to develop or look for a COO? When the CEO feels one or more of the following:

- He or she does not have the energy and freedom to grow the business.
- He or she is unable to take something from concept to a final product.
- There are not enough hours in the day.
- He or she is spending more time managing rather than growing.
- He or she gets bogged down with deadlines, tasks, and employee or customer issues.

These are just a few possibilities to consider. When the CEO cannot grow the business, he or she jeopardizes the life of

the business. So, do you need to find this COO, or can you grow this person? The answer is "yes" to both. Getting your business ready to receive a COO is the priority. The quickest route is typically to hire from the outside. Select someone who already has the experience, knowledge, and proven track record to come in and make an impact. You can also consider candidates from another industry.

If you have sound systems and processes, a COO with business intelligence and clear direction will have the ability to achieve the results. Growing within is also possible. This could be a family member or sibling. The pitfall to avoid is giving up control of the day-to-day decisions of the business too soon while assuming this individual was paying close attention when you did it. In most cases, we see that you need anywhere from two to three years to get the business ready, select a candidate, and train the candidate.

The importance of CEO and COO

The CEO doesn't turn his or her back on the business once the COO is in place. Regularly scheduled one-on-one meetings with the COO are critical to the health and direction of the business. The CEO should know what the COO is working on and the course of action they are planning on taking. They need to mentor and support the COO. Here at ATI, we have a CEO and a COO 20 Group to help support both po-

sitions. As you know, not one person has all the answers, and sometimes having someone not emotionally involved in the business to look and make recommendations could help both positions look at their company from a different perspective. It also helps them learn about trends and new technology that is coming into our industry.

I hope this article helped you understand the importance of having a true CEO that lets the company know where they are going and the COO letting the company know how they are going to get there. I hope you find your COO and can focus your time and energy on making your business the best it can be!

To understand if you are ready for a COO, get **ATI's COO Startup Checklist** at <http://www.ationlinetraining.com/2022-07> for a limited time. It will help you consider what kind of person and skills you're looking for in a COO and what you need to do differently to truly be a CEO. **ZZ**



MIKE HALEY started in the auto industry in 1985 at a four-bay shop while also attending college. He joined Pep Boys in 1987, climbing to District Operations Manager, and then was operations manager for CarMax Toyota, the second largest Toyota dealership in the country. Mike uses his experience and certifications to help shop owners become successful. ATI's 34 full-time, certified coaches, including Mike, have helped ATI's members earn over \$2 billion in return on their coaching investment since ATI was founded.

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Overcome fear with branding

Don't just copy and paste what the competition is doing. Create your own unique brand and love your shop again.

BY DENNIS MICHAEL // Contributing Editor

“YOU SHOULD OPEN YOUR OWN AUTO SHOP.”

These are the seven words that begin a journey into business ownership for most auto repair technicians.

At first, the new business fills you with excitement, optimism, and accomplishment. You're on an emotional high that you feel will never disappear. Friends and family use your shop, and a new referral walks through your doors every once in a while.

Things are great! You can keep wrenching on cars, take the weekends off, and go on a good vacation with the family. This is the life.

Then, it happens: Work slows down, and now you wonder how to increase it again. You've tapped out every relative, friend, and family member. You make a few posts on social media, but there is no traction. You run sale after sale, but no one seems to care. You are now fearing the future.

Bills are mounting. Employees are thinking of leaving. With the bit of work you have, you need to spend more time at the shop and not at home. You are saying to yourself, "Open your own shop! Why did I do this?" Self-doubt creeps into your mind. Your world feels like it's crumbling around you, and you have no idea what to do next.

Here's what happens: Things start to get ugly.

The moment it feels like everything is failing, our instincts tell us to peer into what our competitors are doing. When we see they're successful, we take it as a sign our business will rebound if we do the same as them, so we copy what they are doing.

We go to the extreme. We copy our competitors' words, visuals, and behaviors.

We spend money on marketing and design services that give us slight sharp upticks in revenue, but we quickly flatline again.

Failure keeps coming. What are you supposed to do? Questions fester in your mind:

- Do you look at your competitors again?
- Do you spend the night scouring the internet for business gurus with promises to fix your revenue in as little as seven days?
- Do you spend money on marketing contractors who over-promise and under-deliver... again?

Yes, let's do all of that. Fear-charged copy-paste actions are the new normal. Why do we torture ourselves by doing the same fearful thing repeatedly? Is it because this way is much easier than the alternative?

We are pulled in so many directions that we cannot look to the obvious: our future. Working in and on our business is on our plates every day, and we can't look up. We just want to get through the day.

If someone asked us to answer a simple question, "What's your long-term vision for the company?" We find the question comical. We can't think that far ahead when there is so much to do today.

Our time is finite

Deep in our minds, we know a missing link is holding us back. We secretly admit that our copy-paste antics are not the right move, but we can't overcome this barrier. We know what branding is and how powerful it can be for our company, but we can't invest in this service. We need wins today.

There is no time to dig deeply into what makes us different from our competitors and permanently fix it. As failure after failure continues, fear overshadows logic. As

more questions come to mind, the more they are met with justified self-doubt about why branding is not the answer for our business. Do these sound familiar?:

- We are just another repair shop.
- Who is really going to care?
- It's too expensive.
- I have no time.
- I can't afford another mistake.
- I'll have to change everything in a couple of months, so why bother?
- I can't think about long-term plans right now.
- Fear sets in and never goes away.

The truth about fear

Fear is funny, and I never entirely understood it until I read Napoleon Hill's book "Outwitting the Devil", a book on fear and how to eliminate it from our minds. Fear will cause us long-term suffering. It compounds when left alone, and it makes us unhealthy in mind, body and soul. Fear will also stall us and our businesses, and it holds us back from achievements.

Fear is on your shoulder, whispering sweet nothings in your ear, and sometimes it can be quite deafening. We can easily give in to fear without noticing until we wake up from the spell. When we wake up, we see that time has gone by at an extraordinary pace. We feel left behind and lost. Then anger seeps in, causing harm to ourselves, our families, our employees, and our businesses. We are lost. Now what?

How branding can help

I've been around businesses since I began my career in 2002. I have analyzed and talked with auto shop owners many times, and the stories are all the same: Watch what everyone else is doing and do it as well. It's

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frightening and gross to observe what is happening in this segment of the auto industry. No one is branding themselves.

Branding makes you better: When you properly brand your auto repair shop, your marketing problems go away. Branding gives you the tools to create clear and focused marketing strategies. These branding tools are data, research, strategy, messages and imagery that allow you to develop laser-focus marketing materials that speak directly to your intended audience. They create consistency in everything you do, helping you attract the right customers and employees.

Branding is your accountability partner. When you brand your company, you never have to doubt your marketing actions. You no longer have to worry about those gurus whom you thought were going to help you fix your mistakes, or those marketing contractors who think they know better than you.

Branding is your manual. The significant part of branding is that you can refer back to your brand anytime you feel stuck or pulled in another direction. It will always bring you back on track. It is your guidance manual, and your recruitment manual. Branding helps you find the right employees and retain them.

Why brand your business?

Most new competitors will start with a copy-paste attitude. They will replicate branding and marketing tactics used by everyone else because it's easier than branding properly. Their fear-based assumptions put you in an advantageous position.

When you brand your business, you stand out. As a well-seasoned auto repair shop, branding is easier than your new competitors. Your wealth of experience and knowledge of your customers is something these new businesses don't have, making your journey to branding properly much more effortless than theirs.

For your competitors to gain market share, they need to accelerate their branding beyond your speed, and they need to source

more money and resources to close the gap. The easier way is to copy-paste what they see. They are running on fear.

How to brand your auto shop

Let me remind you that branding takes time. It is not a quick fix. It is an investment in the long-term stability of your company. You have to dig deep into the soul of your company and reacquaint yourself with why you started your auto shop.

You need to address every detail of your existing brand: what is working, what needs improvement, and what needs to be changed must be analyzed inside and out.

Start with building the foundation by following these steps:

- Create a purpose statement
- Rewrite your mission, vision, and values
- Analyze your competitor's customers with a fine-tooth comb
- Dig deeply into what makes you different from everyone else
- Build a community around your brand

It's also important to analyze your existing creation. Are your name, slogan, unique selling propositions, and stories aligned to your target audience? Does your existing logo make the right first impression, or are you blending in with the crowd? What is your customer experience like from beginning to end?

Then, take action. If you have always wanted to specialize your auto repair shop, do it. Specializing creates stronger marketing and branding tactics. You can accelerate your reputation as a specialist because you have been in business for a long time.

If you were scared to show your face on your website, don't be. Customers want to know the people behind the business. Transparency creates stronger bonds and can be a unique selling feature for the recruitment of employees.

If you thought shop tours were a waste of time, toss that fear aside. These are opportunities to get to know your customers and build strong relationships. You can learn more about your customers from a simple 10-minute tour.

Suppose you wanted to start a social media feed with a unique approach unseen today. Do it. Customers want to be entertained or educated in unique ways. Approaching social media from a different angle can help your company stand out and grab attention.

If you want to keep in touch with customers but struggle to find an easy solution, collect email addresses. Email marketing will always be a valuable tool to repeat buys and continued brand awareness. Your customers permitted you to keep in touch. Take advantage of that by sending emails once every two to three weeks!

Fall in love again

Remember when you started your auto shop? Remember the excitement when your first customers — friends and family — spent money at your business? Do you recall when a referral walked in unannounced?

Those were good days. They can happen again when you brand your company correctly. You will no longer be reliant on friends and family to generate revenue. They now become bonuses to your business.

And that fear you once had? Fear is no longer screaming in your ear. It's a dull whisper and a soft tap on your shoulder that you can quickly ignore. Why is that? Because you decided today that your company is better than everyone else, and you tossed fear, self-doubt, and limiting beliefs aside. You decided today was the day to put time aside to think about the long-term vision of your business and take action to build its brand correctly. *TM*



DENNIS MICHAEL is the owner of Holeshot Brandworks, branding experts for the automotive aftermarket. They add

horsepower to automotive brands. Helping them win sales, attention, and retention. Learn more at <https://holeshotbrandworks.com> and follow them on Instagram @ [HoleshotBrandworks](#), on Twitter @ [HoleshotBworks](#), on LinkedIn <https://www.linkedin.com/in/dennismichael/> and on Clubhouse @ [DennisMichael](#).

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Should you have a business plan?

PHOTO 1831237 © MICHAL BEDNAREK | DREAMSTIME.COM

Whether thriving, failing, or just making it, a business plan can help ensure the growth of your shop.

BY JENNIFER LANG // Contributing Editor

When you travel, you have a plan. When you build a home, you have a plan. When you save for your kids' education or your retirement, you have a plan. It sure would seem like a good idea to have a plan for your business, which is probably paying for all your other lifetime plans.

Don't worry, we are not expecting you to put together a lengthy document and you don't have to do it all at once. Your plan can take as long as you need to develop it and, in fact, taking a good hard look at your business is not an over-night thing.

Business plans aren't just for startups. Developing a business plan for an established business serves several purposes: It can help convince investors or lenders to finance your business,

persuade a business buyer to purchase your business, or entice partners or key employees to join your company. The 2022 *Motor Age* reader survey shows that 75 percent of all shop owners are aged 55 or older and 34 percent are over 65. Having a plan to show your potential business purchaser is the best sales tool there is. Most importantly, regardless of the stage of your business, a business plan serves as a roadmap guiding the growth and continued success of your business.

Creating and revising a business plan is your best opportunity to carefully think through every step to achieving your goals for your company. This is your chance to discover weaknesses that may threaten your business, identify opportunities you may not have considered, and plan how you will deal with challenges that are likely to arise.

Be honest with yourself as you work through your business plan. Don't gloss over potential problems; instead, figure out solutions.

According to the *PTEN* 2022 After-market Profile, the percentage of shops offering repairs for advanced driver assistance systems (ADAS), has grown from six percent to 12 percent in just three years and is forecast to grow again in 2022. Is this a service you should be offering? Is your team trained in this area? Is this extra revenue worth the investment? This is the type of research you should be doing and deciding upon. The U.S. Energy Information Administration forecast that 51 percent of the vehicles sold in 2027 will be hybrids and electric vehicles. Are you ready for that?

A good business plan doesn't have to be long and wordy — it needs to be clear and concise. A person outside of your industry

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should be able to understand it. Avoid over-using industry jargon or terminology. Try to spend most of the time involved on researching and thinking and avoid making unsubstantiated claims or sweeping statements. Be totally honest, your assumptions must be supported with facts.

If your plan is primarily for internal use, it doesn't need to be as lengthy or fine-tuned as a plan for outside readers. However, you should still think it through carefully, particularly the marketing and financial sections. You might start with a business canvas model or "lean canvas" form of plan that asks you to fill out nine boxes on one page of paper. If you can write one sentence in each box, you've got the start of a traditional business plan. For the business plan, just Google, "lean business model canvas." There are many free and low-cost plans.

If you are going to apply for financing or look for funding sources, you'll need a

traditional business plan with all the required elements. One trick to ensuring your plan is well written is to write the executive summary, which highlights each element of your plan for the potential reader, last. Doing so will ensure that you highlight the key points in each element and maintain a continuity of your plan that shows how the actions and research contained in each element contribute to your overall goal of sustained profit and growth.

So how do you start? Often a simple SWOT analysis will get you thinking in the right direction. Simply stated SWOT stands for:

- Strengths: What do you do well?
- Weaknesses: Where do you think your business is struggling?
- Opportunities: How can you build your business?
- Threats: What is lurking out there that could torpedo your business?

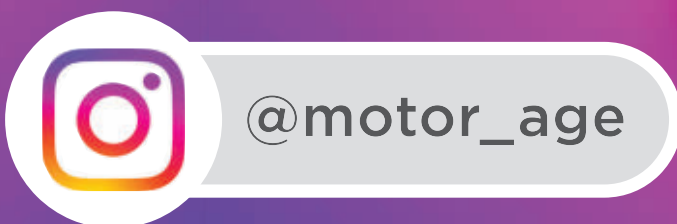
To find suitable forms for you, simply type "SWOT template" into Google, click on images, and print the one you like. Then you'll be well on your way to taking your business to the next level. **ZZ**



JENNIFER LANG is the chair of Score's North Cook and Lake Counties Chapter since July, 2021. Score is a nationwide

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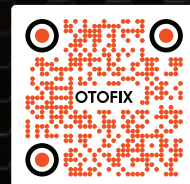
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KEY PROGRAMMING IN THE AFTERMARKET

NOT TOO LONG AGO, PROGRAMMING KEYS WAS SOMETHING TYPICALLY DONE IN THE DEALERSHIP PARTS OR SERVICE DEPARTMENT. BUT WITH TODAY'S TECHNOLOGICAL ADVANCES, JUST ABOUT ANYONE CAN DO IT!

BY BRANDON STECKLER // Technical Editor

In the two recent decades that have passed, and my years spent in multiple automotive dealerships, I've witnessed countless keys and key fobs being programmed. Of course, the dealership was the only one in town with that capability.

Scan tool and programming capability

Part of the reason why was because the dealership service departments were the only ones that possessed the appropriate scan tool capabilities often required to carry out that process. At the time, independent automotive facilities in my

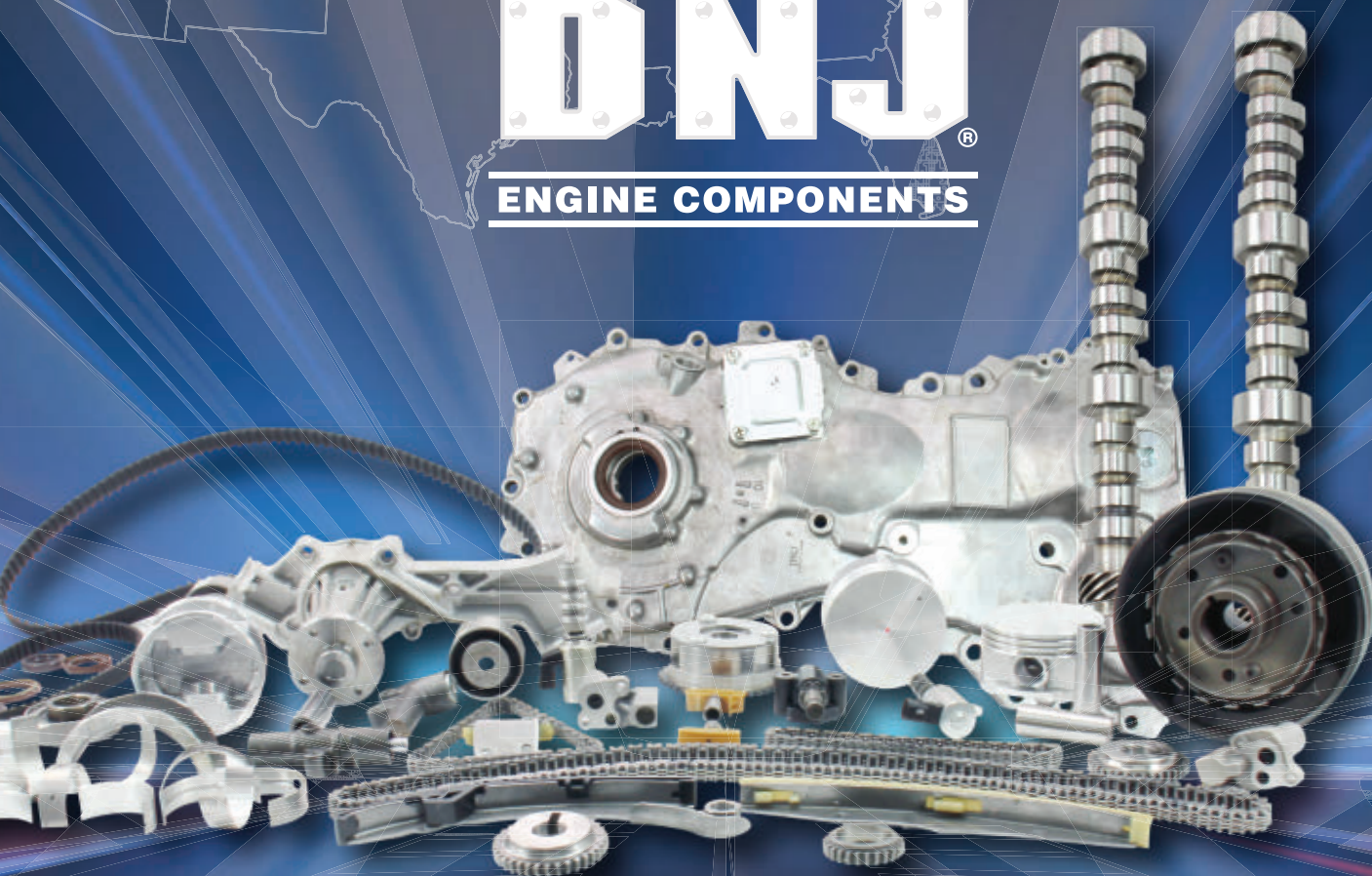
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area didn't typically have their own handheld factory scan tool like the dealerships did.

Early on, when a customer needed a key (or key fob), it was often a matter of pairing the fob to the car with a series of simple button-pushes. When the job was more involved, it was usually sublet to the local dealer. That might mean simply having a key cut/programmed and then shipped to the original shop. Sometimes it could mean driving the customer's vehicle to the dealership. And in the worst-case scenario, it meant towing the vehicle to the dealer (as certain functions may have had to be carried out with the vehicle present).

Key cutting capability

The second half of that equation is the ability to physically create a key to match the vehicle's lock cylinders. I recall in years past having to recode the lock cylinder's tumblers to match the new key that was offered. That was a real pain in the neck, especially when the customer wanted one key for every functional lock assembly:

- Driver's door
- Passenger's door
- Ignition switch
- Trunk
- Glove box

It was either that, or the customer would need multiple keys to operate different lock assemblies. Not many were ever too fond of the latter. But then along came the mobile locksmith. This certainly made life a bit easier. The locksmith had the tools and capabilities to both generate a key and carry out the security routines necessary to make that key function with the vehicle. The fact that he or she was mobile made it extremely convenient as well.

As much of an improvement as this was, it wasn't without its own set of headaches. For one, you had to wait for their availability. After all, being the



THE AUTEL IM608PRO offers tremendous immobilizer/ key programming capability as well as traditional scan tool functions.

only mobile locksmith in town kept them quite busy. The second reason was that there wasn't much room for profit margin. Being "the shop," you were paying the locksmith for their tools, their talent, and the convenience. That doesn't come cheap. Yes, the cost was being passed down to the shop's customers, but the amount of profit that specific operation yielded wasn't always impressive.

The 'independents'

Technology is a wonderful commodity. We can see it everywhere in every industry in existence. And near the top of the list is the automotive repair industry. Currently, the ability to generate/program keys and fobs is relatively simple, fairly inexpensive to get into, always in demand, and can be tremendously profitable.

With liaisons like the National Automotive Service Task Force (NASTF), gaining temporary access to factory service information/security information/tooling and training is a few clicks away. Any legitimate automotive business personnel who meet the criteria can license as a "Vehicle

Security Professional," allowing him or her access to the above to carry out programming. Many of these functions can be carried out through J2534 programming and don't require an expensive factory tool for each make. It's all accessible through NASTF's affiliate website (OEM1stop).

There are other options for the independents as well, especially since the widespread application of push-to-start systems without the need of a traditional key. Some of the aftermarket standalone scan tools (which the shop may already own) possess a similar capability as described with the OEM scan tools.

For instance, the Autel IM608 scan tool is capable of key programming and immobilizer functions on more than 80 make and models. It offers guided automated key learning and can even read PIN codes. Additionally, the Autel KM100 key generation and program solution offers 99 percent coverage of cars and light-duty trucks on the road today. This, coupled with the Autel iKEYS offers an almost universal approach to key generation and programming. With options such as

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this available, finally, the power to profit is back in the independent's hands. The KM100 is designed specifically for key programming and immobilizer functions, making the return on investment very rapid.

So, how profitable can this arena be? Well, I suggest you look at this from a different angle. Many of us think about "return on investment" head-on. But if you see it from a different viewpoint, the fruit appears much more abundant.

Not only will there be a need for key generation/programming for obvious situations (like a lost key fob), or when a car has been recovered after being stolen. But less obvious situations can be the largest source of potential profit.

Consider how many vehicles visit the shop weekly. Then consider how many of those customers hand you keys/fobs in terrible condition (taped up, glued, or even fastened back together with screws). Rarely, do those customers reach out for a replacement. Even if they did, the conversation typically ends quickly when they learn the cost of replacement may exceed \$400 and require a second visit (or extended visit) to remedy. Many keys now are order-only, and some must be sent over from Europe if you can even source one. It's no wonder that these customers are still driving around with keys/fobs in shambles.

Now, what if you could offer that same key and service in-house, for about one-third of the price, and in a very short time (usually just minutes)? I now look at potential "return on investment" like this:

- How many key/fobs/programming can I upsell this week?
- What if I market the shop for hire throughout the community for other shops to utilize?
- Maybe I can put a vehicle on the road and offer a mobile service?

Although this would all require careful preparation and it isn't as simple as it sounded above, it's all possible.

There are other options available from many manufacturers of key cutting and programming solutions equipment, companies such as Launch, OBD Innovations, TOPDON, and XTool. Not every manufacturer may offer 100 percent coverage, and I'm confident that some offer strengths where others are weak (and vice versa). But do your research. Key-cutting and programming is an area to profit in. Don't be so quick to give it away. *ML*



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

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WHAT TECHS NEED TO KNOW ABOUT HYDROGEN FUEL CELL

THE HYDROGEN FUEL CELL ELECTRIC VEHICLE IS NOT A NEW CONCEPT. ALTHOUGH IT HAS PREVIOUSLY MADE ITS DEBUT, IT HAS YET TO SETTLE IN AS MAINSTREAM TECHNOLOGY.

BY MICHEAL SMYTH // Contributing Editor

I'll let you off the hook early on this one. Unless you work at one of the few OEM dealerships that support hydrogen fuel cell vehicles, you probably won't need much technical knowledge on hydrogen (as a vehicle fuel) for a while. But knowledge is power and perhaps we will be seeing more of this technology in the future.

The implementation of fuel cell electric vehicle technology (known in shorthand as FCEVs) is progressing much more slowly than projected 10 years ago and is seemingly being pushed aside by the aggressive growth of electric cars. Nevertheless, many industry analysts still say that hydrogen fuel cell vehicles are our future, will be a preferred long-term choice over electric cars, and that we should be prepared to support the technology once it becomes more mainstream.

I'd have to agree with them. On the surface, fuel cell vehicles look pretty darn attractive:

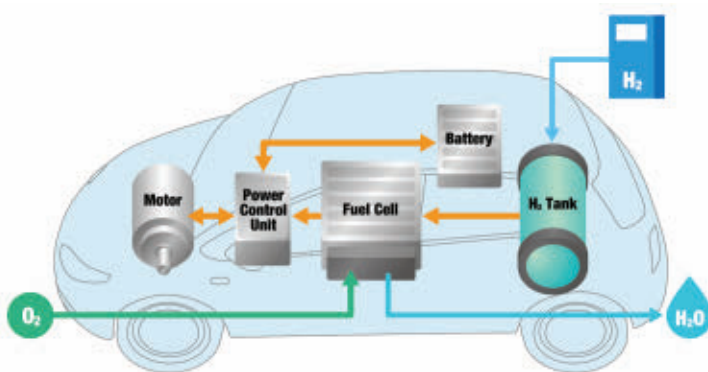
- They run solely on the most widely available element on the earth, hydrogen
- They are a true "zero-emission" vehicle, with only water vapor emitting from the tailpipe
- Millions of dollars in private and public money are being invested in their development
- There are multiple state and federal incentives available to buyers that can take a big chunk out of a new FCEV purchase price

So, it looks like these vehicles check all the boxes that would make them a growing force in today's alternative and green vehicle market. So why is it, then, that hydrogen vehicles and their implementation just seem to be spinning their wheels? Let's take a deep dive into fuel cell vehicles, how they work, and why they are developing at such a slow pace.

What exactly is a hydrogen vehicle?

Since the reemergence of hydrogen cars, two system configurations have been researched that utilize hydrogen as their fuel source: hydrogen-powered internal combustion engines (ICE) and hydrogen fuel cell electric vehicles (FCEVs).

A hydrogen-powered ICE vehicle is very similar to conventional cars in that it has an ICE that burns hydrogen as its fuel, similar to today's propane and CNG vehicles. However, research into hydrogen ICE vehicles has been mostly aban-

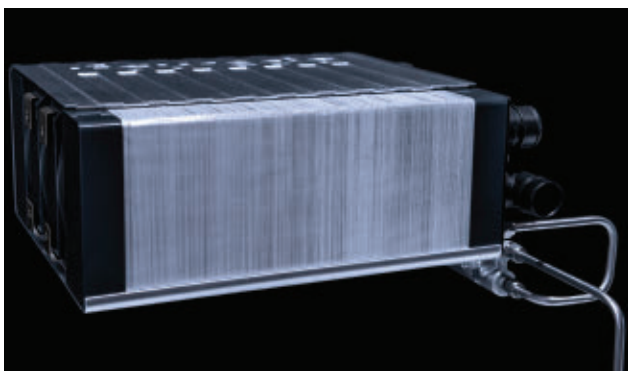


THE MECHANISMS INSIDE a typical fuel cell electric vehicle.



THE TOYOTA MIRAI is the largest selling FCEV in the United States.

VEHICLES



A HYDROGEN FUEL CELL removed from a vehicle.

done. This is because ICE engines require a large volume of hydrogen to produce adequate torque (due to the low BTUs produced when hydrogen is burned in the engine's cylinders). In addition, burning hydrogen in a combustion chamber goes against many of the principles behind newer technology vehicles, mainly reducing tailpipe emissions.

On the other hand, an FCEV is an advanced technology vehicle that uses a fuel cell to generate electricity. It uses hydrogen fuel to produce the electrical power that propels the vehicle. FCEVs are zero-emission vehicles, similar to electric cars. However, FCEVs produce electricity from hydrogen to drive the vehicle's electric motor, rather than from a battery that has been charged from an EV charging station. The on-board production of an FCEV's electricity occurs in a device that is the heart of an FCEV, a fuel cell. The fuel cell works somewhat like a battery, but the fuel cell does not run down or require charging. As long as there is a constant flow of hydrogen into the fuel cell, it will produce a steady stream of electricity and byproducts of only heat and water vapor. The heat dissipates from the fuel cell, the water vapor is removed by a tailpipe, and the electricity is used to propel the car.

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FCEVs also contain a lithium battery (similar to electric vehicles) used to store excess electricity generated by the fuel cell and any power generated by the vehicle's regenerative braking system.

So, what's the holdup?

My first direct contact with an FCEV was in 2010, when I had an opportunity to travel to southern California on a hydrogen junket, visiting Honda and their newly released Clarity FCEV. I also toured Toyota's hydrogen research center and was with Shell Oil Company (which at that time, was the leader in hydrogen fueling station research and implementation).

What I experienced was somewhat overwhelming. These three manufacturers were betting hydrogen vehicles were the future and were putting their money where their mouth was. The Clarity was and continues to be a fantastic vehicle; powerful, good-looking, free to fuel (at that time), and one with zero carbon footprint in its operation.

Toyota was not far behind, and although they did not have a mass-market car available to the consumer then, their research led to the Mirai, currently the world's number-one FCEV. Shell, however, was the most impressive.

We toured five different hydrogen fueling stations (each producing hydrogen differently), designed as a feasibility study for the future of hydrogen fueling. So, that was over 10 years ago. What happened?

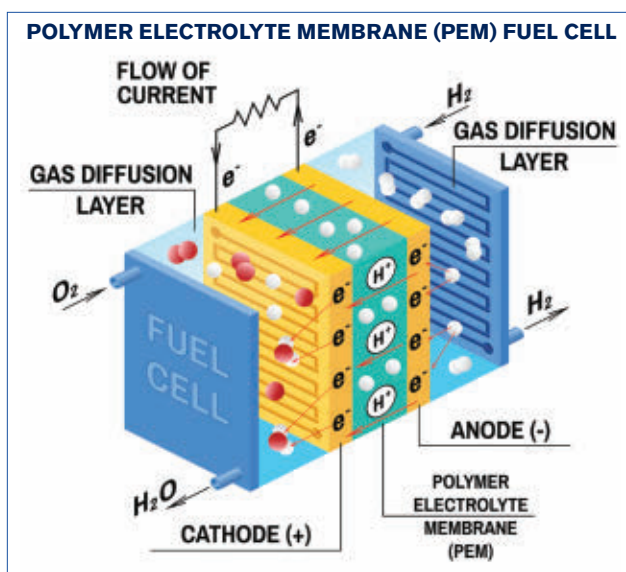
Hydrogen cars are still costly to produce

To date, only three manufacturers offer for sale or lease FCEVs: Toyota (with its Mirai), Hyundai (and its Nexo), and the recently discontinued but still somewhat available Honda Clarity. Although rather reasonably priced (especially when you consider the technology under the hood), the word on the street is that the OEMs that produce them lose tens of thousands of dollars for each one that goes out the door.

Hydrogen is an expensive fuel – and generally not 'green'

Right now, most of hydrogen produced for vehicle fuel is produced by the reformation of natural gas. This creates hydrogen and CO₂, the primary source of climate change. Although operating an FCEV is zero-emission, the fuel production for them is not, somewhat defeating the idea that an FCEV has no climate impact.

As for the fuel, producing quality hydrogen for vehicles is expensive, with some estimates putting the price at over \$16 per gallon. This price would drop once it scaled up in its production as demand grew, but the price is a current factor.



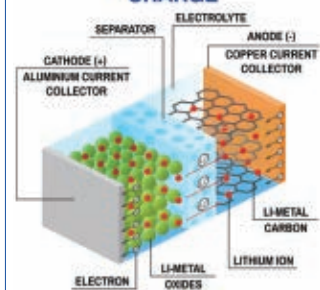
A BREAKDOWN OF the internal workings of a fuel cell.



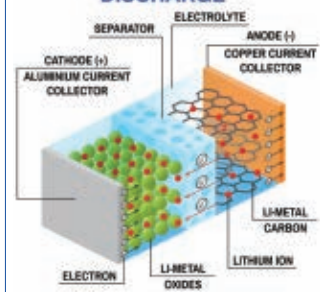
A HYDROGEN VEHICLE fueling station in southern California.

LITHIUM-ION BATTERY

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In addition, there is a push for more production of "green" or environmentally friendly hydrogen. This is accomplished by production through an electrolysis process (with electricity coming from renewable sources). However, green hydrogen costs are even greater than traditionally made hydrogen.

Hydrogen fueling stations are still few and far between – and unreliable

A quick check of the Department of Energy's Alternative Fuels Data Center will show you that public hydrogen fueling stations exist in volume in only one state – California. For numerous reasons, California was and continues to be the



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center of the hydrogen vehicle universe. Jump over to the California Fuel Cell Partnership's web page, and you'll see that there are fewer than 60 fueling stations in the entire state. No fueling stations, no need to think about buying an FCEV. Even in California, the lack of fueling infrastructure becomes more critical when at any given time, 20 to 40 percent of the fueling stations there are offline for various issues.

Car availability

Without fueling stations, there is no need to sell FCEVs, is there? There are plans to add thousands of fueling stations over the next ten years, but this plan has been in place for a long time. We had a hydrogen station at West Virginia University during my time there (under a research grant from the Department of Energy), but until it was taken offline around 2013, it had fueled very few vehicles and was unreliable and problematic.

Without the capability to fuel the vehicles, few OEMs will be investing in hydrogen fuel cells beyond mid-level research and development. FCEV sales are a little stronger when looking at the global market, with just under 42,000 sold globally since 2010. However, to put that into perspective, approximately the same number of Volkswagens are sold in China in four days.

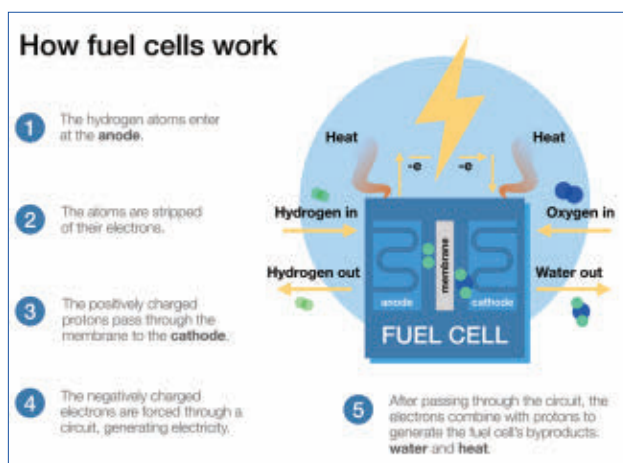
How a fuel cell works

The heart of an FCEV is the fuel cell, where the "magic" of generating electricity happens. A fuel cell relies on some simple scientific principles:

- Positively charged objects are attracted to negatively charged ones.
- Protons carry a positive (+) charge; electrons carry a negative (-) charge.
- Electricity is simply the flow of electrons.
- The catalyst of the fuel cell splits hydrogen atoms into protons and electrons, creating electricity for vehicle propulsion.

What happens in a fuel cell?

- Hydrogen atoms from the storage tank enter the negatively-charged side of the fuel cell, called the anode. The hydrogen molecules are distributed across the surface of the anode.
- As the hydrogen comes into contact with the platinum catalyst, each atom is split into a positively charged proton and a negatively charged electron.
- The protons pass through the polymer electrolyte membrane (PEM) while the electrons accumulate on the anode, creating a negative charge that pushes the electrons through an external circuit. This provides electricity for the vehicle.



A DETAILED DIAGRAM of the operation of a hydrogen fuel cell.

- Meanwhile, on the cathode side, air containing oxygen gas (O₂) enters the cathode side of the fuel cell. The two protons recombine with their electrons and then join one oxygen atom to form a water molecule — H₂O.
- The water is vented to the atmosphere as more air is drawn in to continue the process.

Hydrogen safety

Although hydrogen is not a poisonous gas, it can displace oxygen in a confined area. However, it tends to diffuse rapidly. As it is lighter than air, it rises when released. Rising hydrogen gas can create a safety issue if it becomes trapped. Repair facilities and fueling stations that service hydrogen vehicles are typically designed with ample ventilation so that hydrogen gas will not collect underneath the building's roof and can disperse in the event of a leak. Hydrogen sensors may also be installed in such facilities and be connected to an alarm system that is both audible and visual.

Hydrogen is flammable and burns with a pale blue flame that is difficult to see in daylight. The flame is smokeless and does not radiate very much heat. Therefore, it may be difficult at first to identify a hydrogen flame. An infrared camera can be used to view the heat signature of a hydrogen flame. A common straw broom can also be extended into the location of the suspected fire to see if it ignites.

As with most other gaseous-fueled vehicles, a hydrogen fuel cell vehicle will have at least one temperature relief device (TRD) mounted on the vehicle's hydrogen storage tank. Many hydrogen fuel cell vehicles have multiple hydrogen storage tanks. If so, each tank will have at least one temperature relief device. These devices are designed to rapidly vent hydrogen gas if the temperature at the device exceeds a given temperature (approximately 230 degrees F or 110 degrees C).

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What does a technician need to know?

Simply put, most of an FCEV's components and systems parallel those of an electric vehicle. The high-voltage battery, electric motor, control systems, and inverters use the same technology as EVs, and a diagnostic and repair technician familiar with electric vehicles will feel at home with the vehicle with two exceptions. The differences between EVs and FCEVs reside in the fuel storage system and the fuel cell.

As for safety, the technician should follow many of the same guidelines they follow for EVs and CNG vehicles:

- Use of HV insulating gloves and over-protectors
- Removal of HV battery pack service plugs before component service
- Use of HV-rated meters and leads
- Understanding the proper defueling methods when removing compressed hydrogen from a vehicle's fuel tank

The hydrogen fuel storage and delivery system will be very familiar to those familiar with CNG vehicles. Hydrogen is stored in the vehicle in a fiber-wrapped fuel cylinder at pressures up to 10,000 psi, and it is filled at fueling stations similar to CNG technologies. An FCEV can be filled with hydrogen in about the same amount of time it takes to fill a gasoline or diesel vehicle (a distinct advantage over EV charging).

The fuel cell, however, will be maintained and repaired by specialized OEM personnel for the foreseeable future. Fuel cells are complex, have no user or local technician parts that can be replaced, and are very well protected pieces of technology (system operation and construction are guarded secrets). They are also the most expensive component in the vehicle and can make up over half the price of the whole vehicle. Therefore, it will be a very long time before our industry is capable of any sort of fuel cell repair at the local level.

So, when it comes to FCEVs, it could be a really good thing, especially regarding the cost of gasoline and diesel, currently. If we can get the infrastructure in place, might it be the next best technology since computerized fuel injection? I guess time will tell. *ML*



MICHEAL SMYTH is a founding partner and director of training for AFV Educate, a not-for-profit 401(c)(3) training organization specializing in alternative fuel curriculum development and educational presentation for first and second responders and automotive technicians. His previous positions included director of West Virginia University's National Alternative Fuels Training Consortium and director of training at Automotive Video Innovations. Smyth has over 12 years of experience working with and presenting information on AFVs.

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THE REBEL MODULE

DATA IS ONLY AS RELIABLE AS THE INFRASTRUCTURE IT RESIDES IN. A CORRUPTED DATA BUS HAS THIS CHRYSLER APPEARING POSSESSED AND ITS OWNER ON HIS LAST NERVE.

BY ROSS COLKET // Contributing Editor

VEHICLE INFORMATION

2016 RAM REBEL 1500

5.7 Liter Hemi MDS VVT engine
8-speed Automatic 8HP70

ORIGINAL COMPLAINT:

"Instrument lights all light up and the transmission shifts hard."



ORIGINAL CUSTOMER COMPLAINT:

Customer states the vehicle instrument lights all light up and the transmission shifts hard and bangs when driving.

The customer had originally contacted us on the phone to discuss the problem they were having with their vehicle and to inquire if we were able to diagnose the vehicle for them. After multiple unsuccessful dealership service department visits, the customer was extremely frustrated. Every time they picked up the vehicle, the problem would happen within 15 minutes of them driving the vehicle. Typically, the problem would happen on the way home from the dealership. The customer went on to explain that they had paid for the top-level extended warranty through Chrysler due to the potential expense of what could be wrong. So, our job was to diagnose the problem and they would return to the dealer for the repair.

The interview

We always start problem vehicles with an interview to discuss the specific problem the customer is having. We will ask probing questions like: 'When does the problem happen?' 'Were you in traffic?' 'Were you accelerating?' and many more, depending on the problem. Remember, the customer may not know the techni-

cal terms for describing the problem or the part they think could be the problem, but they do know their car and will do their best to describe the problem it is having. It is up to us as professionals to listen and educate the customer as to what they are describing and to begin formulating a diagnostic strategy.

We were able to determine the vehicle would always begin to have the problem in traffic, mostly on hot days. The instrument cluster indicator lights would all come on. The turn signals would stop working, and you could shut the vehicle off, but it would not restart while the problem was occurring. The most important thing we found out was that the windshield wipers would come on when the problem was happening and would turn off when the problem stopped.

The diagnostic strategy

We now knew we were dealing with an intermittent problem that would signal us with the wipers turning on when it was occurring. We decided to check for codes and check Identifix for bulletins and common problems.

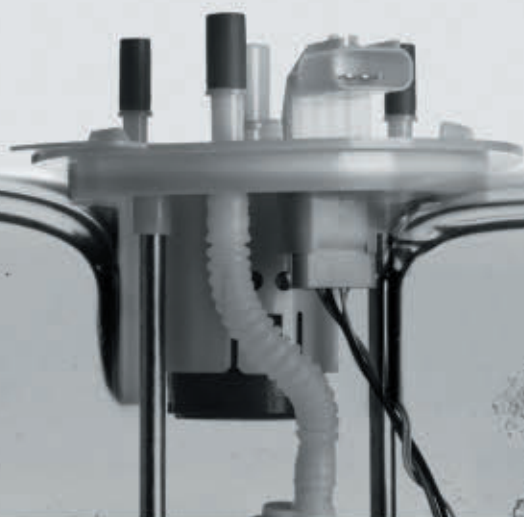
We found 52 codes in 20 modules, and all the codes were communication codes

except one, for a circuit failure in the door handle sense circuit (**Figure 2**). The code for the door handle sense circuit is in the Radio Frequency Hub module (which does happen to be part of the CAN C bus). It was another clue but not enough to justify taking apart the driver's door. Most of the codes pointed toward the CAN C bus performance or being "off."

Identifix showed multiple hits, with possible causes all over the board. This information gave us some direction to the CAN C network but not enough to determine a specific pinpoint test currently. We could see by looking at the network topology that the CAN C bus shutting down would explain all the customer complaints. Now it was time to find the root cause.

One of the great things with network diagnostics is that we often can access the network through the DLC. But first, we needed to be able to duplicate the customer's concern at the time of the test. So, we started by hooking up our oscilloscope

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to the CAN C bus through the OBDII port. We used an OBDII breakout box for a quick connection. Keep in mind we either want to use the proper terminal probes or a breakout box so that we do not damage the pins of the OBDII port. Another great part of the breakout box is I can also hook up a scanner at the same time to watch data (**Figure 3**).

We connected the scope's ground to pin 4 (chassis ground), channel 1 to pin 6 (CAN C High), and channel 2 to pin 14 (CAN C Low). We could see a nice clean and stable CAN C bus signal. CAN C High is 2.5V to 3.5V and CAN C Low signal is 2.5V to 1.5V (**Figure 4**). The signal did have some noise but was not enough for concern at the time. Keep in mind everything was functioning properly at that time.

We also shut the car off until the CAN C bus went to sleep and checked the resis-

tance of pins 6 and 14, finding the bus had the recommended 60 ohms of resistance. We knew that both terminating resistors were on the network at that time.

The test drive

We cleared all the codes in the vehicle in hopes that if any of the codes reset, we might have seen different information than we had before. We began by driving the vehicle normally (in town and then transitioning to the highway). We made sure to hit stop-and-go traffic, but we were unable to duplicate the customer's concern at the time.

We tried it with the vehicle cold, warm, and hot. We drove the vehicle very lightly and very aggressively but were unable to duplicate the customer's concern. We needed to get other jobs done in the shop, so we parked the car behind our service bay and let it idle.

We had as many electrical loads turned on as we could to pull the voltage down and stress the vehicle. We watched the voltage dip down to 12.2V and the idle pick up to close to 1,000 RPM. We kept turning the heated seats and heated steering wheel on, as they would time out and turn off on their own. Finally, about 45 minutes later, we saw the wiper blades come on (Perfect! Now we were getting

somewhere). When we looked at the dash, we could see the gauges were dead and multiple indicator lights were on (**Figure 5**). We opened the door and the wipers shut off. So, we knew the network had begun to talk again and we most likely wouldn't see any problems on the scope. We checked our scope pattern and found the pattern to be slightly unstable, but not enough to shut down the network (**Figure 6**). The pattern indicated the voltage was fluctuating on the network, within its normal toggling voltage levels. This was the first time that we had seen the problem beginning to impact the network signal.

The next step

We continued to stress-test the vehicle and were getting the problem to randomly occur but not for any significant period. We learned that the vehicle's wipers would come on, the hazard flashers still worked, but no turn signals. The vehicle would not come out of park; the power windows would work, but not the power locks. There was absolutely no information on the cluster; the gauges were dead, and just a few indicator lights lit up. And, if you turned the vehicle off, it would not restart.

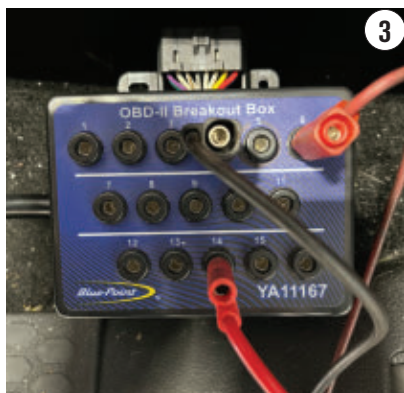
All the trouble codes indicated communication failures or invalid data received from a module. We now were seeing the scope pattern was flatlining at 0V (On both CAN C High and Low) (**Figure 7**). Now that we had seen at what we were looking, we could reconfigure the oscilloscope to better catch the glitch.

Scope configuration

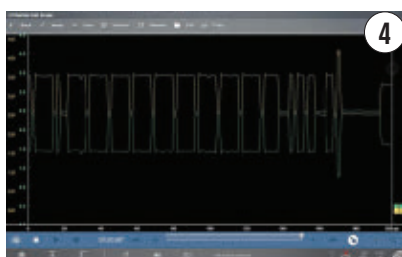
Originally when I set up the scope, I had it on .5V per division and 20 μ S (microsec-



THIS IS THE FIRST FULL VEHICLE SCAN that we did on the vehicle after the customer reported the problem. I did not include all the codes, as there are too many to show in one picture.



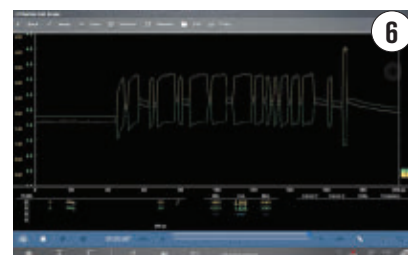
ILLUSTRATING HOW EASY it is to tie into the CAN High and CAN Low bus with a breakout box.



A GOOD PATTERN of the network communicating when the problem was not occurring.



THE INSTRUMENT CLUSTER completely shut down due to the network crashing.



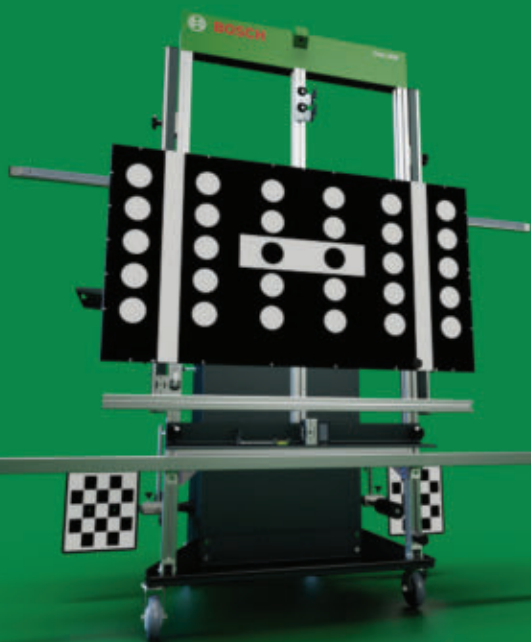
FLUCTUATING WAVEFORM of the CAN bus as the problem begins to occur.

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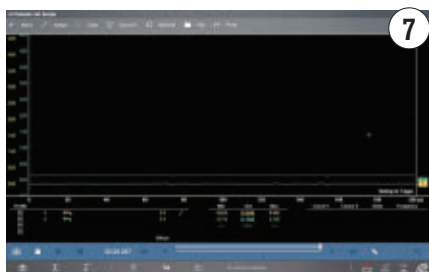
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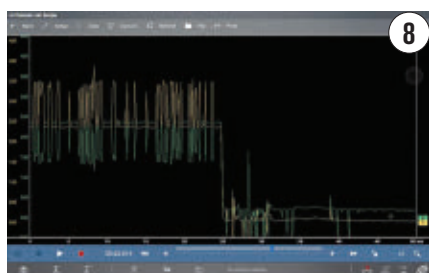


Test, Tune and Analyze

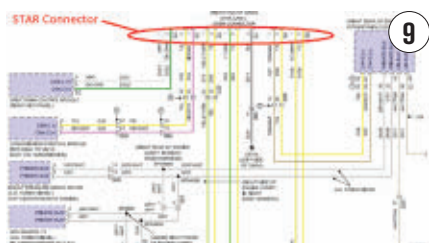
Test, analyze and diagnose your vehicle electrical and mechanical systems.



THE WAVEFORM of the CAN bus of CAN High and CAN Low at zero volts when the module took down the network.



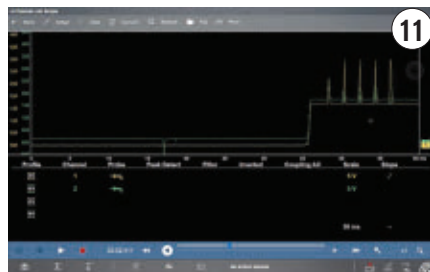
THE WAVEFORM of the CAN bus shows the moment that the bus crashes and also readjusted the time base setting to look at more of the signal on the screen and also adjusted the trigger to better catch when it crashed.



THE STAR BUS NETWORK physical topology allows for a process of elimination when a bus fault (like the one exhibited) is present.



THIS IS A PICTURE of the passenger side CAN bus Star connector. It is located against the right front of a pillar. You can see the edge of the blower motor off to the one side.



SCREENSHOT OF the network bus coming back online when the TCM was disconnected from the network.

ond) per time division. (**Reference Figure 4**). These settings will give you 0 to 5V and a total of 200 μ S (or 200 millionths of a second per screen). It gives great detail but is a very small fraction of time. The chances of actually seeing a problem are very small if you do not have the trace set properly on the scope.

There are so many screens because of all the sampling that has been recorded, and the short period that you are actually looking at will cause you to potentially lose yourself in too much information.

You will notice (in the next image) that I adjusted the time base on the scope to look at a much larger amount of time: 5 ms per division, or a total of 50 ms (milliseconds). By doing this, we were able to look at a much larger time frame and have a better chance of catching the failure.

We now knew the signal dropped to zero volts, so we set our trace to look for a voltage drop. (**Figure 8**) (Perfect! We captured the problem). Unfortunately, there was no way to know from the signal what was causing the problem, but we had absolute confirmation it was an issue in the CAN C bus.

The final diagnosis

Chrysler products have a star configuration bus (as seen by the topology map from the scanner). The scanner's topology map is great for a quick reference, but there is quite a bit more information that can be determined from the network topology map from *Mitchell 1 ProDemand*. Keep in mind this is only 1 page of 5 for this vehicle. But let's take a closer look and see what we can learn about the network from this image (**Figure 9**).

We can see that all the modules on the

bus are parallel to one another (Not like a series network, where if you lose one module, you will lose all the modules after it). We could see that the CAN C star connector is located at the right end of the dash. This was our easiest access point for our next test.

I prefer to be more specific when doing a pinpoint test to verify a problem, but this is the next step in the diagnostic process. We begin by getting access to the star connector (**Figure 10**). Once we have accessed the connector, we will wait for the problem to occur, and while watching the scope pattern. Once the pattern drops off, we will start by disconnecting each two-wire connector. If the problem goes away, the next step is to verify which module is causing the problem.

Got it! The transmission control module was pulling the network down. As soon as we disconnected the transmission control module, the network jumped back to life. (**Figure 11**). So, it was a faulty transmission control module.

STOP! Not yet; we still needed to test powers and grounds to the module. We performed these tests when the problem was occurring and clarified that they were demonstrating no deficiencies. We found the rebel module. Unfortunately for the customer, this particular transmission has the TCM inside the valve body (internal).

The resolution

We contacted the customer and explained what we had found and how we had found it. We also supported this information with screenshots and printouts to show to the dealer. The customer was ecstatic that we had found the problem and was excited to return to the dealer to get the repairs performed.

Never once did they question the amount of the bill, because we had found the problem. I encouraged the customer to schedule an appointment as quickly as possible with the local dealership, which they did. Approximately a week and a

half later I received a phone call from the customer, who was very distraught over the dealership's responses and the overall customer interaction they had.

They explained to me the dealer wouldn't even look at the printouts we had given them. The dealer responded that the vehicle must exhibit the problem when it was hooked to dealer equipment only. The material we provided meant nothing to them. I told the customer I would go speak with the service manager at the dealership to try to explain how to duplicate the problem.

My conversation with the service manager went better than I expected. He allowed me to speak with the senior technician who was working on the vehicle. I explained to him the vehicle needed to be hot and a heavy electrical load for approximately one hour. I left hoping that I had not wasted my time.

Fast-forward a few days and I received another call from the customer. He was so frustrated that he was done with that dealership and asked if I could recommend another one, which I did. This time, I spoke to the service writer and conveyed all the information we had learned on how to duplicate the problem. Again, it, unfortunately, ended up being a waste of my time. Several days later, I received a call from the customer, who asked if we would perform the transmission valve body replacement job. I explained to them that I would not be able to use their extended warranty and that the bill would have to be paid for. They said they understood that, and while they weren't happy about it, they were so impressed with our shop and what we had done for them, they wanted us to at least benefit from the repair (and not the dealer).

We ordered the parts, made the repairs, programmed the TCM, and verified the repairs. In the end, the customers had taken their vehicle to three different dealerships (a total of six times) and couldn't even get a conclusive diagnosis. They were so impressed that we were able to di-

agnose and repair the vehicle accurately that they have begun to bring their other cars to us. And finally, they gave us one of the best online reviews the shop has ever received! But it wasn't magic or luck. It was a solid understanding that allowed us to draw a correct diagnosis. Unfortunately, that was something the dealerships failed to employ on those occasions. *W*



ROSS COLKET is the owner of Colket Automotive Technical Services in Lansdale, Pennsylvania. He is an ASE Certified Master Technician with over 30 years of experience as both a technician and educator. As a former CTI instructor, he believes in the importance of training and giving back to the industry. Ross fully supports and believes in *Motor Age's* mission to "advance the automotive professional."





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EVEN THE OLDEST OF TECHNOLOGIES MAY BE NEW TO YOUR WORK BAY. BUT YOUR UNDERSTANDING OF THE SYSTEM CONFIGURATION SHOULD BE WHAT DRIVES YOUR DIAGNOSTICS.

I PURCHASED THIS TRUCK at age 16. Now, at the age of 61, I'm attempting to coax it out of hibernation.

BY JOHN ANELLO // Contributing Editor

I've faced thousands of "crank/no-start" situations in my tenure as a mobile tech. Regardless of the many different ways engines are configured, to carry out the combustion process, three things remain consistent among all of those configurations. A gasoline internal combustion engine needs mechanical integrity, adequate fuel supply, and spark ignition to function. The process to find the fault is easy when you have a solid understanding of what it is you are working on.

A first-time encounter

I was 16 years old and the first vehicle I ever owned was a 1953 Dodge B-4-B half-ton pickup truck. It was equipped with a straight-six flathead, 218-cubic-inch engine. Back in 1978, I purchased this vehicle from my high school mechanic teacher for a whopping \$500 (which was a lot of money to me). The truck ran well but needed some minor repair work to get it back on the road.

It had a three-speed (on the floor) transmission, and I did not yet know how to drive a stick, so the whole task was an

uphill battle that I was eager to win because I liked the challenge. It would be my summer project to get the truck road-worthy because I was soon about to hit the road at the legal driving age.

When I turned 17, my truck was ready to sail, and I decided to use the truck to do some minor landscaping and even some furniture moving. It was a start to make some revenue while searching for a permanent job at a local garage to work as a full-time mechanic. The truck was not fit for an everyday vehicle, and I did not want to put too many miles on it, so I set out in search of a used vehicle and ended up buying a Ford Pinto (at a bargain price of \$125). When I finally landed a job as a mechanic, I decided to park the truck and use it as a showpiece in the local town parade. So, I kept it in storage in my garage.

I woke up one morning and told my dad that I was always good at building tiny model car kits when I was a kid and I wanted to take my truck completely apart (down to the frame) and restore every piece imaginable. He thought I was crazy at the time, but I was on a mission to perform the task and learn

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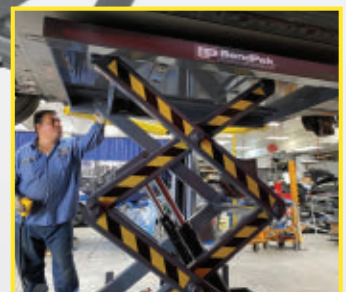
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how to repair and renew every nut, bolt, and component in that vehicle, from bumper to bumper. Within a month I had dismantled the entire truck down to just a frame and cab. I was not set up to yank a cab off a frame, so I worked my way around the cab.

This restoration project lasted almost two years and it allowed me to have hands-on experience with everything involved with working on a vehicle. I purchased a repair manual for the truck and went to many antique salvage yards and vehicle flea markets to find used parts and supplies. This enabled me to perform the endless tasks with which I was faced. In the end, I learned how to rewire an entire vehicle, and rebuild a water pump, generator, starter, engine, manual transmission, rear axle, and a complete suspension system. I learned so much in the process, and it helped me to build a solid foundation of automotive knowledge that strengthened my experience as a mechanic in the industry.

Once the truck was all mechanically put back together, my next task was to restore the body of the vehicle. I never went to school to be a bodyman, but I had many friends in the field who gave me the knowledge and help I needed to get the truck to a panel repair and primer stage of the game.

When the truck was finally body-prepped, I had it towed to a body shop to have it painted. This truck was my pride and joy, and when the body shop finally finished it, I custom-built a wooden bed and mounted fancy chrome wheels on the truck, and it was now ready for a new chapter in its life (**Figure 1**).

I put the truck in many more parades (and even car shows) and occasionally took it on a Sun-

day drive. I always kept it in a garage and moved it around to various locations but then it sat in storage for 22 years. I always said that “When I retire, I will restore the interior of the truck,” but that day did not come until just a month ago.

Waking a sleeping bear

I decided to start the awakening of my old truck at the ripe old age of 61 now (and no, I will not retire but just keep trucking along at a shorter workweek). I had the truck towed to my house from the storage garage, where it had not been started in over 15 years. Everything was still in newly restored condition but just with a little time added to it.

The truck was a six-volt positive-ground system. I always wondered about the positive-ground strategy, but I was told that Chrysler engineering was always overthinking the technology of the vehicle, and they believed that going to a positive-ground system would deter the buildup of corrosion at the battery terminals. They even had the right side of the vehicle with left-hand threaded wheel bolts because the belief was to keep the lug bolts from loosening up under acceleration. They even marked the lug bolts with “L” and “R” so as not to mix them up.

I started by replacing the six-volt battery, changing out the oil and antifreeze, and even draining out the stale gas in the tank (and yes, the gas tank had a drain plug on the bottom of it, which made that task extremely easy to do).

When I purchased four gallons of regular gas, I had to purchase some lead substitute additive (**Figure 2**). Back then, the lead in the gas was used as a lubricant for the engine’s valvetrain, so it was important to keep my truck’s diet the same to support the engine’s running requirements. When adding lead substitute to unleaded gas, it is important to mix the proper quantity. It is recommended to add one 12-ounce bottle of the lead substitute to about 20 gallons of gasoline.

Once the truck was primed up and ready it was time to crank it over. I started by pulling the choke cable for a cold enrichment start-up (and yes, this truck had a choke cable and a throttle cable). Then, as I cranked the engine, I could not get it to start. So, my new challenge was to diagnose why it would not start.

The saga begins

I recruited a helping hand from the college kid across the street to crank the engine while I tested the truck for spark. I instructed him to depress the push-start, but he said he could not see the button on the dash that he was used to seeing. I then educated him that this truck was the *grandfather* of all push-starts, and there was a push-start rod on the floor of the vehicle, above the gas pedal (**Figure 3**). This rod directly engaged the battery starter terminal with the motorized ter-



LEAD ADDITIVE is available to supplement the fuel supply. Older engines relied on the lead’s lubrication properties for the valvetrain components.



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minal after the ignition key was placed in the “on” position.

He was very intrigued by the simplicity of the design, but this was the way it was done before starter solenoids became a common component built into the starter housing. As he pushed on the starter pushrod to crank the engine, I was checking for a spark (the old-fashioned way) by holding the coil wire about a 1/4 inch from the engine block; There was no spark visible. I did not have my dwell meter because it was buried up in my attic (with all my other antiquated equipment), so I resorted to using a test light to see if the positive side of the coil was being energized (on this positive grounded system), and there was no bulb action whatsoever (**Figure 4**). There was voltage on the negative side of the coil, so I had to remove the distributor cap to check the operation (and air gap) of the ignition points.

I grabbed the radiator fan, held pressure down on the fan belt, and I pulled on the fan blade to get the points to open at their largest gap (on the high point of the distributor cam) (**Figure 5**). The air gap was about .020 inches (or the thickness of a matchbook cover) but when the points were open there was no power on the positive side of the coil. This was an indication that either the coil was open or was there a short



WITH THE IGNITION POINTS “open,” there is no path for current to flow through the primary side of the ignition coil. Voltage should be present but is not. This issue must be pursued to find the root cause of the fault.

THIS QUICK TEST proves no voltage is available, yielding only a few possibilities of why this ignition system is inoperative.

in the primary circuit of the ignition system.

Then I saw something that caught my eye on the positive side of the coil. There was an auxiliary wire on the coil (that I do remember installing) to suppress some of the ignition noise I was getting when I installed an aftermarket radio. It was a 6V-to-12v radio inverter I installed when I first purchased the truck. It turns out the noise suppressor was shorted.

Okay, so I removed the wire from the coil terminal and when the engine cranked, I now had spark. I put everything back together and went to the other side to prime the engine up with carburetor cleaner. The engine finally kicked off and ran on carburetor cleaner, but I noticed that the fuel bowls (at the fuel pump and carburetor) were not filling up with fuel. So now there was another hurdle for me to jump but hey, I was up for the challenge.



THIS TEST PROVES the fuel pump/system cannot prove the vacuum necessary to draw fuel from the tank. the root cause must be pursued further.



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One problem down, one to go

I was thinking that the fuel pump diagram may have been dry-rotted, so I had to test the vacuum quality of the fuel pump system. If there was any vacuum leak between the fuel pump and the tank, a leaky fuel bowl, or an inoperative fuel pump, there would be no fuel in the fuel bowls.

I removed the fuel line at the fuel pump and placed my vacuum gauge on the fuel pump port (**Figure 6**). As I had the engine cranked, there was no vacuum at all. So, at this point, I decided to remove the fuel pump from the engine block to bench test and inspect it for issues. When I placed the fuel pump on the bench, I noticed that the gasket (I securely positioned it within the fuel bowl, during reassembly) was partially sucked into the bowl (**Figure 7**). The only way this could ever happen is if I did not secure the bowl properly or the fuel tank line was clogged. I was shooting for the latter possibility.

I walked back over to the truck and tried to blow thru the line at the fuel pump and (you guessed it), it was restricted. I went under the truck, opened the fuel line at the gas tank, and I was now able to blow through the line. The restriction must be isolated to within the gas tank, so I had no choice but to pull the gas tank for further inspection.

I placed the fuel tank on the ground and unscrewed the fuel pickup tube



THIS PUMP CREATED a vacuum and sucked the gasket into itself. This indicated that a vacuum was forming in the pump due to a lack of fuel supply, indicating a restriction upstream.




THIS OLD FUEL TANK

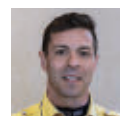
was loaded with rust and was the cause of the fuel system restriction, and ultimately led to the "no-start" situation. This is the reason manufacturers got away from metal tanks and now use plastic.

from the tank. I found it to be clogged with rust.

This tank was contaminated with rust on the interior walls and would have to be replaced or reconditioned. This was a common failure of these steel tanks and that is why many manufacturers over the years had switched to plastic tanks.

It does not matter what you work on in the automotive industry today. The key to a successful diagnosis is just keeping it simple and having a good foundation of how things work so you know how to test them. I just about read the entire repair manual on my truck (when I was restoring it) and that was a crash course in itself. I found that reading the manual gave me the mindset to fully understand how this truck was built, and that helped me to easily build my diagnostic game plan for tackling any problem this truck wanted to throw my way.

It is so important to keep engaged in automotive training with anything new that sneaks into your repair bay, even if the problem vehicle is not "new" at all, but in fact decades old. Staying on top of technology means staying educated, and no one is going to force you to do it. 



JOHN ANELLO is the owner and operator of Auto Tech on Wheels, established in 1991 in northern New Jersey. He provides technical assistance and remote reprogramming with 21 factory PC-based scan tools. Driven by a passion for cars, Anello's business now services roughly 1,700 shops.

TESTING THE ECM:

READ THIS BEFORE YOU ORDER A REPLACEMENT

THE DIAGNOSTIC FLOW CHART'S NEXT STEP SAYS 'REPLACE ECM,' BUT ARE YOU SURE IT'S THE PROBLEM?

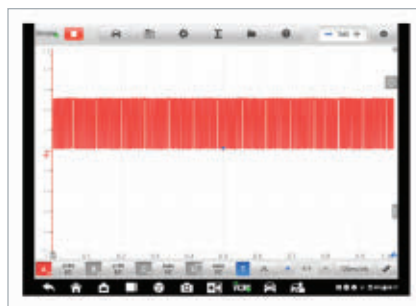
BY PETE MEIER // Director of Training

Ever use an OEM flow chart as part of your drivability diagnostic process? I'm betting you have. And when the next step tells you to replace the engine control module, there is always some hesitation, isn't there? After all, a new ECM can cost a lot of money and you want to be sure that replacing it is going to resolve your customer's concern.

What does the ECM do, and how does it do it?

The engine control module (ECM) is the computer that manages every system on the vehicle related to emissions. When something goes wrong, the ECM will hopefully record a diagnostic trouble code and turn on the check engine light. But the ECM all by itself can do nothing. It first must be programmed. These are the instructions the engineers have given it so it can perform its primary function — maintain the vehicle's emissions levels.

Granted, there are several subsystems involved — like the ignition system, the fuel delivery system, the EVAP system — and others. But generically, the process the ECM follows is the same. First, it has to have the information it needs to carry out its programming. This information is supplied by a variety of



THIS IS A LAB SCOPE CAPTURE of the engine's crankshaft position sensor signal (CKP). This signal is responsible for allowing the ECM to determine engine speed, misfire data and the crank angle space.

sensors, such as the crank and cam sensors for engine position, the MAF sensor for the amount of air being taken in, and the various temperature sensors associated with the engine.

Once the ECM has the information it needs, it plugs that data into the parameters programmed into it and then carries out the tasks associated with those parameters. This is typically done by controlling the operation of numerous circuits using low- or high-side drivers. Drivers are nothing more than a switch the ECM turns on or off. Low-side drivers complete the ground path of the circuit it is connected to, while high-side drivers supply a power source to the circuit it operates.

In many cases, there is also some kind of feedback strategy involved to let the computer know that the action it took was

carried out. Oxygen sensors are an example of a sensor that provides direct feedback to the ECM. In other instances, the ECM looks for certain changes in other monitored systems as feedback.

Granted, this is a bit simplistic. The idea I want you to take from this is that there are several things we need to confirm before we blame the ECM.

Is the ECM getting the information it needs?

We have to make sure the ECM is getting the information it needs from its sensors. We also have to verify that the sensors are reporting accurately. The ECM can only act on the data it's receiving and may not know that it's being lied to!

One way to see if the data is making its way to the ECM is to look at the data PIDs using your scan tool. We can get an idea of the accuracy of the information by changing the engine's state and seeing if the data PID changes in response or by comparing the data to another sensor to see if the two are in alignment.

Here's an example. The RPM PID is a direct input from the CKP (crankshaft position sensor). With the engine warm and idling, is this reading normal or abnormal? Now open and close the throttle. See the data PID change in response?

Sometimes misinformation fed to the ECM occurs intermittently, and at speeds that may be too fast for your scan tool. That's where the scope comes in. Let's connect to the CKP and see what the scope can tell us.

Connect the scope by first looking at the engine performance wiring diagram. Identify the wires leading to the CKP sensor. This engine uses a three-wire crank sensor — one power, one ground, and one signal wire back to the ECM.

I'll connect one channel to the signal wire at the ECM.

Next, we need to set up our scope to capture this signal. I use the 20/20 rule to start. The 20/20 rule means that I need to set my voltage scale to cover a 20V range — appropriate since most of the vehicle systems are 12V systems.

The second 20 means that I need to set the time scale to 20ms per division. That gives me a total time on the screen of two seconds — about the amount of time it takes for the engine to complete two full revolutions.

Last, I need a trigger. Let's use Autel's "automatic" option and see what we get.

Finally, we'll start the engine and capture the signal pattern.

You can adjust the scope's voltage and time scales to get a better pattern. The pattern should be clean and repetitive, with no dropouts. Signals also have to reach minimum levels for the ECM to see and recognize them, so it helps to compare your capture to a "known good".

If you suspect an intermittent signal loss, you can try the



A CONNECTOR to the engine control unit that has damage to the terminals.

"picket fence" technique. This is where you adjust the time scales to a higher value until the pattern looks like this — almost a smear but still somewhat distinguishable. Now if a dropout occurs, you'll see it as a missing picket in your picket fence!

Sensor signals to the ECM will vary depending on the type of sensor. Some will be a digital signal like this one, others will be a AC signal similar to an AC sine wave, and others will be a varying voltage like the one produced by a throttle position sensor. No matter what kind of signal, it must be clean with no drops for the ECM to make use of it.

Are the ECM's instructions flawed?

When the ECM has the information it needs, it will fall back to its programming to decide on the action it needs to take. Very often, issues with the systems controlled by the ECM are a result of mistakes in the programming itself. This is why it is so important to consult the factory Technical Service Bulletins (TSB) early on in your diagnostic process. If a change in programming was made, it's likely the only way you'll find out about it. Reprogramming the ECM with updated software is the fix and the Autel VCI I'm using is also a J2534 interface that I can use to do just that in many cases. If you find yourself in a situation where the vehicle you're working on requires reprogramming be sure to do your homework and get additional training in order to perform this procedure correctly. Mistakes made here can result in your killing an otherwise healthy ECM.

Can the ECM carry out its instructions?

If the programming is correct, the ECM will then carry out the actions specified. As I mentioned earlier, this is done by controlling the electrical components associated with the needed action by opening and closing the circuit via internal drivers — or switches. This is a common area for ECMs to fail. As with any other electrical device, the drivers can become damaged and inoperative, and the actions may be

commanded by the ECM but not carried out. So, the next step in our diagnosis is to verify that the ECM is commanding the action and that the controlled component is working like it's supposed to.

In many instances, you can simply use the bidirectional controls of the scan tool to operate the device. If the PID associated with the device changes state but the component isn't doing anything, troubleshoot the circuit as you would any other.

In the cases where bidirectional control isn't possible, you can use your scope instead. Let's use the fuel injectors on this Audi as an example. This engine uses GDI (gasoline direct injection), with two wires going to each injector. Again, we start by reviewing the wiring diagram.

The operation of the GDI electro-mechanical injectors is a bit different than conventional port fuel injection units. These injectors require initial voltages of 65V to open, and this voltage is supplied by the ECM. The ECM also controls the ground side of the injector circuit. We can look at the scan tool data and get an idea of the time the ECM is commanding the injectors on, but we may not be able to see each individually. We also can't tell if the injector did indeed respond to the ECM's command. We can, though, with a scope.

We start with our 20/20 rule to set up our initial voltage and time divisions. Next, I'll connect one channel on the Autel scope to one of the injector grounds. I'll also connect one channel to the positive side of the injector connector.

A word of caution here — many of the devices the ECM controls use a coil of wire that builds a magnetic field when current is passed through it. The magnetic field is what is used to perform the work — energize a secondary ignition coil, open an injector or solenoid — these are some examples. This collapse also produces what is called a “flyback” voltage on the ground side of the circuit that can reach levels unsafe for your scope unless an accessory called an attenuator is used to drop the voltage to a more friendly level. Make sure you know the maximum input of your scope to avoid damage to it.

I'll then add a new measurement tool to a third channel — the low amp probe — to monitor the current flow on the feed wire to the injectors. With the scope connected, let's start the engine and capture our pattern.

I like to look at the current capture first. What if the current on any of the injectors is lower than the others? That could indicate a resistance issue in the circuit itself — a bad ground, corroded connection, or something similar. What do you think can happen if an injector or other actuator shorts internally? Resistance will be less than specified and that means the current flow in the circuit will be higher than it should be. We'll see that in the current pattern too. This is a

common cause of driver damage in the ECM and I'm going to talk more about that in a moment.

If the component is not working as it should, we need to apply our electrical troubleshooting skills to determine where the circuit fault lies. Many times, it isn't the fault of the ECM, but a problem with voltage drop somewhere in the circuit path. Pin/connector damage is very common and can be caused by corrosion, water intrusion, improper handling of the connector or improper testing methods (like shoving a test probe into a hole too small for the probe).

Disconnect the connector from the ECM following the OE service procedure. Use your phone's camera to take a picture of the connector and the connecting pins on the module. This makes it easy to blow it up and get a real close view. Look for signs of corrosion or damage. You can use electrical contact cleaner or pure rubbing alcohol to clean them up and I like to use a product called Stabilant 22 as a final touch. Stabilant 22 is an initially non-conductive block polymer that, when used in a thin film, switches to a conductive state under the effect of the electrical field. It remains nonconductive between adjacent contacts when applied to electromechanical contacts, Stabilant 22 provides the connection reliability of a soldered joint without bonding the contacting surfaces together.

Once you've determined that every other part of the circuit is correct, then — and only then — consider the possibility that the ECM circuits are damaged. Before you order that new one, though, you need to identify why it failed!

If the ECM is bad, what caused it to fail?

Measure the resistance on the injector and compare to specification. If it's low, odds are the excess current caused by the shorted injector is the reason for the failure. You should also verify the resistance on every actuator circuit operated by the ECM to ensure none of them had anything to do with it. And, of course, use the voltage drop testing method to verify the module's power and ground circuits.

Remember, the ECM is the most expensive fuse on the car! Take the time to determine the root cause of the concern and, if you do determine that the ECM has failed, be sure you check all the possibilities for its failure before replacement. *ML*



PETE MEIER is the director of training for the Vehicle Repair Group with Endeavor Business Media. He is an ASE certified Master Technician with over 35 years of practical experience as a technician and educator, covering a wide variety of makes and models. He began writing for *Motor Age* as a contributor in 2006 and joined the magazine full-time as technical editor in 2010. He believes in the mission of the magazine to “advance the automotive professional” and provides resources to working techs around the country through print, social media, and YouTube. He spearheads the *Motor Age* YouTube channel, delivering essential training videos for technicians at all levels.

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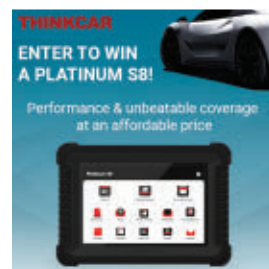
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WHY GET CERTIFIED?

Technicians and shop owners explain the importance and significance of holding an ASE certification.

AMY MATTINAT, SHOP OWNER

"As a shop owner, I rely on my technicians to properly diagnose and repair our customer's vehicles. I have such respect for their skill and knowledge. They have to continually train for the new technologies in cars that seems to get more complicated every year. Because of this I only work with ASE Certified technicians and am proud that Auto Craftsmen has been an ASE Blue Seal for many, many years. We appreciate the training and credentialing that ASE provides. Over the years, ASE has helped our business grow master technicians and build trust and loyalty with our customers."



BRIN KLINE, SHOP OWNER/DIAGNOSTICIAN

"I can't recall when I first heard about ASE, but it must have been early in my career as an automotive service technician. As far back as I can remember, I viewed ASE certifications as the only way to show an employer, prospective employer or a client that I was knowledgeable and worthy to professionally diagnose, maintain and repair automobiles. Naturally, I was learning a lot on the job in those early years. It was exciting but it wasn't enough. I wanted to earn my ASE credentials. In my mind, becoming ASE certified was a rite of passage like transitioning from a boy to a man. A way to earn the respect of your automotive peers. In hindsight, I still believe this to be true today. I believe that I did give my employers and clients a sense of confidence in my abilities and earned the respect of my automotive peers. I don't believe that I have considered this before, but as I reflect on what ASE meant and means to me, I realize that I owe ASE for helping to make my career what it is today."



CONNIE CLARK, SHOP OWNER

ASE is literally a household name, and everyone has heard of ASE and to look for as ASE Certified Mechanic! They do just an awesome job of educating the public. When I was able to have my own shop, some of my competitors literally told me that I wouldn't last 3 months, but 2022 marks 30 years that I have run my independent Repair Facility, and part of that is the trust people have in ASE - I have the only ASE Blue Seal of Excellence Shop in Detroit / Wayne County that is open to the public and people actually seek that out!"



STEVE ANDERSON, LEXUS DEALERSHIP DIAGNOSTIC SPECIALIST

"The best way to describe being ASE-certified is that it makes me feel like I am part of a big automotive family, and the last thing I would want to do is let my family down. Since ASE made me proud 33 years ago, by being a part of their organization, I could never let them down while wearing the Blue Seal of Excellence. This propelled me into a very successful automotive career, and I have ASE to thank for much of it."



BRANDON STECKLER, MOTOR AGE TECHNICAL EDITOR

"I've been an ASE-certified master automobile technician for over 20 years, and an Advanced Level Specialist (in three other areas) just a few years shy of that. I can say confidently that the opportunities presented to me across the duration of



my career in the automotive field, as a technician, technical instructor, curriculum developer, and technical editor (of both *Motor Age* magazine and *PTEN* magazine), would indeed not have been presented to me without the credentials I possess. In many important situations, my input was held in high regard, even in a court of law, as I was the ASE-certified professional speaking as a subject matter expert. This carries a lot of weight with me and allowed me to hold my head up high as I represented my dealership's service department. Being ASE-certified allows me to represent the companies I work with with pride. The customers that entrust their vehicles to us do so with confidence largely because of the Blue Seal of Excellence we proudly display."

SUSAN SWEENEY, **TECHNICIAN**

"With every ASE that I have obtained, the feeling of accomplishment and knowledge of that certificate is rewarding in itself. Having used the ASE Test prep app has been a game-changer for me versus reading the study guides. I love how ASE has adapted study guides for different types of learning. Knowing that ASE is a certificate of accomplishments in the field of study and mastery, which is proudly displayed by those who have dedicated their time and efforts to become knowledgeable in the areas they have completed. It allows us who have trained and passed the tests to be acknowledged and rewarded with higher pay, moving forward in our field to accomplish more for ourselves and being the best we can be, to address the customer's concern with each vehicle accurately."



TIM IEZZI, **SHOP OWNER/TECHNICIAN/ INSTRUCTOR**

"ASE certification was a point of pride for me. I remember being a kid and seeing my dad's ASE certificate hanging up in the office of the shop. I could not wait to sit the tests and passed my first 4 at age 18, and the rest for "Master" on my 19th birthday. I remember the phone call I made to my dad when I got my score report to tell him I passed and was master certified like he was. An ASE certification shows our customers that we have demonstrated competence in the areas in which we are certified. It shows our customers and our peers that we care about what we do. We advertise that we are ASE-certified master technicians, it's on the calendars that we give out every year,



and it's on my oil change stickers so that the ASE logo is front and center in front of my customers. It is the benchmark we judge others by."

G. TRUGLIA, **SHOP OWNER/TECHNICIAN/ INSTRUCTOR**

"NIASE/ASE has helped me in my career from my early days in the industry when I was working at Goodyear and passed my first NIASE certification test. Goodyear provided me with a raise and a gold wrench award pin. When I opened my first repair shop, I promoted NIASE in my shop logo which was a combination wrench with the NIASE logo on the box end. Later on, I made it a point to recertify and employ ASE technicians and become an ASE Blue Seal shop. I have always encouraged all my students to become ASE certified to show their professionalism and commitment to the industry. I'm proud to call myself an ASE-certified professional. Again, we'd like to offer a huge congratulations to the National Institute for Automotive Service Excellence, on their 50th anniversary. As demonstrated above, being ASE-certified is like be inducted into a family of professionals. Get yourself registered and join the ranks of thousands of certified professionals before you."



MATT FANSLAW, **LEAD TECHNICIAN**

"I feel that there are a couple of positive aspects of ASE Certification: acquisition and possession. From the 'acquisition and maintenance' aspect I can take the exams or use the mobile app to test and earn the credential(s), but I also get to see areas of my knowledge that are lacking. Maybe I did pass that engine performance exam, and I have the certification, but looking at my performance on the exam I can see that I struggled on the electrical questions. I can now modify or tailor my training to strengthen that area of my skill set. From the 'possession' aspect, I have something more to put on my resume. It may allow me to be considered for a position I may not have been at all without it/them, or it separates me from my competition for that position. It's also something I can display to my clients, that I voluntarily took these exams to demonstrate that I at least meet a minimum level of knowledge in a given area of auto repair as set by the industry."



ASE releases Spanish-language option to its website

The National Institute for Automotive Service Excellence (ASE) recently launched a Spanish-language option to its website, ASE.com. Visitors can select "Español" as their preferred language by clicking on "English" in the lower right corner of the homepage.

"At ASE, we are always looking for ways to make it easier for service professionals to access information about testing and certification," said Tim Zilke, ASE president and CEO. "By translating ASE.com to Spanish, we have made it easier for the growing number of Spanish-speaking technicians, as well as employers, students, instructors and motorists, to learn more about the ASE certification process, the array of ASE test offerings and the advantages of ASE certification, all in Spanish."

The new Spanish-language option allows the same easy navigation, informative content, and experience of the streamlined functionality of the newly redesigned website as the English version. The site offers helpful information for technicians from

preparing/earning/maintaining ASE certification to tips for employers on how to help their employees earn ASE certification to give their business

a competitive advantage. It also includes career development resources for students and instructors and information for consumers about ASE's rigorous testing and certification process that validates technician knowledge and expertise.

Earlier this year, ASE announced it had expanded the number of test offerings with Spanish-language translations to include all of the auto series certifications tests (A1-A8), as well as the G1 auto maintenance and light repair certification test.



ASE Foundation's Adopt-a-School program connects shops with qualified students.

BY AMANDA SILLIKER

How have automotive repair shops gotten by in recent years during the technician shortage? Well, they scavenged and poached technicians from shops and dealerships down the road. But now, there simply aren't enough techs to go around.

Despite there being about 100,000 students in accredited technician programs across the country (ranging from high

school freshmen to second year community college students), 20 percent never actually go in to the automotive industry. Yet another 20 percent leave the industry after working in auto repair for just two years, said Mike Coley, ASE Education Foundation president.

"People come into the industry and, sadly, in too many places they get chained to the lube rack. So, it's like, 'I thought I was going to have a career — and it wasn't spinning oil filters,'" he said. "So, we want to educate employers on the right way to grow their own."

ASE's Adopt-a-School program is

one way to solve these issues. Shops can partner with an accredited school in their area and get that pipeline of qualified students who will be ready to work at their shop upon graduation. The partnering shops are able to go into classrooms and educate students on available career opportunities, as well as provide hands-on experience to the students as part of the program's work-based learning component.

"We are getting them out and working in the industry while still at school, so they can take the tech knowledge and start transferring it out of their fingertips and become those productive entry-level techs the industry so badly needs," Coley said.

ASE's research has found that students who graduate from accredited programs and who have that work-based experience are more likely to get in the industry and stay in the industry.

"By getting involved in your local program, you're ensuring a stream of students who will come into this industry and stick," Coley said. Interested shops can sign up at the Adopt-A-School section of the ASE Education Foundation website, and they will be provided with a toolkit outlining everything they need to know for partnering with a school in their area. It also includes valuable resources on how to ensure these young technicians succeed in your shop, such as putting a mentorship program in place.



ASE renewal app provides a 1-year extension on your certification

Automotive service professionals who download and subscribe to the ASE renewal app will find it to be a big timesaver when it comes to ASE recertification.

The ASE Renewal App is a remote option for managing A1-A9 certifications and testing their technical knowledge through an app on their phone, tablet or computer. Subscribers earn one credit for each question they answer correctly. After earning eight credits in one certification area during the subscription period, the service professional will receive a one-year extension to that certification, allowing them to keep their certifications current without having to go to a testing center. Users must re-subscribe annually to keep their ASE renewal app account active.

"One of the primary reasons we implemented the ASE renewal app was to simplify the recertification process and help automotive service professionals save valuable time," said Tim Zilke, ASE president and CEO. "With the app, those who hold A-series certifications do not have to take time off from work or go to a test center to be recertified. The app allows them to renew on their own time schedule by answering questions that demonstrate their knowledge about today's complex vehicle systems."

Since the introduction of the ASE Renewal App, over 11,000 automotive service professionals have enrolled and are using the innovative application to extend their A1-A9 certifications without stepping foot in a test center, ASE said.



Throughout the race season, Kasey Kahne Racing will feature the ASE 50th anniversary commemorative logo on its two World of Outlaws series cars, the No. 49 car driven by Brad Sweet, and the No. 9 car driven this season by Kahne.



ASE, Kasey Kahne Racing team up to celebrate ASE's 50th anniversary

The National Institute for Automotive Service Excellence (ASE) and Kasey Kahne Racing will partner for the 22nd straight year to celebrate ASE's 50th anniversary and promote the high standards of service and repair achieved through the assessment, certification and credentialing of current and future industry professionals.

Throughout the race season, Kasey Kahne Racing will feature the ASE 50th anniversary commemorative logo on its two World of Outlaws series cars, the No. 49 car driven by Brad Sweet, and the No. 9 car driven this season by Kahne. Last season, KKR and Sweet won the World of Outlaws season championship for the third straight year in a vehicle sporting the ASE insignia. As part of the partnership, Kahne will also make appearances on behalf of ASE.

"As ASE celebrates its 50th anniversary this year, we are proud to continue our long-term partnership with Kasey Kahne and his race team," said Tim Zilke, president and CEO of ASE. "Kasey is a tremendous representative of ASE and its mission. Not only is he recognized as a world-class driver, but he also understands that it is imperative to have well-trained, certified professionals working on his team's cars. We look forward to working together during this milestone year to promote service professionalism and the importance of ASE certification."

ASE and Kahne first teamed up in 2000. Since that time, KKR has won over 200 World of Outlaws races and four series championships, and during Kahne's NASCAR career, he has 18 Cup Series wins, eight Xfinity Series wins,

and five Truck Series wins.

"I am very honored to have been partners with ASE for over 20 years, and we're excited to chase a fifth championship at KKR while we celebrate ASE's 50 years of service," said Kahne. "They have been a part of many of my NASCAR wins as well as our sprint car wins, so I am grateful to have their support as I prepare to run my first full schedule with the World of Outlaws. We are looking forward to a year full of celebrations for ASE's 50th year in business on and off the track."

New ASE military tests now available

The National Institute for Automotive Excellence (ASE), in partnership with the United States Army Ordnance School, has made available five additional competency tests. ASE will continue to offer the MIL2 Diesel Engines and MIL6 Electrical/Electronic Systems tests, which were introduced in January, in addition to the five new test options.

The five new intermediate level tests for military tactical wheeled vehicles are for individuals with a minimum of two years of experience servicing cars, trucks or military vehicles:

- MIL3 - Drivetrains
- MIL4 - Chassis
- MIL5 - Suspension, Steering and Hydraulics
- MIL7 - Heating, Ventilation and A/C
- MIL8 - Periodic Maintenance Checks and Services

The new ASE military tests were specifically designed to align ASE tests to U.S. Army equipment, task lists and processes. They provide an assessment tool that measures an Army maintainer's level of technical job competence. Successful completion of the tests by qualified Army personnel, plus an experience requirement, will result in ASE military technician credentials. Those who become certified in tests MIL2-MIL8 will be recognized as ASE-certified master military tactical wheeled vehicle technicians.

ASE will eventually offer three advanced level tests with a focus on diagnosis and repair of more complex problems found on military tactical wheeled vehicles. The tests are designed to follow the career advancement of the Military Occupational Specialty (MOS) 91 series enlisted Soldiers, Non-Commissioned Officers (NCOs) and the 915A and



PHOTO BUMBLEDEE | DREAMTIME.COM

919A Warrant Officers. Successful completion of the tests, plus an experience requirement, will result in ASE military technician credentials for qualified candidates.

The intermediate tests are administered at Prometric test centers. Soldiers will earn promotion points for successful completion of tests and will be able to utilize the Credentialing Assistance (CA) program to pay for the ASE registration and test fees.

"Our Military ASE test program has gotten off to a great start," said Tim Zilke, ASE president and CEO. "We have already had several hundred personnel take the MIL2 and MIL6 tests, and we are anticipating many more active military members taking the other intermediate tests now that they are available. We want to thank the U.S. Army for all of its help in making this program a success."



// PRACTICE TEST

TEST TIME

Can you ace all these questions on advanced engine performance?

Motor Age Training helps you get ready to pass whatever ASE certification is on you're working towards. From heavy duty to alternate fuels, we have the study guides that you need. One of our most popular offerings is the ASE L1 Advanced Engine Performance study guide and practice test, which provides

automotive service repair professionals the knowledge to successfully take and pass the ASE L1 Advanced Engine Performance certification exam. This guide offers detailed illustrations and the most current L1 certification task list provided by ASE for anyone preparing for the exam. Most importantly, this book contains details on the L1 Composite Vehi-

cle Type 4, which is essential for passing the certification exam.

The back of the book contains an ASE practice test with 82 questions written in the exact style of the ASE certification exam. Below is an excerpt of these questions. You can find the answers upside down at the bottom of the page. Good luck!

1. A cylinder leakage test is being performed on an overhead valve V8 engine. When air is applied to the No. 5 cylinder, a hissing noise is heard from the tailpipe. Technician A says that the cam lobe for the No. 5 exhaust valve could be worn down. Technician B says that the No. 5 exhaust valve could be burned. Who is right?

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

2. All of the following statements regarding the schematic shown in Figure 1 are true EXCEPT:

- A. The solenoid coil receives battery power at KOEO and KOER.
- B. A blown 20A fuse would result in 0 volts at ECM terminal 23.
- C. The EGR valve is shown in the de-energized state.
- D. The pintle position sensor is shown at approximately the 2.5V position.

3. The composite vehicle fails a loaded mode I/M test for excessive hydrocarbons. Which of the following is the root cause of the problem?

- A. Shorted CMP signal wire to the ECM
- B. Open CKP sensor
- C. Poor connection at ECM terminal 19
- D. Blown fuse No. 4

4. Two technicians are discussing the injector waveform shown in Figure 2. Technician A says that the waveform is typical of a peak and hold injector. Technician B says that the rise in control circuit voltage is normal. Who is right?

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

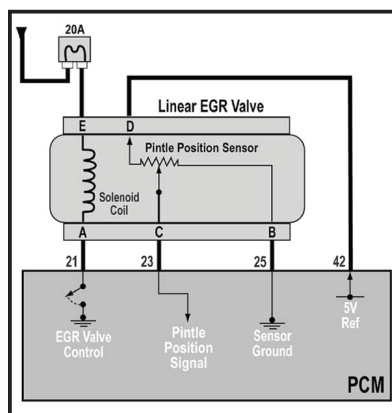


FIGURE 1

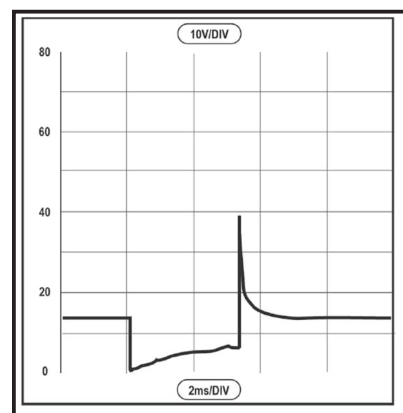


FIGURE 2

5. The EFE heater stays energized all the time on an engine with TBI. Which of the following symptoms would not be associated with this condition?

- A. Poor cold drivability
- B. Spark knock
- C. Lack of power
- D. Excessive NOx emissions

6. A vehicle with throttle body injection failed the ASM5015 test based on the Vehicle Inspection Report (VIR) in Figure 3. Technician A says that the gas readings could be the result of a bad catalytic converter. Technician B says that the engine may have a leaking throttle body gasket. Who is right?

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

7. What conclusion can be drawn from the I/M 240 inspection report shown in Figure 4?

- A. The vehicle passed.
- B. The vehicle failed for high HC.
- C. The vehicle failed for high NOx.
- D. The vehicle failed for high HC and CO.

8. All of the following will disable the air conditioner compressor clutch on the composite vehicle EXCEPT:

- A. A shorted A/C request switch
- B. An open circuit at pin B of the A/C pressure sensor
- C. An open circuit at pin A of the A/C pressure sensor
- D. An open circuit at pin 9 of the ECM

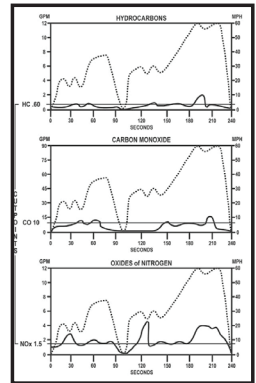


FIGURE 4

FIGURE 3

MODE	CO %			HC ppm		
	Loaded	Limit	Reading	Result	Limit	Reading
ASM5015	0.44	1.32	FAIL	78	238	FAIL

NOx ppm			RPM	DILUTION
Limit	Reading	Result	Reading	Reading
625	379	PASS	1528	12.1%

- 1. B
- 2. B
- 3. C
- 4. D
- 5. A
- 6. A
- 7. C
- 8. A

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Entry-level certification

The program is designed for students about to begin their careers in the field and helps shop owners find qualified job candidates.

BY GEORGE ARRANTS // Contributing Editor

Employers in every field face a perennial challenge: Evaluating and selecting new employees. Unfortunately, hiring managers often find there is not a shortage of applicants, but rather a shortage of qualified applicants.

Many auto repair shops use the National Institute for Automotive Service Excellence (ASE) certifications for hiring, promotion, and recognition of their experienced technicians. It only makes sense to look for similar credentials to qualify entry-level applicants.

ASE is here to help with its entry-level certification program for students who are near the end of their studies (in other words, future technicians about to begin their careers). By making solid entry-level hires, shop owners can avoid churn and feel confident their new technicians can grow with the company into full-fledged service professionals.

There are 19 entry-level tests total in the areas of automobile service, collision repair and refinishing, and medium/heavy truck repair. ASE developed the tests in partnership with the ASE Education Foundation and SkillsUSA. The tests in each series parallel the instructional standards of ASE accredited training programs. The entry-level automotive series consists of tests in the following core areas:

- Automatic Transmission/Transaxle
- Automobile Service Technology
- Brakes
- Electrical/Electronic Systems
- Engine Performance
- Engine Repair
- Heating and Air Conditioning
- Maintenance and Light Repair
- Manual Drive Train and Axles
- Suspension and Steering

ASE's entry-level certification offers an independent assessment that is valuable

for all stakeholders:

- Instructors and administrators, who are working to respond to today's increasing demands for measurable outcomes and accountability.
- Students, who gain a respected credential and pride in accomplishment (along with their parents, who can rest easier knowing their children's program of studies is subject to an independent evaluation through ASE program accreditation and exit testing of the students).
- Hiring managers, who can use ASE entry-level certification as a meaningful tool to evaluate potential service employees.

ASE entry-level certification can be thought of as the first step in what should be a career-long process of credentialing and professionalism:

- ASE entry-level certification
- ASE professional technician certification
- ASE master medium/heavy truck technician status
- ASE advanced-level specialist

A deeper look

Those who know ASE through its professional technician certification series know ASE does not dictate content areas and test questions. Its certification tests are developed in response to industry needs, with panels of industry experts, including working technicians, service managers, and trainers, developing the scope of ASE tests and writing test questions.

ASE uses the same approach for its entry-level certification program, but here the tests are tied to the school's training program and curriculum. More specifically, the tests are built around the ASE Education Foundation's program accreditation task lists (formerly NATEF Program Evaluation).

The tests are designed to maximize accuracy and meaningfulness. Test ques-



tions are developed in workshops and are validated through pretesting. Non-scored questions are included to measure potential test questions' performance before they become "live" questions.

Behind the scenes, the process even includes Item response theory statistical techniques in test development – esoteric to all except testing professionals, but an extra level of assurance to students, instructors, and hiring managers the tests are doing their job.

Unlike professional-level ASE certifications, there are no work experience requirements for ASE entry-level certifications. The student simply needs to pass one or more of the entry-level tests.

All high school and college level medium/heavy truck training programs nationwide may use the ASE entry-level certification program, regardless of their accreditation status or involvement with ASE, the ASE Education Foundation, or SkillsUSA. The tests are available year-round.

All tests are administered at the school through secure computer-based testing delivered via the internet. A proctor, who is a staff person other than an automotive

instructor, enables the test for students and monitors their test sessions.

Upon successful completion of a test, the school prints the certificate, has it signed by the school principal for validation, and then awards it to the student. Students also receive a detailed score report, and a digital badge that can be displayed, accessed, and verified online.

ASE entry-level certification is valid for two years and does not renew. Having graduated from a training program and earned their first ASE certification, the students are ready to launch. Those holding ASE entry-level certification represent a pool of job candidates whose eagerness is matched by demonstrable qualifications, including a nationally recognized credential.

How you can get involved

ASE credentials are respected throughout the industry because they are industry-developed. There is no ivory tower approach. These are real tests for real working profes-

sionals and their employers. This is only possible through the decades of direct involvement and support from working technicians, employers, fleet managers, instructors, corporate trainers, and more.

If you are looking for ways to get involved and shape the future of the service and repair industry, it starts right in your neighborhood. Consider the following:

- Joining your local high school or college program industry advisory committee to help shape course and program curriculum. You can find local schools at aseeducationfoundation.org/find-a-program.
- Encouraging those programs to maintain ASE accreditation and use the ASE entry-level certification tests to qualify their students.
- Volunteering at career days, so students can interact first-hand with industry professionals.
- Becoming a mentor in ASE's student career development process that offers

students on-the-job internships while pursuing their studies.

- Looking for ASE entry-level certification when interviewing new graduates.
- Advocating for the service and repair industry as the dynamic field it is, offering meaningful employment to countless thousands and career pathways that are limited only by personal talent, drive, and ambition. *TM*



GEORGE ARRANTS

is the vice president for ASE Education Foundation. Arrants works with instructors and

administrators to develop partnerships with local businesses and industries through program advisory committees. He is the past chair of the Technology and Maintenance Council's TMC SuperTech – the National Technician Skills Competition – and TMC FutureTech – the National Student Technician Competition. His entire career has been in the automotive service and education industries.



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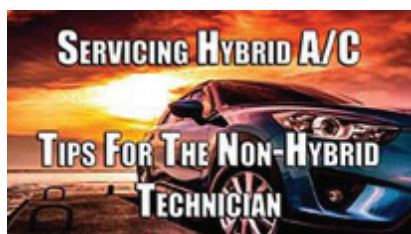


ASE Test Prep - A5 Brakes Certification

The ASE A5 study guide book and practice test by *Motor Age Training* provides technicians the knowledge, and know how to successfully take and pass the ASE certification exam. The ASE A5 test prep book includes the ASE certification task list for the car and light truck brakes certification exam. The task list outlines the topics technicians will be tested on during the ASE A5 certification exam. In addition to the easy-to-read text, the *Motor Age ASE A5 study guide* contains dozens of detailed illustrations for reference to real life applications. You'll also find the *Motor Age* self-study guide to be a handy for quick reference when servicing brakes after you've successfully taken the ASE certification exam.

The topics covered in this edition of the ASE Study Guide are:

- Hydraulic system diagnosis and repair
- Power assist units diagnosis and repair
- Parking brakes
- Drum brake diagnosis and repair
- Wheel bearings
- Disc brake diagnosis and repair
- Electronic brake control systems - ABS, TCS, ESC diagnosis.



Servicing hybrid A/C – tips for the non-hybrid technician webinar

Did you know that A/C season for most hybrids is an all-year thing?

That's because many models rely on the A/C system to keep the high voltage battery cool. Without proper temperature control, the battery can suffer premature failure – an expensive repair option when compared to the cost of keeping the A/C working properly. And you needn't be a fully certified hybrid tech (but it helps!) to work on these systems.

In this webinar, *Motor Age's* Pete Meier and TST's G. Jerry Truglia will show you the fundamentals of hybrid technologies including an overview of heat exchangers, as well as the particulars of safely and properly servicing hybrid air conditioning systems.

ASE Study Guides - B-Series Collision Repair Set

This is the most recent *Motor Age* ASE study guides for the collision repair (B-Series) certification exams. This set provides the knowledge necessary for technicians to successfully prepare for and pass all B-Series ASE certification exams. The study guides provide detailed information on all the required topics related to collision repair. Each study guide includes an ASE B-Series exam task list, easy-to-read text with detailed illustrations and real life examples. Also included are ASE practice tests (questions and answers) in the back of each book that are written in the style of the ASE exam to help you prepare. The practice tests are perfect for gauging your knowledge prior to the exam.

The ASE B-Series Study Guide Package includes all 5 B-Series books:

- B2 - Paint & Refinishing Certification
- B3 - Non-Structural Analysis & Damage Repair



- B4 - Structural Analysis & Damage Repair
- B5 - Mechanical & Electrical Components Certification
- B6 - Damage Analysis & Estimating Certification

PASS OR DON'T PAY GUARANTEE

As a testament to the confidence in the quality of the study guides, *Motor Age Training* offer a pass or don't pay money-back guarantee. If you don't pass your ASE test within 90 days after purchasing one of our corresponding study guides, send us a copy of your test results and book receipt, and we'll refund the entire cost of the study guide — less shipping and handling.

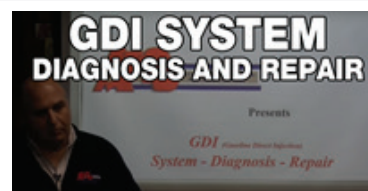
GDI system — diagnosis and repair webinar

G. Truglia, TST president, brings his immense expertise to the webinar, covering the gasoline direct injection (GDI) system from the low pressure pump to rails, high pressure pump and GDI injectors.

Why learn this now? You're bound to run into this technology, since for the past 10-plus years GDI has been used on European vehicles and moved on to domestic and Asian engines. The webinar covers all the components involved and teaches you how to identify, diagnosis, test and repair them.

Specific topics covered include:

- Scan data analytics
- Fuel trim diagnostics
- Carbon build-up drivability symptoms, diagnostics and cleaning
- Low pressure fuel pump
- Direct Injection fuel pump testing
- Lab scope connection to the GDI injector



- Tools and equipment
- Injector removal processes
- Injector seal replacement and installation
- High pressure pump failures - diagnostics and repair
- PCV and breather system issues
- Common failure case studies.

T2 Study Guide - ASE Test Prep for Diesel Engines Certification

The ASE T2 Diesel Engines Study Guide and test prep contains tips on preparing for and successfully passing the T2 certification exam. The topics discussed in the ASE T2 cover the subjects that will be included on the ASE certification exam. This easy-to-read study guide contains dozens of useful illustrations to visually explain the real life scenario's that are questioned on the ASE T2 exam. The topics covered in detail include:

- General engine diagnosis
- Cylinder head and valvetrain diagnosis and repair
- Engine block diagnosis and repair
- Lubrication and cooling systems diagnosis and repair
- Air induction and exhaust systems diagnosis and repair
- Fuel system diagnosis and repair
- Starting and charging systems diagnosis and repair
- Engine brakes.

The back of the book contains an ASE practice test with 75 questions written in the exact style of the ASE certification exam. There is an answer key with explanations for why an answer is correct.



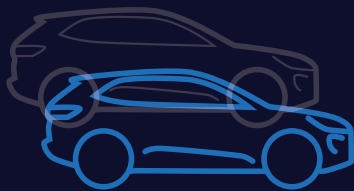
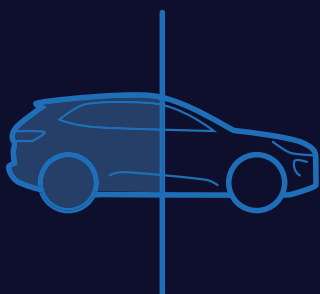
EVAP systems — operations and troubleshooting webinar

In this webinar, Pete Meier and G. Truglia will go over the operation of a variety of EVAP system designs and demonstrate the testing of the various components. They will cover system operation, vent and purge valves, lines, the charcoal canister, gas tank, as well as gas caps and "capless" systems. The pair will also demonstrate a number of techniques you can use to find even small leaks using a smoke machine, ultrasound, and CO2. A downloadable handout will be provided. The webinar was shot live and in real time, and hosted in G.'s New York shop. Real cars and components are used in the demos.



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SMP EXPANDS GASOLINE DIRECT INJECTION PROGRAM

Recently released GDI fuel injectors cover an additional 4.7 million vehicles in operation. The most popular applications include the 2018-20 Toyota Camry, 2019-20 Toyota RAV4, 2019-21 Ford Edge and Ford Ranger, and 2018-20 Ford F-150. Additionally, fuel pressure sensors are now available for General Motors, Ford, Volkswagen, Chrysler, and RAM vehicles. Over 6 million 2014-20 General Motors vehicles will also benefit from the addition of a fuel feed line and a fuel pressure sensor connector has been released to fit the Ford Focus, Expedition, F-150, and Transit. Several high-pressure fuel pumps have been introduced.

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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.

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HAS A TEST RANGE OF 1MA TO 60A DC/AC

The High Accuracy Low Current Clamp Meter, No. 683, from Electronic Specialties was developed with new circuitry designed to maximize low current accuracy and zero stability. The clamp is able to measure parasitic drains accurately, efficiently, and with dependable/repeatable readings. It features a 1mA low reading resolution and can read up to 60A. The 16mm x 18mm clamp opening is large enough to clamp over most negative battery cables. The 683 reads both DC and AC currents, and it detects the current automatically. The clamp can also record up to 99 records for recall later. Unit comes with zippered storage case, manual, and 9V battery.

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POWERS ALL ELECTRIC VEHICLES

The Enel X Way Juice-Box 40 Plug-In is a smart home charging station that combines speed, performance and value. Built on the universal J1772 charging standard, it can power all electric vehicles on the market today, including Tesla via an adapter.

Use the JuicePass app for a seamless EV charging experience at home or on the go. The app allows users to find public charging stations near them and monitor their charging progress. Users can charge electric vehicles at times when renewable energy is at maximum production through JuiceNet Green.

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NO PROGRAMMING REQUIRED

The Hamaton Tesla BLE Sensor is a direct replacement for the Sysgration BLE sensor. An alert is sent to the vehicle's computer system via BLE (Bluetooth low energy) when air pressure drops, triggering the TPMS light. BLE sensors are found in Model 3 (2021+), Model S (2022+), and Model Y. The sensor comes preprogrammed, enabling technicians to install them on the Tesla models without needing to program. Available in two metal clamp-In valves (black or graphite).

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DESIGNED FOR USE WITH GAS ENGINES AND DIESEL ENGINES UP TO 10L

The NOCO Genius Boost Pro 4000A UltraSafe Li-ion Jump Starter, No. GB150, is a Li-ion jump starter for 12V batteries that offers spark-proof technology and reverse polarity protection. It can safely jump-start a dead battery in seconds and up to 80 times on a single charge, says the company. The GB150 integrates with a high-output 500 lm LED flashlight with seven light modes. It also features rapid charge technology that charges in three hours, plus a 12V auxiliary port for powering tire pumps, inverters, and lights. The GB150 is designed for use on gas and diesel engines up to 10L and more.

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THE TRAINER #129: P0420/P0430 – PERFORMING A COMPLETE DIAGNOSIS

THEY'RE THE MOST COMMON DTCS TECHNICIANS FACE IN THE SHOP. TO MAKE SURE YOUR REPAIR KEEPS THE CHECK ENGINE LIGHT OFF, CHECK OUT THE TIPS I HAVE FOR YOU IN TODAY'S THE TRAINER!

PETE MEIER // Director of Training

The P0420/P0430 trouble codes are the #1 DTCs in the U.S. And the most common repair made is the replacement of the catalytic converter.

But all too often, this doesn't keep the Check Engine light off.

When tackling these DTCs, the first step is understanding how converters fail. A common cause of converter failure is overheating, leading to damage to the converter substrate.

Another common cause is the poisoning of the converter. This occurs when the substrate becomes covered with a foreign substance – usually oil or coolant. If the substrate is coated, active conversion can't take place.

Physical damage is also a cause of converter failure. Damage to the converter housing, cracks in the exhaust system allowing air into the converter, and broken welds are all examples of physical damage.

The second step in a successful repair is understanding how the ECM determines that the converter isn't converting. The ECM monitors the oxygen sensors upstream and downstream of the converter and compares the switch ratio between the two. The upstream sensor, conventional or wideband, is expected to switch continuously from lean to rich while the

downstream sensor should remain relatively stable in its output. The more the rear sensor activity mirrors the front, the higher the switch ratio will be.


The third step is to see if any conversion is taking place. This can be done with an IR temperature gun or thermal imager.

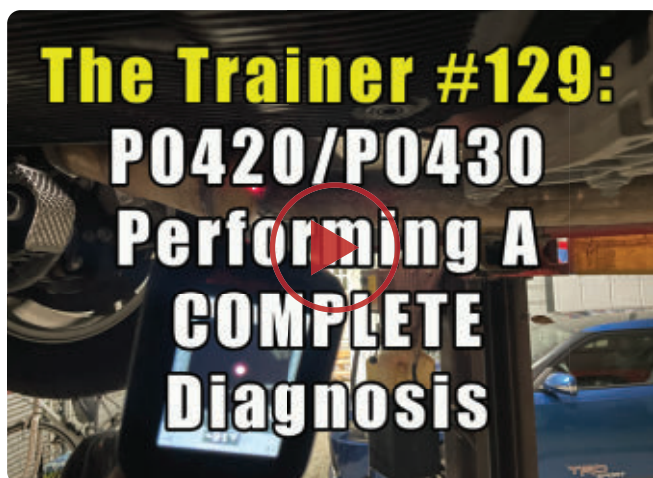
The fourth step is to check for any related Technical Service Bulletins. Many times, all that is needed is a reflash to turn the Check Engine light off. This is a good possibility if your earlier observations led

you to believe that the cat is working, even though the ECM says it's not.

Converters rarely fail due to age alone. Instead, it's a symptom of another problem. Unless you correct the cause, the P0420 and P0430 you're repairing will be back!

For more information on the Autel tools I used in today's video, visit www.Autel.com.

Scan the QR code for the video, and for the complete article, go to vehicleservicepros.com/21277410. 



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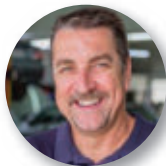
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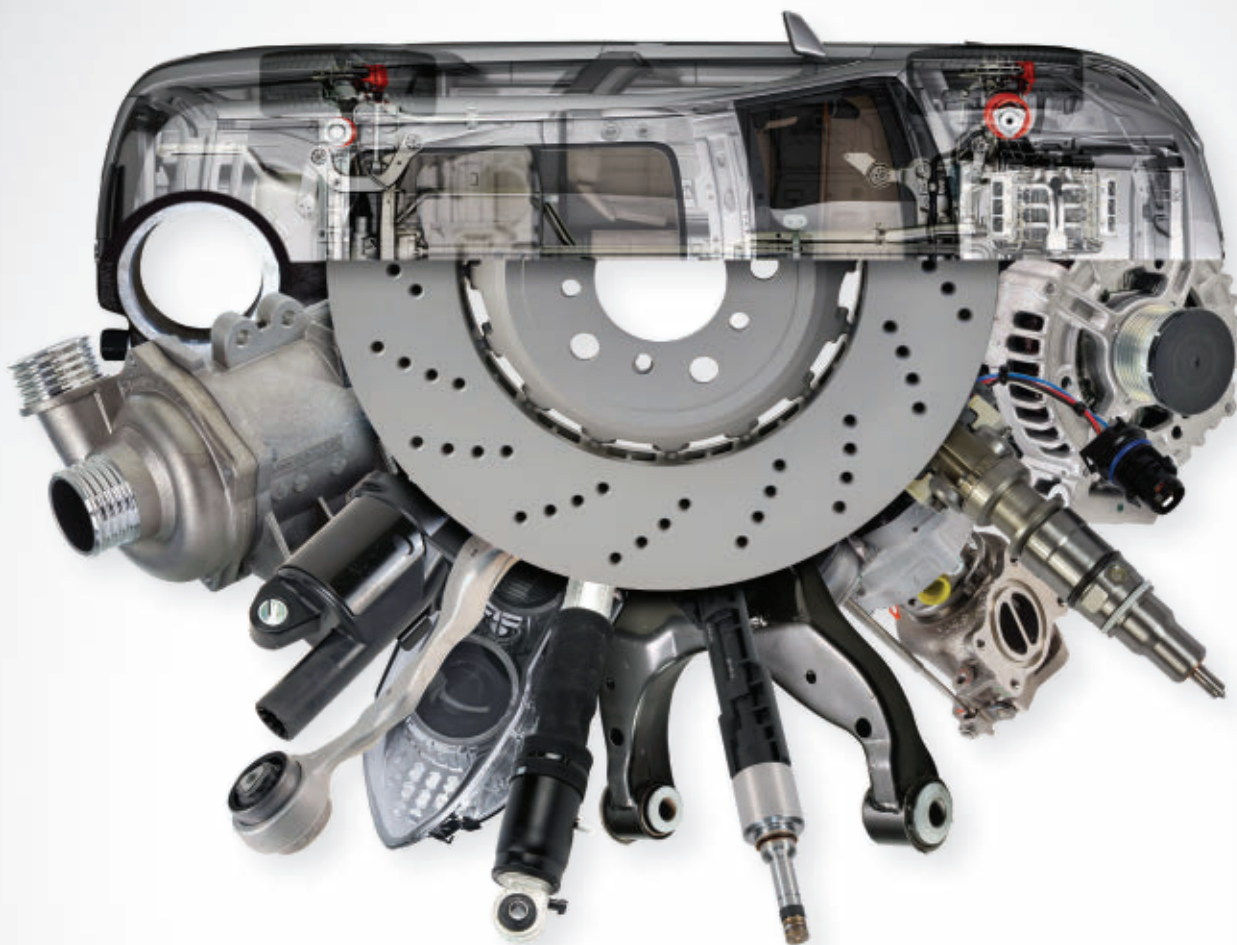
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