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The tech shortage is real, but our industry can take steps to contribute to a solution

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Following a logical process helped break a 2001 VW Cabrio from eating ignition coils

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DATA ACCESS

HANVEY ADDRESSES NEED FOR DATA ACCESS, CONSUMER CHOICE

MOTOR AGE STAFF //

➔ Vehicle data and access is a hot topic in today's industry, as advanced technologies in today's cars are hindering the independent repair sector from servicing their customers.

Motor Age spoke with Bill Hanvey, President and CEO of the Auto Care Association, which has been pushing the "Your Car. Your Data. Your Choice." movement to get consumers and the industry up to speed on the realities of vehicle data access and what everyone can do to ensure consumer privacy and choice.

Tell us about the initiative.

What we are trying to do is garner support, recognition and drive within our industry to be able to make the consumer and our legislators, whether at the state or the federal level, aware of the fact that consumer choice is being threatened by the fact that the car manufacturers are beginning to shut us out of wirelessly transmitted data from the vehicle.

Why is consumer choice and vehicle data ownership so important to the independent aftermarket?

Seventy percent of the repairs made

>> HANVEY CONTINUES ON PAGE 6

BREAKING NEWS

ELECTRIC VEHICLES

EV CHARGE STATIONS POSSIBLE PORTAL FOR CYBERATTACKS

➔ Electric cars are an essential component of a lower-carbon future, but a new report from researchers at the New York University Tandon School of Engineering raises the specter that plug-in electric vehicles — and the charging stations that supply them — could be prime vectors for cyberattacks on the urban power grid.

In simulations using publicly available information about charging station usage in Manhattan and the structure of the island's power grid, our research team found that a fleet of just roughly 1,000 simultaneously charging electric vehicles would be adequate for mounting an attack whose effects could rival the blackout that affected the city's west side last month," said Yuri Dvorkin assistant professor in NYU Tandon's Department of Electrical

>> EV CONTINUES ON PAGE 6

TRENDING

QUICK LANE OPENS NOMINATIONS FOR SCHOLARSHIP

Quick Lane Tire & Auto Center will support "Trading One Uniform for Another," a program that awards scholarships to U.S. military veterans and first responders.

MOTORAGE.COM/UNIFORM

CAWA LOOKS AT STARTING STATE INSPECTION PROGRAM

CAWA met with the Chief of the California Bureau of Automotive Repair and his team to discuss establishing a vehicle safety inspection program in California.

MOTORAGE.COM/INSPECT

CARDONE APPOINTS NEW CEO

Cardone Industries announced the appointment of Mike Carr to the role of CEO. A seasoned executive in the automotive aftermarket, he brings nearly 30 years of industry experience.

MOTORAGE.COM/CARR

AACF GOLF OUTING SET DURING INDUSTRY WEEK

The Automotive Aftermarket Charitable Foundation will host its annual All-Industry Golf Outing on Nov. 4 at the Spanish Trail Country Club in Las Vegas.

MOTORAGE.COM/GOLF

NASTF NAMES WOLFE TO DIRECTOR ROLE

The National Automotive Service Task Force has hired Holly Wolfe, of Wolfe Strategies LLC, as Managing Director. She will spearhead outreach initiatives and oversee communications.

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>> **HANVEY CONTINUED FROM PAGE 4**

in today's market outside of warranty are performed in our industry in the independent repair facility. Consumers choose that particular channel. The local shop is more convenient; the local shop is less expensive than the dealership. We want to ensure that being able to choose your local mechanic is still in place not just today, but ad infinitum. If the car manufacturers have complete monopoly over vehicle data they will effectively shut out our entire industry from being able to do diagnostics and those things that are necessary in order to fix the vehicle.

Can you talk about the impact of data access in today's market?

As many may know, we passed the Right to Repair Act in Massachusetts in 2012. The Right to Repair Act allowed us access to the OBDII port so that you can plug in your individual scan tool and find out engine codes or diagnostic codes. Well, that piece of legislation did not

support wirelessly transmitted vehicle data, which is taking place on today's vehicles. We have to be able to ensure that the same right to access that vehicle data through the OBDII port is also preserved for that wireless transmission of data.

Vehicle data has been dubbed the next great privacy issue. Can you explain what this mean?

Several months ago, there was a quote by the Ford CEO saying that in the future, the sale of vehicle data will surpass new car sales in terms of revenue contribution to Ford Motor Company. Obviously, the car manufacturers see a tremendous opportunity to take that data that you are generating, that you own, that you control, and turn it into a profit center. And our ask is simple. We want to be able to have the consumers control that data, whether it is diagnostically or personal data.

Where do we stand legislatively?

We are approaching it from two ways. The first is an amendment to the

Right to Repair Act to include wirelessly transmitted data. We are also pursuing a federal path through a coalition that we are a part of called the U.S. Vehicle Data Access Coalition. And that is an initiative of many like groups who see the threat of vehicle data monopolization by the car manufacturers to free choice and the free economy.

How can the industry get involved in supporting this initiative?

Our industry employs 4.6 million people. We contribute more than \$400 billion to the economy. We have to collectively speak and really amplify that voice of 4.6 million people to say that this is unacceptable. We are going to fight at the state level, at the federal level, and in the local trenches to make sure everybody is aware of this initiative. Now is the time to get involved, be part of the political process and stand up and say this is unacceptable and I am going to fight for this right to control my own data. *TL*

>> **EV CONTINUED FROM PAGE 4**

and Computer Engineering.

"This simulation is a wake-up call to the public and policymakers, and an encouragement to take steps to protect the data generated between electric cars and charging stations — most of which could be co-opted by a hacker with college-level skills," Dvorkin said.

EV charging stations represent a link between plug-in EVs and the power grid — a high-wattage access point that hackers can potentially exploit to manipulate the grid. Each vehicle that uses a public charging station generates data on its location and charging time, along with information on the average hourly power draw at each station. Information on the power usage is critical for someone who wishes to manipulate demand at a particular

charging station. This information is easily accessible, as it is transmitted wirelessly by third-party apps that cater to EV owners.

Information about the structure of the power grid is more fragmented and difficult to access; however, the research team demonstrated that a combination of public documents and resources available through industry standards-setting organizations and from utilities' public releases may be tapped to construct power grid topology and model the system components.

Together, these elements allow an attacker to use charging stations as portals to remotely manipulate EV charging and the power grid by causing instabilities that could range from barely noticeable to significantly disruptive.

In 2015, a sophisticated cyberattack crippled a power grid in

the Ukraine, and this year, a small-scale attack in the western United States became the first reported successful incursion on a domestic power grid. The NYU Tandon researchers emphasized that while the number of electric cars on the road today — about one million — is not concentrated in one place and is therefore insufficient to produce the impact reported in their simulations, the threat potential will unquestionably rise as the electric fleet grows. The Edison Electric Institute estimates about 9.6 million charging ports will support 18.7 million plug-in electric vehicles by 2030 — a disputed number, although all forecasters predict remarkable increases.

At present, there is no consensus on a cybersecurity protocol to protect data generated by electric vehicle charging. *TL*

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What you should look for in a second in command

Define and set your expectations to ensure the best fit for your shop

You've spent many years building your business with a great culture and happy employees. Now it's time for you to enjoy the fruits of your labor and take a much-needed vacation. But first, you'll need to designate a Second in Command (SIC).

An SIC is the person that fits the criteria you deem fit to run your business when you're not there. You would train this individual on your standard operating procedures and expectations until you're confident that they could run your shop on their own.

For some shop owners, this is a difficult pill to swallow. They take that much-needed vacation, but they're constantly watching the phone until they finally give in and call the shop. Meanwhile, their wife and children are irritated and feel ignored and less important. These shop owners don't trust that their SIC has it covered, because they don't trust that they've hired the right person.

In some cases, the shop owner's suspicions are confirmed. They find out that the SIC does not have everything under

control at the shop. They find out bad news: customers are upset, their lead tech is ready to quit or their service advisor needs help.

So, how did this happen? Chances are they didn't hire the right person for the SIC position. The reason why many shop owners make this mistake is because they don't take the time to define and set their expectations. Then they don't allow the new hire time to learn while the owner is present in the shop to mentor them. Let's listen to ATI Coach Bobby Poist explain how he mentors shop owners on dealing successfully with this extremely important position.

KNOWING WHAT YOU ARE LOOKING FOR WILL HELP YOU STAY ON TRACK TO FINDING THE RIGHT PERSON FOR THE JOB.

How to hire the best SIC

The first step in hiring an SIC for your shop is to create a job description. Think about what duties your SIC will

be responsible for on a daily, weekly and monthly basis and write them down.

Once you have a job description you can interview potential candidates. You can also use this information to determine whether promoting from within is best. Consider whether any of your current employees would fit the job description and be effective in the role. You already know these individuals and have seen their track record of successes.

If none of your current employees meet your expectations, look outside your shop by placing an ad for someone with management experience, among other qualities. You can use your job description to help write the ad as well as pre-qualify candidates before interviewing them in person.

Last, create reference check questions based on your hiring criteria. A candidate with a good professional background usually comes with great references and no shortage of past employers who will discuss their performance.

What to expect from an SIC

The SIC's main duty is to free you up to do the things you enjoy and allow you time to work on growing your business. You can't do this if you're tied up in running the day-to-day operations of your shop. In order to be the reliable support you need, a good SIC must be multi-faceted and possess the following attributes:

Good communicator. An effective SIC listens and communicates with their shop owner. They'll understand what you want and regularly keep you updated. They possess good upward and downward communication skills, along



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with the ability to be an active listener on the team.

Empowered decision maker. Empowering SICs to make decisions is crucial to their success and your ability to have free time. SICs should be problem solvers and take the initiative to work toward overcoming daily challenges without being micromanaged. They can be more creative when they think of the consequences to their decisions.

Shared values. As a shop owner, you should identify what's important to you and what made you successful. Understanding your strategic business values is very important and necessary for educating your SIC. This level of understanding is crucial to achieving desired results.

A drive to succeed. A good SIC will recognize where your shop needs to focus to be successful. They'll take the time to work with employees and customers to achieve the best results. They'll strive to make your shop look good and aim to please internal and external customers. Their goal is to identify areas of improvement and work to make it better. With your guidance, they'll come up with ways to keep the company in a healthy growth cycle.

The power to hire a good SIC is in your hands. Placing the right person in this role will make your business grow, and you'll regain some of your own passion. The time and effort you've put into the business should allow you to reap

the benefits of all your hard work. The time has come to start living the life you dreamed about all those years ago when you started your business!

Getting started

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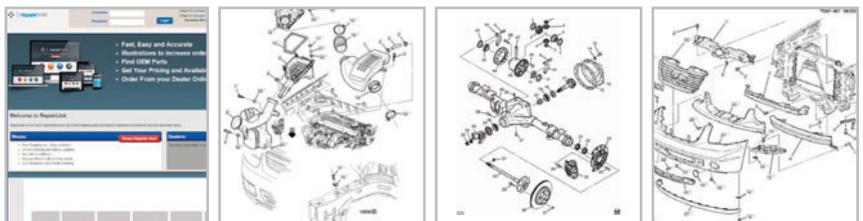


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CHRIS "CHUBBY" FREDERICK is the CEO and founder of the Automotive Training Institute. ATI's 130 full-time associates train and coach more than 1,500 shop owners every week to drive profits and dreams home to their families. Our full-time coaches have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

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GET YOUR BUSINESS MOTOR HUMMING!

From pricing to marketing, lead your shop to growth

DAVID ROGERS // Contributing Editor

Running a small business is anything but easy. Between dealing with employees, vendors, customers and a million different logistical issues every hour of every day, being your own boss can sometimes feel like more trouble than its worth. It's a good thing we love what we do!

One of the most challenging aspects of running a small business is being able to forecast the level of profit you'll be able to attain and how long you'll be able to sustain it. Countless external factors — the local and national economy, weather, new competition — all affect your bottom line, meaning that making accurate financial predictions is difficult to say the least.

Setting goals based on qualitative progress can often be more productive than using quantitative criteria. Just like a successful athlete or team — if you stick to the process and do things the right way, the results will come

more often than not.

You should have two sets of goals when establishing your business' plan of attack: short term and long term. Your short-term goals should be geared towards building and streamlining your operation into a lean, mean fighting machine and then you can think about the long-term plan and how you can grow your business at a realistic rate.

Establish favorable margins...

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you need to have a strong grasp of what your costs are — equipment, labor, rent, etc. — before you can determine what you'll be charging for both parts and labor. Once you know what you are spending, you will have a better idea of what you will need to charge customers in order to turn a profit.

At our shop, we have a sliding scale on markups, with low-cost items having the highest margin and vice versa. We aim to achieve a gross profit of more than 50 percent on parts by marking items up between 1.8 and 2.3 times what we pay for them.

It took us a while to determine where to set which price points and what to include in which category — your pricing matrix constantly adapts and evolves to various circumstances, and it should definitely be changed if and when you notice it is not producing the results you need. Flexibility is important in business and the longer you stick with a plan that isn't working, the worse your headaches will get!

...And protect them!

Once you've got an idea of what your margins will look like, you must protect them at all costs. If you offer coupons or discounts to try and attract new customers, make sure you're still making money on every transaction.

Over-discounting can lead to Red Herring measurables, which can be extremely detrimental to your business' progress, as you can become distracted by numbers that aren't actually adding to your bottom line. For example, just because your shop is busy doesn't mean you're doing well. If you attract the wrong kind of customers — customers like coupon chasers who aren't liable to return to your shop after they've gotten whatever discounted service they've come for — you most likely aren't turning a profit.

Having a high car count isn't nec-

essarily a good thing. This may sound crazy, but it's true, believe me. You need to be attracting the right kind of customer in order to be consistently profitable.

At one point in Keller Bros. history, we consistently had lines around the block and were as busy as could be. The problem? We weren't making any money because (a) our pricing matrix wasn't right and (b) we were attracting the wrong type of customer. The ticket on our average job was simply too low, and we were losing money despite all our bays being full.

Sometimes less is more. If you are attracting the right type of customer and have the correct pricing matrix, having less activity in your bays at a greater ROI is definitely more profitable.

Grow your brand

I've said this to more shop owners than you can imagine over the years and I'll say it here one more time: re-investing your profits back into marketing is something you must do!

The Better Business Bureau recommends investing anywhere from 5 percent to 10 percent of your net profits into marketing to ensure you are able to both maintain your current client base and stay in the new customer game.

On top of this, you need to stress to your staff that marketing your shop is everyone's responsibility!

We preach to our techs and service writers that the flow of production begins as soon as a customer walks through our front doors.

Establishing a sense of trust and familiarity with your customers is imperative to maintaining a strong retention rate. When you have regular, repeat business from a high-quality roster of car owners, you'll be able to get a better handle on what your average weekly/monthly/yearly revenue streams will look like and from there you can work

towards incrementally increasing your car count and profit lines.

Lead the charge and stay the course!

Setting personal goals is also something every shop owner and manager should focus on. Self-evaluation is tough to do when you're in the eye of the hurricane that is small business ownership, but being able to constructively critique your leadership style and its effectiveness is as important to your success as anything.

Part of being a good leader is keeping your eyes on the big picture and not getting too caught up in the trap of defining success purely based on monetary factors. Refraining from obsessing over every penny coming in and going out of your shop is tough — believe me, I know. This is something I've struggled with my entire career, and I've learned that taking a step back and getting some perspective on things is the only way to maintain your mental health as well as the health of your business.

Running a small business is tough. You need to have a solid work ethic, strong business instincts and an iron will in order to make a go of it. A lot of days and the number of obstacles you face over the course of a week can sometimes seem to go on forever. But at the end of the day, it's all worth it when you realize you're making a living doing what you love! **ZZZ**



DAVID ROGERS is chief operating officer of Keller Bros. Inc., president of Auto Profit Masters and president of Shop 4D, the industry's first Artificial Intelligence

(AI)-enabled, self-learning system for proactively managing repairs, customers, marketing, profits and employees. Reach David via email at contact@shop4d.com, toll-free at 1-866-826-7911, or online at <https://shop4d.com/>.

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Are we properly measuring our knowledge?

We account differently for training and equipment, but shouldn't

The aftermarket spends a tremendous amount of money each year on training courses, seminars and information programs. The purpose is to increase the employees' and management's knowledge required to maintain today's vehicles in a safe and reliable condition, understand new products and enhancements and continue with ongoing business management and employee development.

These training opportunities build employee and management knowledge, which in turn makes everyone more productive. Effectively executed productivity leads to enhanced company profitability, and higher wages for all. This ongoing knowledge development is very necessary as it is designed to secure the company's future.

The industry also spends a great deal of money on physical shop/company equipment required to execute its day-to-day business professionally. Up-to-date equipment increases shop productivity and profitability as well.

The problem with both examples is that under today's business accounting rules, they are treated very differently. Consider the following:

Training courses, seminars and information programs are treated as an immediate expense for "accounting purposes," which means they are written off completely in the year that they are incurred. For example, if a shop spent \$5,000 on training in one year, these monies are an immediate expense. This means the shop's net profits are immediately reduced.

Physical equipment that is acquired for the shop, on the other hand, are considered a "capital investment" and written down over time. Basic current equipment purchases are written down at 20 percent each year (for example only) on a declining basis. For example, if the shop spent \$50,000 on equipment, the first year expense would be \$10,000 ($\$50,000 \times 20\%$); the second year the expense would be \$8,000, ($\$40,000 \times 20\%$); and the third-year expense would be \$6,400 ($\$32,000 \times 20\%$), etc. This depreciation method does not reduce the net profit by the total amount of monies spent in that given year on equipment.

BOTH EXPENDITURES — TRAINING AND EQUIPMENT — ARE AN ABSOLUTE NECESSITY FOR SURVIVAL AND SUCCESS WITHIN OUR INDUSTRY.

Both "expenditures," when executed properly, increase productivity and profitability. Both expenditures realize a business return over time as an investment. Due to the way they are handled for accounting purposes, they can mislead management. For example, imagine spending \$35,000 between equipment purchases (\$30,000) and training (\$5,000) in one year. The \$35,000 cash is gone, yet on the expense statement management will see \$5,000 as an expense to training and \$6,000 as an expense to equipment depreciation. Management can very easily fall into the trap that if the training expense is

cut back, the bottom line and cash flow would improve.

That type of thinking in our industry will lead to disaster, BUT when things are tight, expenses are the first to be examined. Very rarely do you hear management desire to cut back on "equipment purchases" because 1.) management understands equipment in a more defined manner and its contribution to the back shop; and 2.) it is a physical, touchable item. However, the entire cash spent on equipment is not shown as a current year expense to bring the awareness of how much real cash was truly spent. It is shown on the Balance Sheet as a capital item.

Both expenditures are an absolute necessity for survival and success within our industry. The problem is that training is rarely seen as an investment, it is continuously talked about as an expense. To compound the problem with this type of thinking is that this investment is considered by management as intangible and perceived difficult to measure in immediate terms.

An investment in a piece of equipment may see a true dollar increase to the business in day one of entering the business, whereas a knowledge investment may only see a true return mid-way through year one. Yet, staff and management knowledge today are truly "assets" to the business. As with equipment, without it, the shop cannot survive.

Consider that even with the most progressive, professional looking facility, in the best location in town, and containing the best equipment ever, without the right knowledge base inside this fa-

cility, the business cannot succeed in today's business climate.

It is important to understand that the shop's knowledge base is a human capital asset to the business. Proper investment in this asset realizes a tremendous return but calculating how much you are investing each year can be tricky. Consider this simple exercise to get the process rolling:

1. Add all actual monies spent on various staff technical and management business courses and seminars over the past year.
2. Calculate the total number of hours in classes to attend such functions in No. 1.
3. Calculate all the hours spent doing in-house training and internal staff training.
4. Add all the hours spent in No. 2 to the total hours in No. 3, and then multiply the total by the shop's diagnostic door rate.

5. Take the answer in No. 4 and multiply it by your shop's efficiency rate (efficiency objective minimum of 75 percent).

6. Add together the amount in No. 1 and the final amount in No. 5.

7. Take the total amount in No. 6 and now artificially add that to the bottom line of the businesses net profit/loss and also add it to the Balance Sheet of the business under a new heading titled "knowledge capital investment account." This is what you can consider was re-invested last year in the business in which the business does expect to see a return. This is a knowledge investment and every year it should increase and realize a return. If the business did not see a proper return (35 percent for shops and 20 percent for national companies is reasonable), then management must revisit what type of knowledge investment is required to get the desired results.

This exercise makes a statement that in the automotive aftermarket, the business is constantly working with its knowledge assets and when an asset of this type leaves the business, is lost, or is not properly maintained, the bottom line of the business is dramatically affected.

In successful businesses in our industry, knowledge investment is clearly understood. Are you measuring and managing this important account properly? **ZZ**



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



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NO SHORTAGE OF SOLUTIONS

The automotive technician shortage is real, but our industry can take some steps today to contribute to a solution

BRYCE HOLT // Contributing Editor

Do a quick internet search for “auto technician shortage” and you’ll come up with more than 2 million results, many of which are people merely talking about the existence of a shortage. Unfortunately, the solutions are absent from most of these mentions. Some of the headlines use phrases such as “chronic shortage,” “high demand,” “scrambling for technicians,” “shortage crisis” and “shortage may mean more expensive repairs.” Is that last headline enough to make the average person notice?

The largest unsolved problem faced by the automotive industry is the growing technician shortage. It’s not a new problem. It has been a long, slow-moving situation that was predicted for decades. But as with many predictions, many hoped it wouldn’t happen. Turning a blind eye is something people do when they don’t want to face a problem.

But now’s the time. Only over the past couple of years has the industry recognized that this shortage has reached crisis levels. The shortage is now firmly established and is an issue automotive businesses must accept and address. As an industry, those in automotive must recognize that the worker shortage both has no easy answer and is not going away.



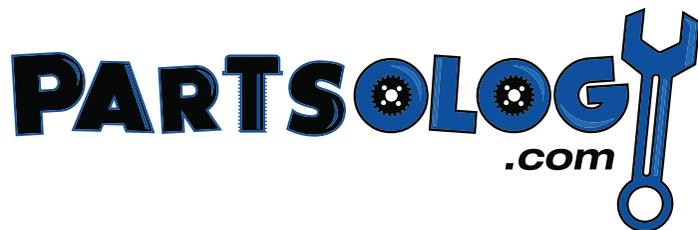
How bad is it?

The technician shortage is discussed at every auto service, collision repair and heavy-duty/diesel event. It is covered regularly in not just trade press publications; it makes national news in conventional consumer journalism. Why? Because everyone has a vested interest: most people have a car, and they all need those vehicles repaired.

Obviously, this topic is mentioned whenever conversations are had with or about automotive-related career tech education (CTE) programs. But the truth is that all skilled trades are suffering from a shortage. In its June 2019 job openings and labor turnover summary, the Bureau of Labor Statistics reports that there were

nearly 7.4 million job openings in April. According to the Association for Career & Technical Education, more than 80 percent of manufacturers report a talent shortage, nearly half of talent recruiters at Fortune 1000 companies report trouble finding qualified candidates with a two-year STEM degree, and between now and 2024, 48 percent of all job openings will require education beyond high school but less than a four-year degree.

According to the TechForce Foundation’s “Technician Supply and Demand Report Update for Fall 2018,” in 2017, the demand for new technicians was nearly 138,000. The number of 2017 post-secondary graduates numbered nearly 56,000. This leaves a shortage



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of more than 82,000 for the automotive service, collision repair and heavy-duty/diesel industry segments.

These numbers assume that 100 percent of post-secondary graduates in all three segments enter the automotive trades upon graduation. In fact, some of those graduates will not enter the industry at all. This shortage must be offset by high school CTE graduates directly entering the industry (skipping post-secondary school), as well as other technician candidate sources, such as returning military or unskilled, untrained individuals to enter the transportation trades.

Why is it such a struggle?

Specific to the automotive industry, what are the struggles?

- Baby boomers (those people born between 1946 and 1964) are retiring and taking decades of skills and experience working in shops with them. There are about 76 million boomers in the United States, representing nearly 30 percent of the population.
- Educational programs are struggling to stay ahead of vehicle technology, especially in a two-year high school. But even post-secondary career technical education (CTE) programs often lag behind technologically. This is particularly true given the significant budget reductions that CTE programs have faced. Also, CTE programs have for years been struggling to find qualified instructors.
- More and more high school students are pressured to pursue 4-year college degrees instead of career readiness or trade skills programs, despite research that says students who take advanced CTE courses in high school see higher earnings.

What can be done about it?

In its research, the ASE Education Foundation found that 42 percent of the automotive CTE graduates (both high school

and post-secondary), leave the transportation industry altogether within the first two years of employment.

What are some of the reasons, and where can the industry start to make improvements?

- **Low starting pay.** How are you paying your techs? It's common for techs to be paid in one of three ways: hourly, salary or flat rate. Because flat rate pays technicians by the specific job they perform, it benefits those employees who work quickly. Putting an entry-level technician on flat rate often results in them earning less than a living wage. Consider an hourly rate or salary for those technicians just starting out. In most states, entry-level auto service and collision techs make \$10-12 per hour, while the diesel and trucking industry pays \$18-22 per hour for entry level. You're not just competing against the shop down the street. You're competing against every segment that wants to hire that technician candidate.
- **Benefits.** Paying more may seem like a no-brainer, but it's not always about the starting salary. Benefits are a major draw, so strongly consider health and dental benefits, 401K plans, established advancement opportunities and a career path.
- **The high cost of tools.** Consider a tool program where the employer provides tools for all starting employees to use at the shop with tool ownership retained by the company. Or, the shop can purchase a new tool set for employees when they start, and employees vest toward ownership in the toolbox as they reach goals and benchmarks. Expecting a new employee to spend thousands of dollars on tools from the start of their career just isn't feasible for most people, especially at entry-level pay rates.
- **Lack of sufficient training/mentoring.** One method that can dramatically improve retention is to better equip shops and dealerships with mentoring.

According to the Spherion Emerging Workforce Study, those who receive mentoring at their place of employment are 77 percent more likely to stay with their employer. By improving mentoring practices, the probability of improved retention increases, with a goal of reducing the 42 percent attrition rate.

- **Bullying in the workplace.** Harassing and bullying behavior that may have once seemed acceptable and overlooked should have no place in today's shop. Take a hard look at your work areas and strengthen your HR policies if necessary. Remember, leaders in your shop set the example.

- **Non-automotive sectors are recruiting graduates from automotive-related career tech programs.** Graduates from your local auto service and collision CTE programs are great candidates for other industries, such as aviation, oil and gas, and wind energy. How can the automotive industry as a whole make the industry more attractive so that we aren't losing people to other industries? It's an important question and one that may not have an easy answer. Take some time to research what these industries are paying for employees with similar skill sets.

Start today

There isn't one solution to the technician shortage, and conversations about the reality of the situation are a great starting point. But this problem isn't going away, and just talking about it isn't going to change anything. It is going to take a commitment from everyone to strengthen and grow the industry. **ZZ**

BRYCE HOLT is COO of S/P2. Each year, S/P2 provides online training to more than 175,000 workers and students nationwide on industry-specific safety and pollution prevention, ethics, soft skills, and human resources topics, as well as an online workplace mentoring program for the automotive industry. info@sp2.org

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What's next for autonomous vehicle policy?

Telematics & Technology Forum to address new technology policy issues

The failure of the 115th Congress to address new vehicle technology policy has created quite the dilemma for the automotive sector.

Although autonomous vehicle legislation (AV), the Self-Drive Act, passed the U.S. House of Representatives by a voice vote, the U.S. Senate's AV legislation, the AV START Act, stalled after Senate Commerce Committee passage. With the failure of the Congress to address AV research and implementation policies, this leaves the U.S. Department of Transportation (DOT) or state governments to move forward with policies. The DOT has not, but it is a different story for states.

The Obama Administration opted for policy guidelines versus regulation in September 2016 publishing "Federal Automated Vehicles Policy, Accelerating the Next Revolution in Roadway Safety." These best practices and model state policy guidelines provided no regulatory teeth to AV implementation. The current administration has issued two additional broad policies, "Automated Driving Systems: A Vision for Safety 2.0" and "Preparing for the Future of Transportation: Automated Vehicle 3.0." Despite these additional guidelines, the lack of federal legislative and regulatory implementation has created a breeding ground for inconsistent new vehicle technology policies. This comes in the form of a patchwork of state laws, and also multiple areas of direction for federal legislation. States have not waited on the enactment of federal law and have moved forward with their own AV legislation. A 50-state footprint of laws is not the best approach for AV regulation and could actually inhibit innovation.

According to the National Conference of State Legislatures earlier this year:

- Twenty-nine states have enacted legislation related to autonomous vehicles.
- Governors in 11 other states have issued executive orders related to autonomous vehicles.

At the federal level, there has been some discussion of



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reviving last year's AV legislation. Former U.S. Senate Commerce Committee Chairman John Thune (R-SD) noted that AV legislation for the 116th Congress still has problems related to how much power states should have. These were issues in the Senate last year. With the House now controlled by Democrats, preemption will become an even greater issue in the AV debate.

How does this impact data access for independent repairers? The AV START Act contained provisions for a stakeholder data access and cybersecurity committee at the National Highway Traffic Safety Administration. The Federal Trade Commission was also approved by the Commerce Committee to be part of this stakeholder process. Since this bill was not considered on the Senate floor, many of these critical issues have rolled to the 116th Congress. Various bills have been introduced at the federal level, which directly or indirectly impact automotive repair shops. At the state level, California has passed significant privacy legislation, and the Massachusetts legislature will soon consider amending their Right to Repair law.

Highlighting the lack of action at the federal level, the U.S. DOT recently terminated the Advisory Committee on Automation in Transportation, a federal advisory committee established during the Obama Administration.

The next 18 months will be important for determining a path forward on new vehicle technology policy and, important for independent repairers, data access policy. The Automotive Service Association (ASA) and the Alliance of Automobile Manufacturers are hosting a Technology and Telematics Forum in Troy, Michigan on Sept. 12, 2019 to discuss many of these issues critical to independent repair shops. Get more information at www.asashop.org. 

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

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Keeping a legacy alive

Shop owner's widow is determined to keep the business her husband built

ROBERT BRAVENDER // Contributing Editor

➔ When a shop owner is as strongly linked with their company as much as Francisco “Frank” Carrillo was with his, it makes it that much harder when he passes. On November 19, 2015, Alignments 2000 lost its founder to cancer. And while the community of South Houston, Texas, mourned, his family and staff had some hard decisions to make.

“My dad had been the main guy,” explains Dulce Carrillo, his youngest daughter. “He was the mechanic, the one who ran the whole shop. One time he was short staffed, so he’d be fixing three cars at the same time, yet would still go and talk to customers, treating them with the same respect that he was raised on.”

Robert Farmer, the shop’s longtime senior service writer, notes that “Frank never put a technician on anything that he wasn’t perfectly willing to do himself. If it came to scrubbing the floor, he’d get out there and do it.”

Dulce affirms that “at no time did he say, ‘I give up,’ and throw in the towel. So, we said, do we want to keep this a family business, or do we want to go ahead and sell it?”

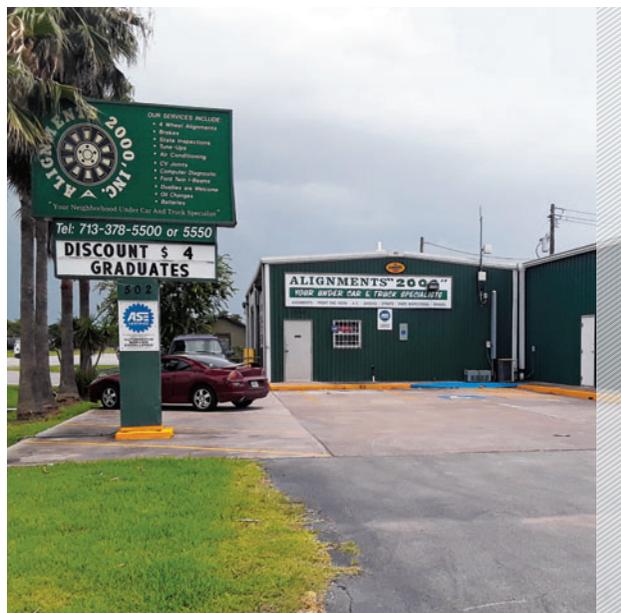
An expert on alignment, Frank Carrillo had established the business 15 years earlier. “We were a shop created out of the American Dream,” Dulce declares. “He came over here from Mexico looking for a better future. He wanted to establish a business that would help the community as well as provide for his family.”

Since its opening in 2000, Carrillo had doubled the number of bays from three to six. Armed with Hunter alignment equipment, he also added HawkEye Elite precision cameras for greater speed and accuracy. And he expanded the shop’s services with diagnostics via Snap-On.

“One of the mottos on our sign is ‘Your neighborhood undercar and truck specialist,’” reports Farmer. “(Carrillo) wanted us to be a company you could bring your vehicle to so we could take care of nearly anything that could go wrong on it.”

One thing they lacked, though, was a complete estate plan. Carrillo’s reputation had significant weight in the decision to stay open, but some aspects of the business, like his ability to align tractor trailers and his certification as a state inspector, were lost with his passing. Ultimately the company’s fate fell to Carrillo’s widow, Ernestina.

“Come hell or high water, she wanted to keep the shop,”



ALIGNMENTS 2000, INC.

South Houston, Texas // alignments2000@gmail.com



Ernestina Carrillo

Owner

4
No. of employees

1
No. of technicians

1
No. of shops

6
No. of bays

19
Years in business

100+
No. of customer vehicles per week

reports Farmer. “She wants to keep her husband’s legacy alive as long as she can.” Ernestina would take over running the company, assisted at first by Dulce, later by Farmer, with Christopher Small as the senior technician. Carrillo’s shoes were mighty big, but he had instilled a solid work ethic in his family and crew.

“Chris (Small) was trained by Frank, so he’s got that same willpower,” says Farmer. “You make a mess, you clean it up.”

You don't sit there for a month and let it pile up" — especially when it came to alignments.

"Frank taught every mechanic who came through the door to do alignments," Farmer points out. "Nine out of 10 [technicians usually think] alignment is just setting tone. No — the angles of the tires are of key importance, which has to be addressed in order to do a proper alignment. Most vehicles nowadays require a special aftermarket kit to straighten that up, so we know when one hasn't been properly realigned."

And from testing alone, Small can determine what usually wears out tires prematurely. "But just like Frank, he'll take a customer out to the shop to show them," Farmer proudly reports. "Don't just take my word for it, I want you to physically see what the problem is. That's what I like about what Frank instilled in the mechanics; you want to educate the customer, not just preach to them."

Farmer estimates that alignment work constitutes about 50 percent to 75 percent of the business. They have fleet accounts handling suspension maintenance for the city of South Houston, U.S. Postal Service mail trucks, sev-



eral plumbing companies and other shops, as well as nearly "every single used car lot in South Houston."

But with Carrillo gone, Farmer admits "I have to think about what else we can do, because we lost a great deal. He was a fount of information; there was so much knowledge stored inside of his head because of all the hands-on work he did for decades. His training has been passed down, but still you don't have that teacher to call upon."

To that end, Farmer has turned to resources like the internet — something Carrillo was admittedly old-school about. One is [Alignable.com](#), ironically a small business network with no direct connection to auto repair. For Farmer it functions like a 20 group.

"We share information, give input. People from all over the country can ask questions, like how to design a website, etc., and you'll get 20-30 people chiming in. It's a forum for all industries to communicate things that can help us succeed, or maybe stay away from. It's really great."

Nonetheless, the new management team was really put to

the test when Hurricane Harvey hit the area in 2017.

"We only got six inches, while 90 percent of south Houston was under a couple feet of water," Farmer recalls. "But we were one of the only shops on this side of Houston that had a pit, and all of the big rig equipment was down there. Unfortunately, we didn't have flood insurance, because in the 17 years we've been here we've never had water get anywhere near the inside of the building. So replacing a \$20,000 piece of equipment was something we just couldn't see spending the money on."

And while the Hunter alignment racks were high and dry and all the tools were safe, filing cabinets with years of paperwork were damaged. "We had to go through everything and sort it out," Farmer recalls. "We laid it all out on the ground and dried it out as much as we could. Basically, we all pulled together like a family."

"You pull it together to make it successful," emphasizes Farmer. "That way you keep the doors open." *ZZ*



ROBERT BRAVENDER

graduated from the University of Memphis with a bachelor's degree in film and video production. He has edited magazines and produced shows for

numerous channels, including "Motorhead Garage" with longtime guys Sam Memmolo and Dave Bowman.

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Three talent groups are the key to the industry's longevity

WE MUST BRING IN NEW TALENT IF THE AFTERMARKET IS GOING TO SURVIVE

CHRIS CHESNEY // Contributing Editor

As this industry faces the largest challenges in its history with respect to the advancements in vehicle technology, our industry is being left behind as an attractive option for young people. We must realize that while we provide services for consumers on their vehicles that are some of the most complex technology machines on the planet, as an industry we lack innovation in making our careers one of the most preferred places to work. At the core of what we do lies a crumbling cornerstone that we must replace if we are to survive: new talent.

Here we outline three industry groups with currently critical stances: young people looking for a career, the talent already in our industry but always seeking something better, and the skilled workforce leaving our industry for others.

Let's start with the first group: youth who are looking for a career. There are many in vocational schools giving our industry a try while their friends enter other segments of vocational trades because it is a pathway to a good job that requires less upfront money than a college degree. But, many of these students in an automotive program are beginning to look at other industries for several reasons. First, other industries, such as engineering, wind industry, etc., are more attractive because the cost of

entry is low, and the benefits are on par with other industries. Entry-level professionals don't have to buy their own tools, and they receive a benefits package that includes health care, retirement, life insurance, vacations, bonuses and — get this — a career path that illustrates to them the opportunity for growth and advancement. The second reason is that other industries are actively talking to young people; these industries act like they want them. In the meantime, the majority of our industry waits for graduates to show up and ask if we have an opening. Think about how you can offer a comparable compensation and benefit package that rewards talent for working in a production environment that provides the tools needed to be successful, and engages them in a career path that is planned and encouraged.

The second group consists of the journeyman techs. What makes them move every year or two? These journeymen come in two types: skilled but without direction, and unskilled with inflated confidence and value. The former is worthy of investment and being put on a career path and training program. The latter evolved out of the typical flat-rate model and lack of process in handling technology problems. Over the years, lack of skill could be hidden by speed of the wrench. This inflated the confidence of many techs who became known as the Master Tech in their shop, but who have not been given the foundational skills needed to solve problems on the

technologies that are the norm in today's bay. This tech is salvageable in the same way as the former, but it requires humility on their part. Both of these journeymen need process and support to thrive and gain satisfaction in their career.

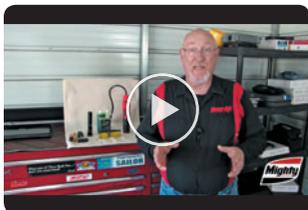
The final group are those that are leaving our industry. If you follow any of the blogs and forums common in our world, you've read post after post about a shop's best tech leaving the industry for something they find more attractive. With our industry facing many professionals departing after spending years crafting their skills one has to wonder: what made the tech take this route? Is it because they don't see a future in our industry? Or has a different industry always been their dream or goal? Ultimately, if they are the type of person I wanted when I hired them, and they aren't satisfied with what they have with my company, then I need to find a way to challenge them in a way that allows them to stay.

Talent doesn't grow on trees. Attitude doesn't either. It is far more profitable to invest in and keep talent by stretching your business model to leverage that talent than it is to let them ride off into the sunset and hope an able replacement is picking up the phone to call. *TC*



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

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MECHANICAL MOMENT

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

GRAND CHEROKEE — DTC P20EE, SCR NOX CATALYST EFFICIENCY BELOW THRESHOLD BANK 1

VEHICLE: 2015 Jeep Grand Cherokee,
4WD, 3.0L Turbo Diesel, Automatic
Transmission

MILEAGE: 32,158

PROBLEM: The vehicle came to the shop
with the MIL on. The engine seemed to
run normally.

DETAILS: The bulletin stated to connect a
scan tool and pull codes from all modules.
If any of the following DTCs are present,
check for signs of DFE contamination:
P20EE, P2BA9, P20E8 or P20E9.

The technician connected a scan tool
and pulled DTC P20EE. He inspected
the Diesel Emission Fluid (DEF) fluid
and it looked good, but he replaced the
fluid anyway, using new DEF fluid in
from a sealed bottle. There was still no
difference.

An ALLDATA Tech-Assist consultant

suggested that the technician check the
DEF injector for signs of contamination
based on a factory TSB he found in
ALLDATA (TSB #25-003-15). It
appears that the DEF system on Grand
Cherokees with a 3.0L Turbo Diesel
engine, built on July 10, 2015 to July
11, 2015 and vehicles built on August
24, 2015 to August 25, 2015, may have
been contaminated during manufacturing.

NOTE: Based on the vehicle's VIN,
additional replacement parts are
suggested. Please review the full TSB in
ALLDATA Repair.

CONFIRMED REPAIR: The technician
checked the DEF injector, and it was full
of limestone deposits. He was able to
clean the injector and reinstall it. After
clearing the DTC and test driving the
vehicle, the MIL remained off and did
not return.

Learn more at [ALLDATA.com](https://www.alldata.com).

TRAINING EVENTS

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Mobile Tech Expo
South Point Hotel & Casino
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SEPTEMBER 18-20

**2019 Auto Care Association Fall Leadership
Days and Legislative Summit**
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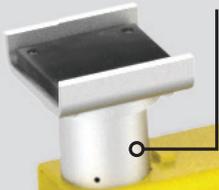


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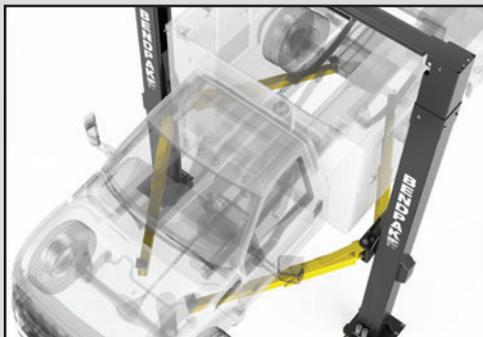
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REPEAT IGNITION COIL FAILURES — A LESSON IN TROUBLESHOOTING

A 2001 VW CABRIO ATE IGNITION COILS LIKE MY GRANDKIDS EAT M&MS. FOLLOWING A LOGICAL PROCESS HELPED BREAK THIS CABRIO'S BAD HABIT.

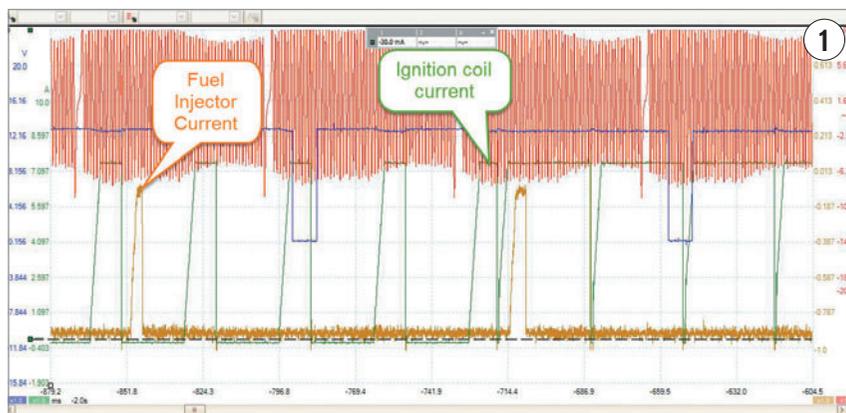
ALBIN MOORE //
Contributing Editor

Every now and then an interesting diagnostic problem comes into the shop. Many of these problem vehicles come from other shops, and many of the vehicles have been backed up to the parts store and loaded up with everything in sight. This 2001 VW Cabrio was one of those vehicles.

You might think a car this old would be a car that nobody would invest any money in, but please keep in mind, beauty is in the eye of the beholder and when a person loves their car, takes great care of it and keeps up on the maintenance, the vehicle will last a long time. While I had this car apart, the owner walked into the shop and loudly exclaimed, "MY BABY." I think she had a love affair with this car.

"Baby" has a problem

The story of the problem started out about six months earlier. The owner was on her way home from work on a Friday evening. Her commute was 134 miles. She was 50 miles from home when the engine lost power and died. The car was loaded on a flatbed and hauled to a shop that specialized in VW, Mercedes-Benz



SCOPE CAPTURE OF THE CMP VOLTAGE, ignition coil current and fuel injector current. I found the reason for the engine stall when the ignition coil control was lost.

and Volvo vehicles. The shop found the problem was caused by a bad ignition coil, so a new coil was installed. The engine started and ran OK and was driven about two weeks before the engine stalled again.

The vehicle was hauled back to the European shop, only to find the shop had closed its doors, so the vehicle was hauled to another shop for the needed repairs. At shop No. 2, they replaced the ignition coil, put in a used ECM, installed a new distributor and put on a new MAE. The vehicle was driven for two weeks and stalled again. The car was taken back to the shop where they found the ignition coil had failed yet again. A new OE coil from the dealer was

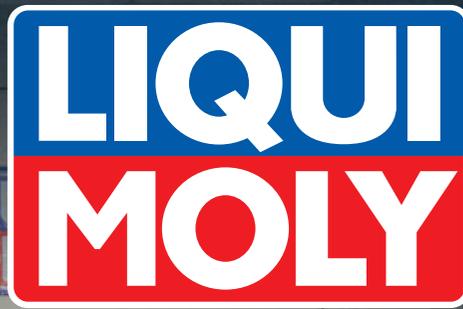
installed. This repair also lasted about two weeks, then the stalling problem reoccurred. At this point, the car was brought to my shop to be fixed.

Each time the engine stalled, the problem has been that the ignition coil quit making spark, and installing a new ignition coil got the engine running again. Any time I hear something like this, my mind always wonders if the problem is really an ignition coil or is the defective ignition coil a product of something else that is causing the ignition coil to fail?

Let's take a look

With the Cabrio at my shop, I found the engine could be started and it would

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The automobile export in 2018 generated income of US\$ 21,128.90 million, an increase of 6.65% from 2017. This includes 52.75% of passenger cars; 37.01% of pick-ups, buses and trucks and 6.39% of motorcycles. Thailand's major markets for automobiles include Australia, the Philippines, Vietnam, and New Zealand.

The automotive industry has gained continuous supports from the Government through a number of policies including investment promotion policy which consists of various measures such as the offer of

investment privileges, duty exemption for auto parts import, promotion of domestic manufacturing and the use of parts produced in Thailand, promotion of eco-car or electric vehicle manufacturing, etc.

As Next - Generation Automotive is one of the 'First S-curve' target industries to be promoted in Eastern Economic Corridor (EEC), the industry will receive many benefits including income tax exemption; import duty exemption for machines and materials; financial supports for investment and R&D; land ownership allowance, services from One-Stop Service center, Work Permit and VISA issuance for foreign specialists, etc. This will draw investment to the country's electric vehicle industry and establish Thailand as an electric vehicle manufacturing base in the future.



One of the world's premier regional manufacturing hub for automotive parts and accessories

Apart from automotive production, Thailand is also well-known for expertise in auto parts due to its commitment to excellence and attention to detail in every production process. Auto parts from Thailand have been entrusted by leading car companies for over 50 years and they are now widely used throughout the globe.

Thailand's auto parts industry is the strongest with highest potential in ASEAN, demonstrating by Thailand being No. 1 in auto parts export in all categories in ASEAN and No. 14 in auto parts export to the world.

Thailand has more than 2,400 auto parts manufacturers comprising 710 Tier-1 and around 1,700 Tier-2 and Tier-3 manufacturers. 80-85% of the export value comes from OEM products with the rest 15-20% from REM products. Major export products include parts of engines, electrical wiring, bodyworks, windows, gears, tires and other rubber parts which have high competitiveness in global market.

The complete supply chain which brought about an economy of scale and the continuous development of production technology has enabled Thailand to manufacture a variety of international standard auto parts products. The superb geographic location has also established Thailand hub of auto parts manufacturing and exporting of ASEAN as well as destination of global sourcing.

In 2018, Thailand's export of auto parts and accessories valued US\$ 16,602.24 million, an increase of 14.50% from the previous year, 47.26% of which or US\$ 9,984.95

million came from parts and accessories of motor cars products with an increase of 10.55%. Major markets include Japan, Indonesia, Malaysia, South Africa, China and the US.

TAPA 2020

We organize trade fairs to showcase outstanding capabilities of Thai manufacturers and traders across industries on a regular basis every two years.

The upcoming event: Thailand International Auto Parts & Accessories 2020 (TAPA 2020) will be hold on 2nd - 5th April 2020 organize by Department of International Trade Promotion, Ministry of Commerce, Thailand.



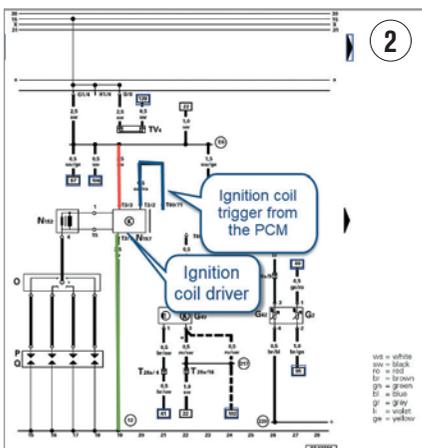
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WIRING DIAGRAM SHOWING the design of the ignition coil and its control circuit.

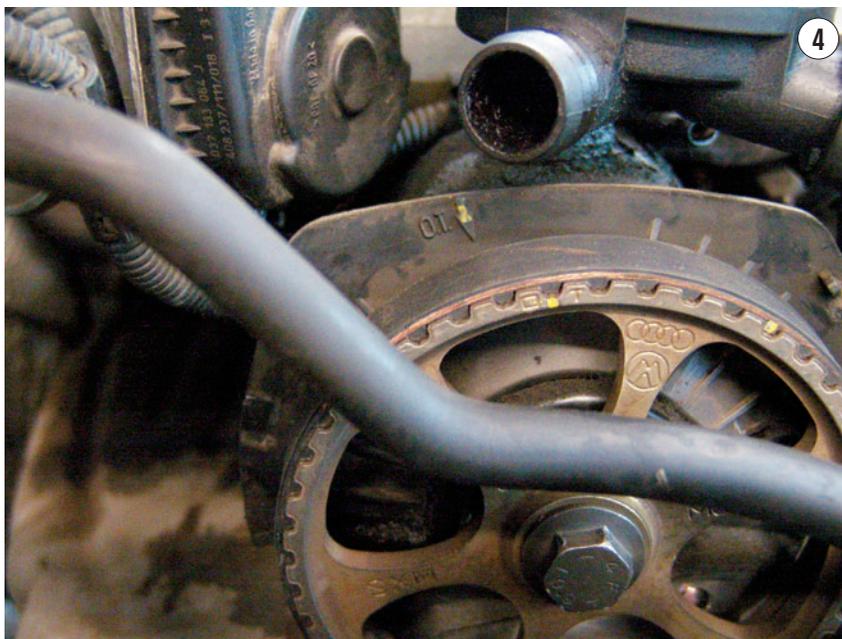
run about 15 minutes and then stall. The engine could be restarted and it would run, and then stall again. Each time the running time would get shorter until it would not run at all.

On any problem like this, my first step is to always take a look at anything stored in the computer's memory. A scan tool was hooked up and all modules scanned for any clues that might have been stored in memory. There are a few codes stored in the ABS module and two codes stored in the PCM. Code P0341 (Camshaft Position Sensor circuit range/performance) and P0102 (MAF flow too low). The P0341 code is set by the CMP and the CKP signal correlation being wrong. My gut feeling is the P0102 code is set by the engine not breathing properly. Clearing the codes, starting the engine and running a few seconds until it will stall will cause both codes to come back. At times, the codes must be cleared before the engine will restart. This engine will run with the CMP sensor unplugged, so the P0341 code is not an issue with the stalling problem.

My first question was, "What is going away — spark or fuel? To answer this question, I used two current probes and my lab scope. One current probe went to the ignition coil power feed while the second went to the #4 fuel injec-



PHOTO OF THE TDC MARK on the flywheel and the distributor not in the correct position.



THE CAMSHAFT IS 1-1/2 teeth out of time. Strangely, the engine ran smooth, although it was lacking in power. I have no idea how long it had been driven in this condition.

tor power feed. I also hooked a voltage probe to the CKP and CMP sensors. The engine was started and allowed to run until it stalled. At this point, I have my first test results to find a direction.

What has changed?

In **Figure 1**, the waveform shows a prob-

lem with the ignition coil current. Something has caused the coil on time to suddenly increase to the point that would overheat an ignition coil. My next question is, "What is causing this problem? Is it the ignition coil itself, is it an input to the PCM or is it the PCM that is causing the destruction of the ignition coils?"

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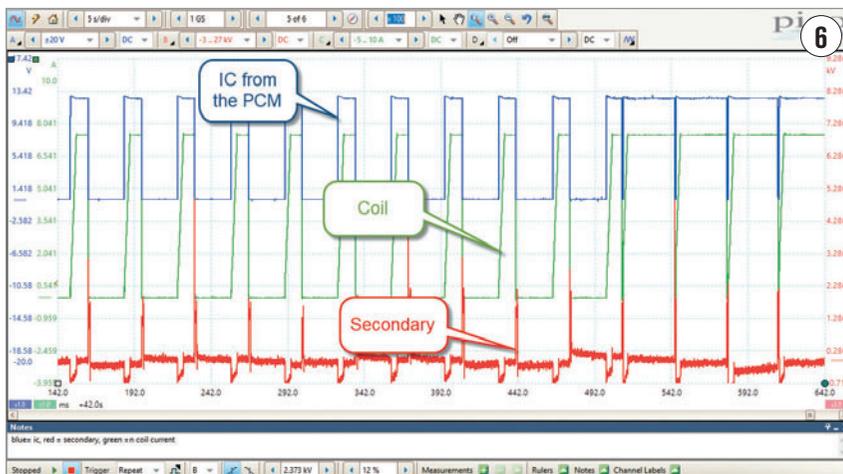
CRANKSHAFT TIMING belt sprocket with the locating lug broken. According to the vehicle owner, the timing belt had never been changed and this part never taken off.

The ignition system on this engine is a distributor ignition system with the Camshaft Position Sensor (CMP) housed inside of the distributor. The ignition is triggered from a Crankshaft Position Sensor (CKP) that reads from the reluctor on the crankshaft. The CMP has no effect on the ignition system and is used only to identify cylinder 1 position. Let's take a look at a wiring diagram to see how this circuit is designed.

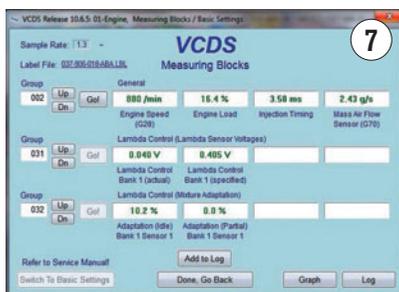
The wiring diagram in **Figure 2** shows the single ignition with a built-in driver housed in the ignition coil. There are only three wires to the ignition coil: power, ground and the trigger from the PCM. The haunting question is what is causing this car to destroy its ignition coils? So far in the repair history, it has had three different coils installed. The first two were an aftermarket part and the last coil was purchased from a VW dealer. All coils failed in the same manner.

Any time I am confronted with a problem like this, I will ask myself what has changed? After all, this vehicle is over 10 years old. I can understand it having one ignition coil failure, but not three. What has changed to cause this problem?

When it comes to an ignition coil failure there are only three things that come to my mind: 1) something is causing the ignition coil to work too hard; 2) something is causing the ignition coil to



THE SCOPE CAPTURE shows the ignition coil current is following the coil control from the PCM.



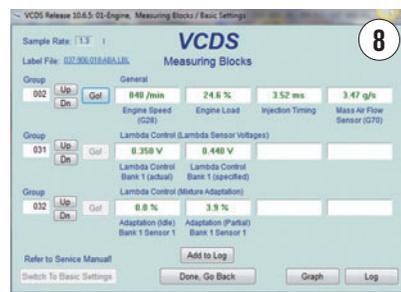
SCAN DATA OF THE MAF DATA and fuel trim data. This data plainly shows the MAF is not reporting the proper amount of air going into the engine.

be turned on too long resulting in overheating; or 3) the ignition coil has worn out from a long life. Since there have been multiple coil failures, we can rule out No. 3.

Nailing down the cause

Since I have verified the stalling problem is ignition-related and caused by the ignition coil failing when it gets hot, the next step is to find out why. We have two diagnostic trouble codes that might help give us a direction. Over my years in this business, I have seen a low flow MAF DTC stored by an engine breathing problem, so that is where I want to start my quest for information.

Since this engine has had some work done to it, I want to verify a few things. I have a cam timing code, so I want to address this first, but I feel that I might be



SCAN DATA WITH THE NEW MAF INSTALLED. Now the data looks correct and the engine is running like it is supposed to run.

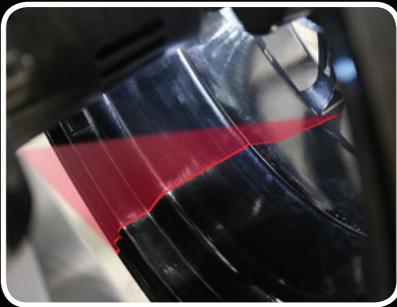
able to fix both the low MAF flow code and the CKP/CMP code at the same time. This engine has timing marks on both the crankshaft harmonic balancer and the flywheel. The flywheel inspection plug is already missing, so it is easy to turn the engine and line up this mark. In **Figure 3**, you can see the mark on the flywheel is in the correct position. I have taken the hold-down clamp off the distributor and the aligning pins are not in the correct position.

Since the timing belt cover is already loose, let's have a look at the marks on the camshaft sprocket. With the crankshaft mark at TDC, I found the mark on the cam sprocket is 1-1/2 teeth advanced (**Figure 4**). Removing the clamp from the distributor, I found the distributor had been installed in the wrong position, possibly in an attempt to eliminate

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the P0341 code. I feel that the cam is out of time (which lowers the volumetric efficiency of the engine) and this might be the cause of the MAF code.

At this point, the engine was in need of a timing belt, so a new belt was installed. During the belt installation process, I removed the crankshaft sprocket. The bolt holding the sprocket on was very tight. After talking to the vehicle owner, I learned that the belt had never been changed, but when I removed the sprocket I found the locating lug was broken in the gear (**Figure 5**). Finding this explained why the timing belt was 1-1/2 teeth out of time.

With the new timing belt installed and the distributor properly installed, the P0341 DTC is gone. The vehicle was test driven for a few miles; the engine runs good, although it seems to lack power especially at high RPM. With the vehicle at the shop, the engine was run at 1500 RPM for about half an hour when the engine stalled and this waveform was captured (**Figure 6**).

Better, but not fixed yet

The waveform shows the ignition coil current following the command from the PCM. I had to ask myself: is the PCM supplying a pulsed signal to trigger the driver in the ignition coil or is the PCM pulling the 12V output from the coil driver low to trigger the coil? To answer this question, I unplugged the ignition coil and put a power and ground to the coil. I then had 12V on the signal wire from the ignition coil, so the PCM is in charge of pulling the circuit low to trigger the coil. My next question was what is causing the PCM to suddenly increase the on time of the coil, causing it to self-destruct?

In researching this coil driver, I found it is a “smart driver” and has the ability to report back to the PCM things like misfires and KV demand, so the PCM can make adjustments to the control of the ignition coil. In this case, the ignition coil

is overheating, and then the coil driver goes and loses its mind and turns the coil on way too long, resulting ultimately in the engine stall.

When it comes to an ignition coil being overworked, there are three things that come to mind: 1) the resistance in the secondary is too high; 2) the air fuel ratio is too lean; or 3) the coil driver is leaving the coil on too long. I think I can rule out the problem of the coil driver, since there are no problems with the coil on time until the coil overheats. That leaves only fuel mixture and secondary ignition.

In going over some of my scope captures of the secondary ignition, I noticed the engine would idle with a KV spike from 9KV-15KV, depending on engine RPM. This is a little higher than normal although this in itself shouldn't cause coil failure. The only thing left is air/fuel ratio. This makes me kick myself in the back side, since I did not take a look at the fuel trim at all. In fact, it totally slipped my mind.

Fuel trim provides the clue

Going back to the stored diagnostic trouble codes, the P0341 has been fixed with the new timing belt. I thought the P0102 DTC would also go away when I got the engine to breathe properly, but now it's time to address this problem. With my Ross-Tech scan tool hooked up, I noticed some data that didn't look right. In **Figure 7** data block 2, the last two fields, injection timing and mass air flow sensor data should both be very close to each other. This is something I have paid attention to on VW vehicles over the years; it's just one of those quirky things I look at when working on VW MAF problems. The next thing is in data block 31, field 1 and 2. VW does a great job of giving many PIDs of actual and specified. Any time you see those two together, pay close attention. In this case, the actual and specified are not even close.

The last data block, 32, tells the final

story. Field 1 is showing fuel correction at idle from the oxygen sensor. This fuel trim is not like generic long term and short term — it is the actual correction at idle in field 1 and the actual trim off idle in field 2. Trying to relate this to long term and short term in OBD II generic will cause you to age very quickly. When this data was taken, the engine was at idle and is reporting 10 percent correction on the scan tool. To compare that to OBD II generic trim, that would be close to a 20 percent correction.

Now, without having to get out of the driver's seat, you can watch these three data blocks, run the engine at different speeds and get a very good idea how the MAF is reporting the air being inhaled by the engine. In this case, the MAF is out on vacation, The MAF on the vehicle is a brand new part. In this case, the NEW means Never Ever Worked.

A new MAF sensor was installed and the engine started and test driven. The data in **Figure 8** tells the rest of the story. Data block 2, fields 3 and 4 are very close to each other. Data block 31, fields 1 and 2 are very close to each other and data block 32 fields 1 and 2 are right where they are supposed to be. The problem of the coil failures is now fixed. Since these repairs were made, the vehicle has been back several times for service and has had no problems with the ignition coil.

Vehicles with problems like this, I call “sandwich vehicles” since there are so many problems all sandwiched one on top of each other and the only way you get to the bottom of the problem is by persistence and following a logical testing plan. *TL*



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

bwrench@yahoo.com

TALES FROM ACROSS THE POND

A COLLECTION OF REAL-WORLD SHOP EXPERIENCES WITH A FOCUS ON EUROPEAN MAKES

G. JERRY TRUGLIA //
Contributing Editor

Let's start our trip across the pond with a BMW that is one of the most commonly sold Euro vehicles in our country. A 2012 BMW X5 came into our shop from a recommendation from another one of our customers. The lady that owns this BMW had taken the vehicle to the BMW dealer already and was not satisfied with the repair that was performed.

The problem on this X5 was that the vehicle's battery would go dead in a couple of days. Now, if you're thinking that this dead battery was caused by something that they missed, such as a parasitic draw, you're correct. Take a look at the dash warning messages (Figures 1 and 2) that were displayed as a result of the problem.

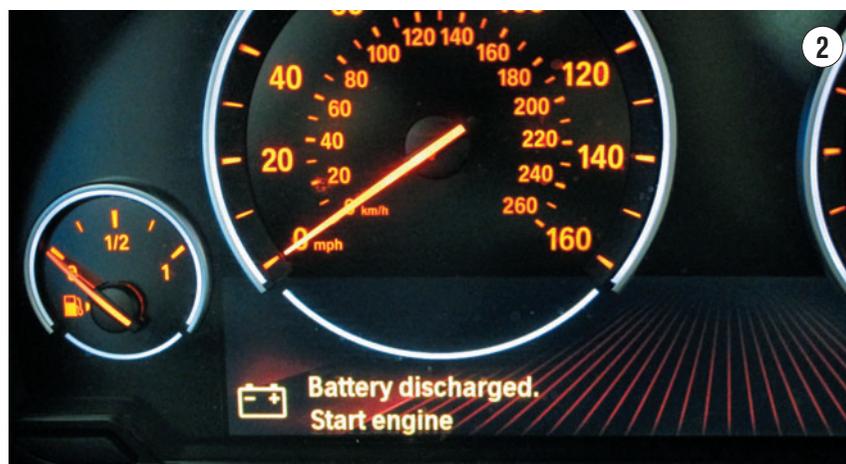
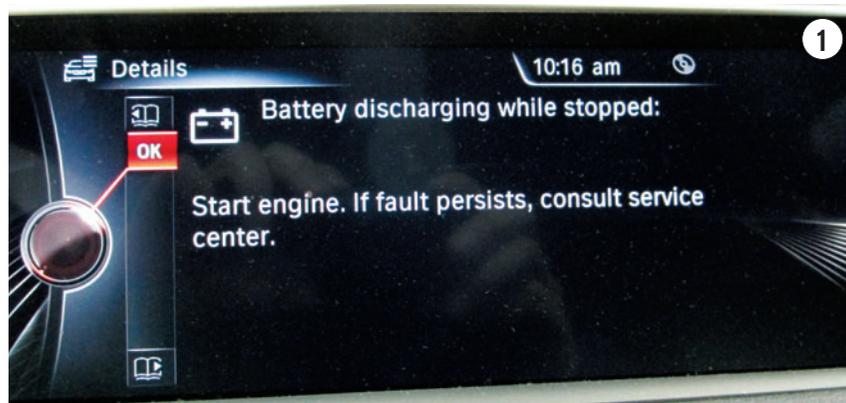
The dealer had recommended that the battery and alternator be replaced in order to solve the problem and performed the repairs. Unfortunately, after the repairs were performed, the vehicle still had the same problem. She brought the vehicle back to them a couple of times but they were, for some reason, unable to resolve her concern.

We started our diagnosis at the most important electrical power component in any vehicle: the battery. We found that the battery was low after performing a battery, starter and alternator test. The Midtronic battery test results stated the battery needed to be charged

and retested. Our next move was to attach our associated battery charger and set it to the AGM setting to charge the battery up to specifications. After the battery was fully charged, we repeated the battery test, but the battery failed once again. We charged the battery one more time before we condemned it.

But before we called the vehicle owner, we installed one of our new

AGM batteries so we could continue our check of the starter and alternator. There is nothing worse than calling a customer multiple times and telling them each time you found something else wrong. My lead tech Bill had also performed a vehicle scan to check for codes and battery registration. Since there were no codes and the battery was properly registered, the problem



had to be elsewhere. With a new battery installed, Bill proceeded to retest and continued to look for the problem. The issue he found was not with the alternator, but rather a problem with the negative battery cable current sensor. Now we felt comfortable calling the customer and recommending that the battery and the battery cable current sensor both be replaced.

The BMW owner refused to provide the information for the battery warranty and told us just to replace the battery since she no longer wanted to deal with the BMW dealership. We followed her request and installed a new battery and negative current cable before starting to test for a parasitic draw.

Bill proceeded to test for the parasitic draw by installing the shop's Fluke 233/A meter (**Figure 3**), along with our Fluke i30s amp clamp. The amp clamp has a big enough jaw opening to fit around all battery cables that

we have encountered so far. The Fluke i30s amp clamp is our tool of choice for parasitic draw, since it can accurately measure current with a resolution of 1 mA/5 mA up to 30 A. Since the amp clamp sensitivity range is 100 mV/A (100 millivolts equal 1 amp), our reading on the meter (**Figure 4**) is not interpreted by using the decimal

point but rather by just reading the three digits. This is a very confusing problem for technicians when they use an amp clamp on a meter. I have seen this confusion for years both in seminars and hands-on classes, so in both my electrical and scope books, I make sure to highlight the use of an amp clamp on a meter.



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On this vehicle, Bill selected to use the millivolts scale on the meter since it's the most accurate and can read up to 600 mV (6 amps). If the meter's display reads OL, the limit has been exceeded. Then all that needs to be done is to move the meter dial to the voltage position and read the display. On our X5, the maximum milliamps reading is 40 mA; anything over that indicates a problem. The reading that our meter displayed on this X5 was 26.5 (**Figure 5**).

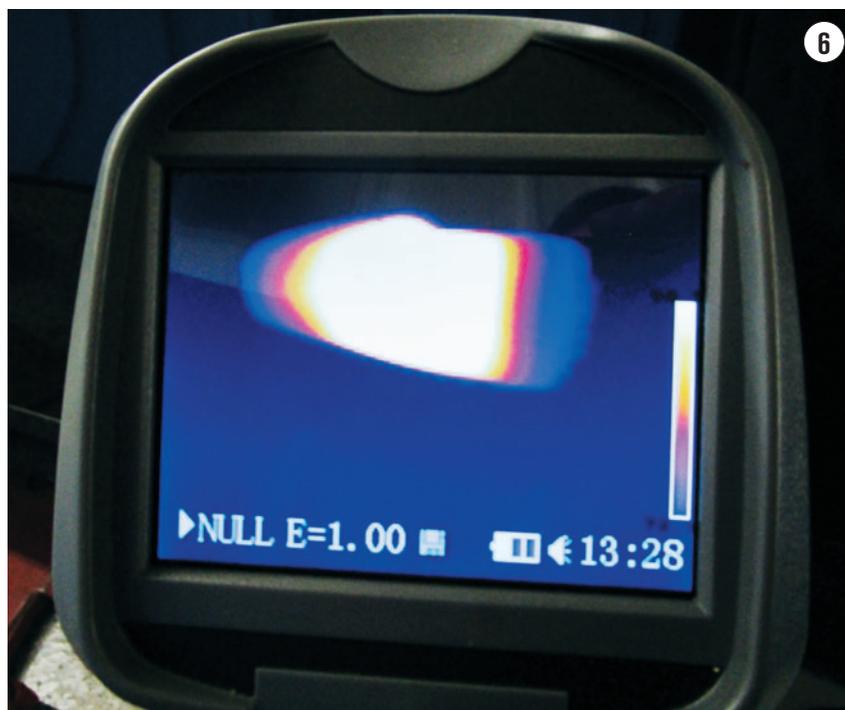
Remember what you just read above? The 26.5 is NOT 26.5 milliamps but rather 2 amps 650 milliamps — that is way over the 40 milliamp maximum tolerance! Can you see why the new battery that the BMW dealership installed was draining down and went bad? Our next step was to find out where the problem was coming from. We could have started our diagnosis by disconnecting the alternator since a shorted diode can cause a draw, or voltage drop each fuse, or last but not least disconnect one fuse at a time. All those methods have been used for years but take time to perform. We found that a better method, allowing us to be more proficient, was by using our thermal imager on a cold vehicle.

We checked all around the vehicle until we found a bright color on the thermal imager screen. Take a look at the short video that we shot on the X5 to get a better idea on how helpful using a thermal imager can be. Go to our YouTube channel by plugging this link into your browser of choice: www.youtube.com/watch?v=j5utqUC1xhw&t=4s.

Using the thermal imager, we were able to check the alternator and fuse boxes, followed up by looking all around the vehicle. We found the driver rear door handle was causing the thermal imager to glow a bright yellow (**Figure 6**), indicating a draw. If you're not familiar with the Passive Entry door handles on a BMW, I will explain.

BMW uses special door handles on some of their high-line trim models called the Comfort Access System, or CAS for short. The first vehicles that used this system were the BMW 7 series. The system uses a Passive Entry that allows the driver to open up the trunk or door without using the vehicle transmitter/fob. Passive Go is another part of the system that allows the driver to start the engine without using the transmitter and Passive Exit. It closes in some cases and locks the vehicle, without using the transmitter. The door handle has a sensor that sends a signal to the CAS, allowing the door to be unlocked when the handle is touched. The CAS has many other functions on this vehicle, but the one we were concerned with is the door handle.

We proceeded to remove the door panel, followed by removing the wires from the load — the door handle actuator/sensor. With the wires disconnected from the door handle, we rechecked the current draw on the meter. The draw was now under 40 milliamps, indicating that we found the

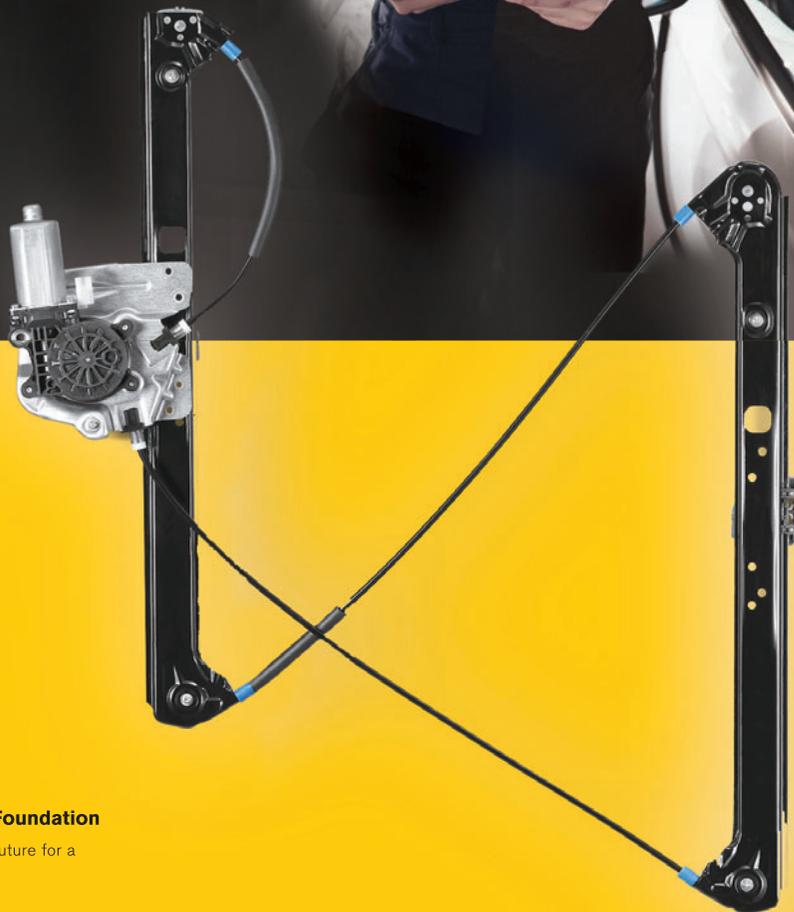


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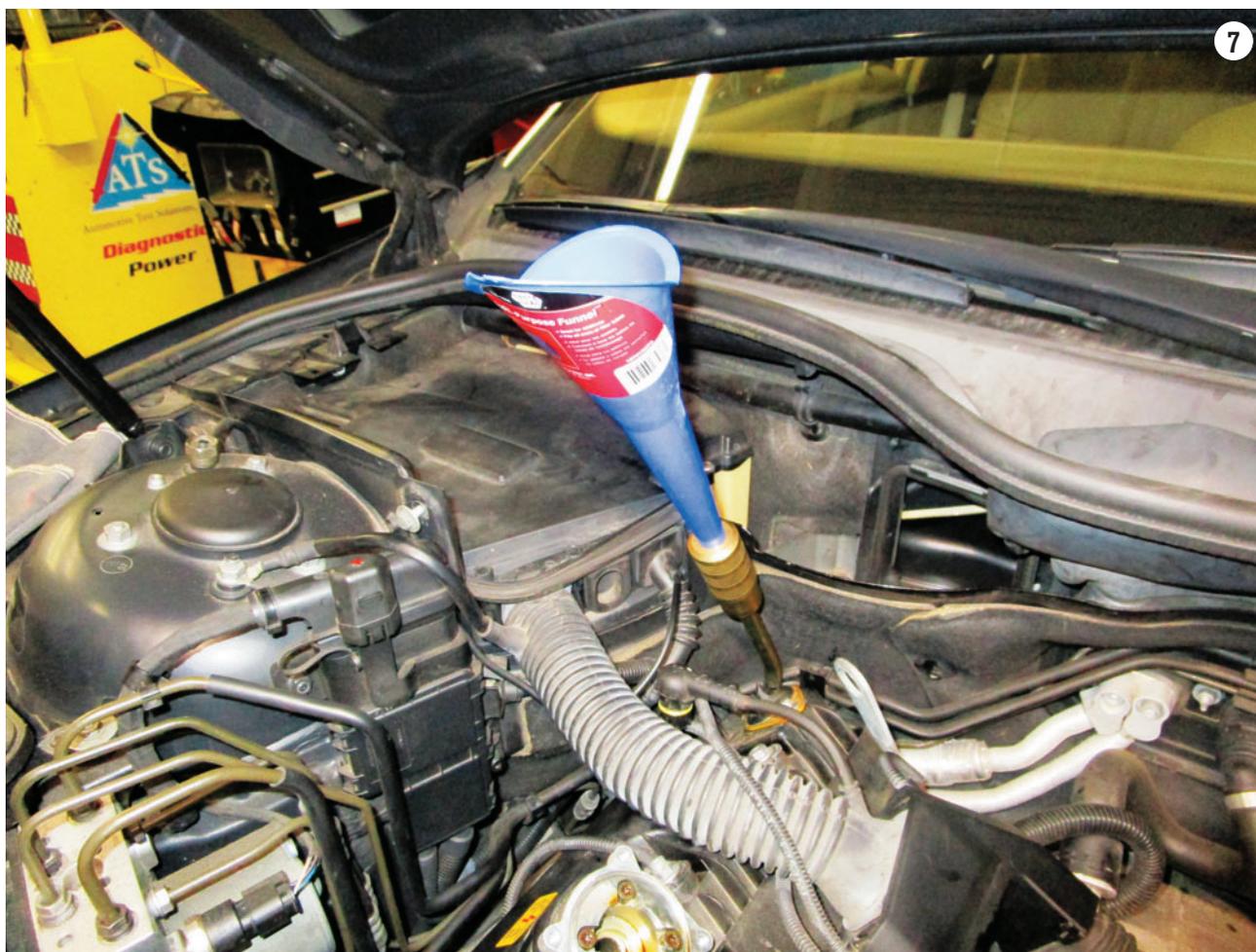
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source of the draw that caused the battery to go dead. We had to wait to use the thermal imager to check the door handle since the handle was still hot as the result of a shorted actuator/sensor in the handle.

When we returned to recheck the door handle, the imager displayed no draw by matching a blueish color on the screen that was equal to the other three door handles. We called the vehicle owner to explain what we had found; unfortunately, she decided to have us just leave the door handle disconnected since it would still function normally except for touch open and auto lock. We released the X5 to a happy customer who no longer had to deal with a dead battery or the stress of hoping the vehicle would start.

A BMW MIL

Next is a 2004 BMW 745i N62 that came in with a Check Engine light illuminated along with a few other issues. Even though this Bimmer had 172K miles on it, the vehicle owner still wanted to repair it. He had already tried Seafoam, a chemical carbon cleaner, and then taken his vehicle to an aftermarket BMW shop. The BMW shop tried to resolve the problem by using other professional carbon cleaners to clear the clogged secondary air passages in the cylinder heads. The results were not what the 745i owner wanted to hear — or for that matter see. The codes came right back and illuminated the Check Engine Light. The shop recommended removing the cylinder heads to properly clean the passages and keep the MIL off. The owner did

not like what he was told and went for a second opinion. The second opinion was given by the BMW dealer who also recommended the same course of repair. Since we had worked on his BMW in the past, the owner decided to give us a call and see what we thought. After speaking and emailing us a few times, he decided to drive from Ohio and have us diagnose and repair his 745i.

We did not want to let this customer down and knew that if we could not properly clean the air passages, the Check Engine light would once again illuminate, and we would look bad and have an unhappy customer. When the vehicle arrived, we connected our scan tool and performed a full vehicle scan that came up with the following DTCs: 170 10080 (P0491) and 171 10081



(P0492) — Secondary Air Injection Insufficient Flow Bank 1 and Bank 2. This was the same information the other shop and BMW dealer had diagnosed. We had already done some research on this BMW Secondary Air problem and came up with a different solution that we found on the AGA tool website. Since we had used AGA tools on other BMW problems with great success, we thought that it was worth a try.

We explained the option to our customer, Robert, and asked him to review the AGA video. The video had a good explanation of the problem and the solution on cleaning the air ports on a 745i N62 motor. We explained to the owner that this was a less expensive way to clean the 16 air injection ports without removing the cylinder head. Even though this is a time-consuming job, it is way easier and cheaper than removing the cylinder heads.

The first step of the procedure is to install the AGA BMW Secondary Air N62 tool and funnel (Figure 7), followed by pouring a carbon cleaner down into the secondary air tubes. The cleaner we chose to use, Run-Rite, was the same one that we have been using for years on carbon issues and has always yielded us good results. We started by removing the air tube on Bank 1 first (right/passenger side) and proceeded to pour the cleaner down. We then followed this by performing the same process on Bank 2. We ran the engine and then let it sit a bit before restarting it, then drove the vehicle. There was a load of smoke on our test drive that exited the exhaust system, which meant it must have cleaned up some of the carbon. This is the first step of the AGA-suggested cleaning process, but it may not be the last.

If this procedure does not break up all the carbon and the MIL illuminates for the same DTC, then phase two must be performed. As luck would have it, the procedure did not fully work even though the MIL stayed off for a few test drives. We informed the owner that we recommended a repeat of step 1 for the next course of action to see if the results were any

better. Unfortunately, the results did not solve the problem, so that meant step 2 of the cleaning process needed to be performed. Since Robert has been a very good customer over the years, we provided him with our shop loaner vehicle so he could drive back to Ohio.

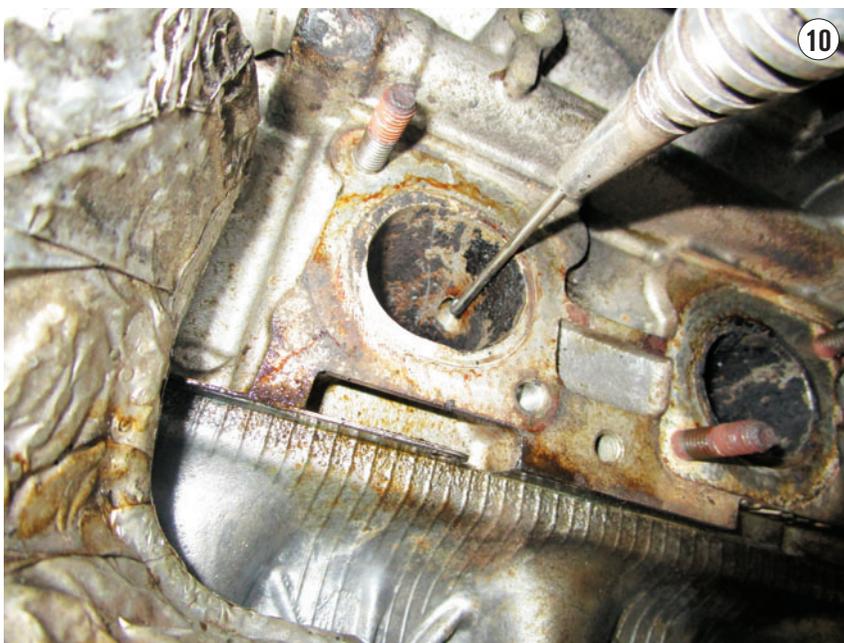
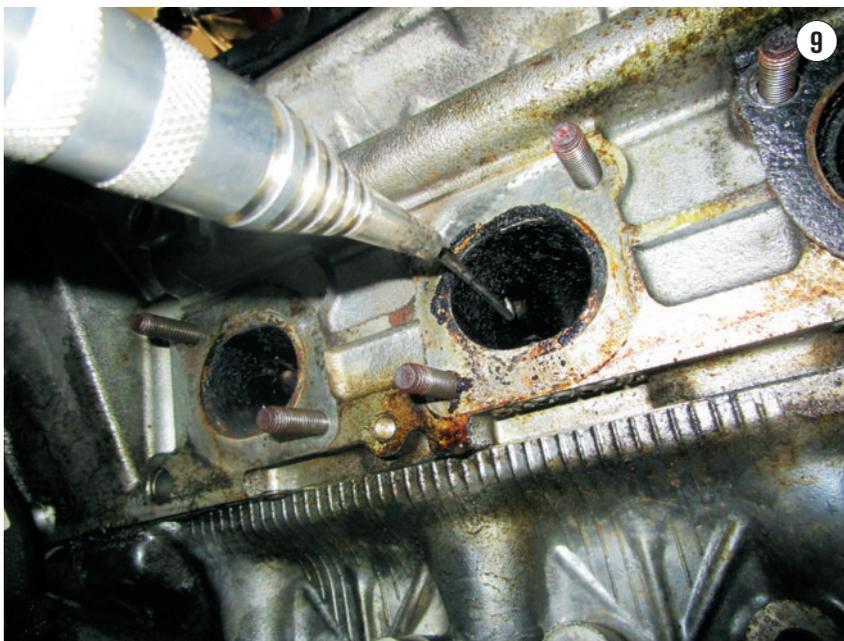
We knew that we had our work cut out for us since our two upper secondary air port cleaning only made a small difference. The carbon was going to be extremely hard and difficult to remove. AGA makes two different cutting hooks that can be used to break the carbon from the passages. One of the hook tools is more rounded at the tip and the other is more squarish and looks more aggressive.

The next step was to secure the engine, remove the exhaust and drop the engine cradle and exhaust manifolds so we would have enough room and access to properly clean the air ports. As you can see from Figure 8, the air ports were clogged with carbon. This was a time-consuming job that took hours of hand cleaning one port at a time. I started by selecting what I thought was the worst looking port so I could gauge the time it would take to clean the other 15 ports.

As I proceeded to clean the first port, I encountered heavy resistance, so I decided to spray an intake cleaner as I was dig-

The time is RITE for a Bartec TPMS Sensor!





ging and poking the tool into the port (**Figure 9**). After some time and much effort, I had success in cleaning the first port (**Figure 10**). Now I knew what I was in for cleaning the other ports. In the process of cleaning the other ports, I wore out and broke a few of the hook ends. We called AGA, and they overnighted a few more replacements just to make sure we would have enough to

finish the job. While we had the vehicle apart, we noticed there was an oil leak from the rear main seal and others from the oil pan. We suggested to Robert that since we had access to the pan, we remove the transmission and replace the rear main oil seal and oil pan gasket. Our customer is a mechanical engineer who is super fussy and likes everything replaced. Robert had us order new oil pan

bolts, new control arm cradle bushings and bolts, front transmission seal, transmission pan gasket and pan bolts and so on. It looked like Bill and I were going to replace everything from the starter to oil lines and just about everything else. As an engineer, Robert understands the stress that each component has to go through with hot and cold, never mind the mileage that was on his 745i.

After waiting for three weeks or more, the bolts finally arrived from BMW and the time had come to reinstall everything we had taken apart. This vehicle was now in Bill's bay for over a month; we thought that Robert was going to have us replace just about everything we touched. Now we had to make sure the secondary air ports were flowing freely. We connected our Power Probe Hook, since we needed amperage capability to run the secondary air pump. With the hook connected, we operated the pump to make sure all the air ports were able to blow a good stream of air. Check out these videos of the air pump and ports: <https://www.youtube.com/watch?v=qEBleNTjiVU>, <https://www.youtube.com/watch?v=mx5WpqPEEs>.

After our successful test of the air ports, we were able to install the exhaust manifold, starter, engine cradle, exhaust system and suspension components along with all new hardware. We started the BMW up and drove the vehicle for a week to make sure that the MIL would no longer illuminate. The 745i was now fixed and running well without the MIL illuminating. **ZZ**



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Accessory and suspension modifications present diagnostic challenges

By **LARRY HAMMER** // Technical Services, Mighty Distributing System

Accessory components and suspension modifications that enhance the cosmetics or performance of a vehicle are readily available for most vehicle makes and models. When modifications are made to steering, suspension, or tire and wheel assemblies, they can have an effect on the handling characteristics of the vehicle, illuminate fault lamps and display failure messages. These additions must be considered in the diagnostic process and how they may affect the performance and life of other system components. Failure to do so and not communicating with the customer may come back to haunt you in the form of a customer returning, convinced the repairs should be made at the shop's expense. In some cases the customer will have to make a choice between removing the accessory, returning the suspension to the factory spec, or accepting a symptom as a normal characteristic.

Suspension modifications

Premature failure of some suspension components may result from cosmetic enhancements such as taller and wider tires, off-set wheels and suspension kits to level, increase, or decrease the vehicle's ride height. These modifications may result in upper ball joint wear-out in 30K miles or less. Taller and wider tires are more aggressive, resulting in a load on the driveline, in addition to causing noise and vibration at highway speeds. Suspension modifications affect u-joint

angles, stressing the components, resulting in premature wear and vibration. Drop spindles or other lowering devices can promote the same alignment issues with the u-joints, promoting vibration and premature failure.

Accessories

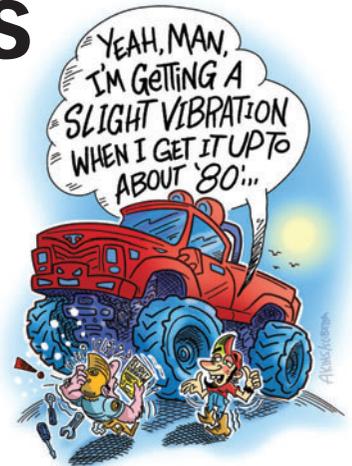
Running boards, bicycle or ski racks, brush guard grilles, emergency lighting, etc. can affect the airflow around the vehicle, promoting annoying noises. Steps or running boards mounted rigid to the frame or cab without insulation can transfer noises and create vibrations in the passenger compartment. Pinpointing the source of these noises may require removal of some of these accessories for diagnostic purposes.

Steering pull or wander

Low aspect ratio tires can create some challenges for the technician trying to resolve a customer complaint of steering pull or wander. This is considered a normal characteristic for these type tires, as they have a tendency to follow grooves or inconsistencies in the road surface. Increasing the tire pressure above the vehicle manufacturer's recommended specification may stiffen the sidewall and further aggravate the symptom. While wheel alignment is often thought to be a contributing factor, it will not correct this condition.

Flashing Traction Control Light

Vehicle owners may complain of a flashing Traction Control Light that may occur



under hard acceleration at higher speeds. In addition, ABS lamp illumination may occur, or they may have a handling or brake related complaint. These symptoms may occur following the installation of a new set of tires or custom wheels. GM states that these symptoms may be the result of tires that do not meet the same tread wear, traction or temperature ratings. Their recommendation is to ensure that the original equipment type tires have been installed, which will be documented via the VIN number. It is imperative that the same type be installed, such as summer or all season, the original size, and with the same or higher load and speed rating. The information can be accessed on the GM website or their Tire Hotline.

For additional diagnostic challenges, refer to Mighty Tech Tip #194 "Vehicle Modifications" on our website.



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LIVING IN A VACUUM — CRANKCASE VENTILATION SYSTEM TESTING

OFTEN OVERLOOKED, THIS SYSTEM CAN CAUSE DRIVABILITY ISSUES WHEN NOT WORKING PROPERLY. DO YOU KNOW HOW TO TEST IT?

SCOT MANNA // Contributing Editor

In this article, I will be talking about a subject that does not get much respect or attention among many automotive technicians and that is the engine crankcase ventilation system. Many technicians consider these systems to be pretty simple and trouble-free, but they are often overlooked in their importance as well as their ability to cause rather confusing problems on modern powertrain platforms. It is my goal to show you the importance of considering the crankcase ventilation system in your diagnostic routine and how to test crankcase pressure to determine if the system is working correctly.

Understanding crankcase ventilation

Crankcase ventilation is as old as internal combustion engines and has to be addressed in any modern, emission-controlled powertrain. Prior to federal emission control standards, the crankcase of an engine was vented to atmosphere through a component called a road draft tube. The tube was connected to the side of the engine block or valve cover and routed down to slightly below the bottom of the engine in the vehicle's slipstream. When the car was moving, air rushing past the tube would create

a low-pressure area and fresh air would enter the engine through a breather that was usually the oil filler cap. This would allow the engine blow-by gases to be drawn out of the crankcase and vented to the outside.

While simple, there were problems. When the vehicle is not moving, there is no crankcase ventilation and when driven at high speeds, the system is too efficient and oil was drawn out of the engine along with blow-by gases creating a black, oily stripe down the center of the highway. But the main problem with this type of system is the release of unburned hydrocarbons into the atmosphere.

Crankcase emissions were considered one of the main causes of smog in the Los Angeles basin in the 1950s and '60s. In 1961, Positive Crankcase Ventilation systems became mandatory in California and in 1964 all new cars were equipped with this system. PCV systems allow the combustion blow-by gases to be rerouted into the engine intake manifold to be burned with the incoming air/fuel mixture. These systems are basically vacuum controlled, so there is less flow at low engine loads when blow-by would be less and greater flow under road load conditions when blow-by increases.

Many modern powerplants have



EXCESSIVE CONDENSATION DEPOSITS from poor crankcase ventilation.



PCV FRESH AIR INLET HOSE can be seen connected to the throttle body snorkel after the mass airflow sensor. Disconnecting this hose at the valve cover caused no change in fuel trim values.



CRANKCASE VACUUM READING with leaking valve cover gasket.

done away with the common PCV valve and now utilize fixed orifice systems or an integrated flow control valve and oil separator. So much for the theory and history lesson — let's see what goes wrong with these systems and how to test them.

Testing crankcase ventilation system function

The first indication that something may be amiss with crankcase ventilation is an excessive amount of condensation in the crankcase (**Figure 1**), and this is commonly seen during an oil change by milky deposits found on the oil fill cap or seen inside the oil fill hole.

The problems I am more concerned with is when crankcase ventilation problems create a “Check Engine” light concern, which most often shows up as fuel trim codes. One particular vehicle comes to mind that was sent to me from another shop. The 2001 Chevy S-10 Blazer with a 4.3 VIN W engine had lean fuel trim codes set for both banks. There was a disconnected vacuum hose found, but even after plugging the hose, the fuel trim numbers were very high at idle — each bank was positive 24 percent.

A new replacement mass airflow sensor had already been tried with no change in fuel trim values. Knowing that false air or unmeasured air can skew fuel trim, it was decided to disconnect the crankcase air inlet hose to see if the trim values changed at idle. They did not (**Figure 2**).

Crankcase air supply is provided after the mass airflow sensor so that this air is measured. If air is being drawn into the crankcase from a leak, then this air cannot be measured and the system will be lean.

One final check was made. A vacuum gauge was connected to the dipstick tube, and the PCV fresh air inlet at the valve cover was blocked with the engine idling. The vacuum reading is shown in **Figure 3**. Almost no vacuum was present, indicating there is an air leak into the crankcase. When smoke from a smoke machine was added to the crankcase, the problem became evident. There was an improperly installed valve cover gasket on the passenger side of the engine (**Figure 4**). Replacing the gasket corrected the high fuel trim values (**Figure 5**).

This issue has played itself out many times on different vehicles and has caused a large amount of unnecessary parts replacement because many technicians do not look at crankcase leaks as a possible cause of fuel trim codes and do not measure crankcase pressure.

Pressure, vacuum or both?

While I have been mentioning measuring crankcase pressure, what is normally seen is a negative pressure or partial vacuum. This is because a regulated vacuum is applied to the crankcase in order to draw out combustion blow-by gases. Keep in mind

when taking crankcase vacuum measurements that the fresh air intake should be blocked off and that it will take a few moments for vacuum to build in the crankcase.

Do not let the engine run for more than a short time once the vacuum gauge settles to a stable reading, as excess under-pressure or over-pressure may damage some seals or gaskets!

This brings to mind some more theories on crankcase pressure. I remember purchasing a tool long ago from my Snap-on supplier called a MT-383 Blow-by tester (**Figure 6**). This tool measured the amount of blow-by gas flow leaving the crankcase. The PCV valve was removed from the valve cover and the flow meter installed in its place. The fresh air inlet was plugged and the engine ran at both idle and high speed. The clear, graduated flow meter measured flow in standard liters per minute.

The theory is as an engine wears out, especially from piston ring and cylinder wear, there will be an increase in crankcase pressure due to greater blow-by and this can be measured to determine wear. This leads to the issue that there can be both a crankcase over-pressure condition as well as an under-pressure condition. If engine wear causes too much crankcase pressure, it will overwhelm the PCV system and lead to excessive oil leaks. Excess crankcase pressure may also occur



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if the PCV system vacuum supply becomes restricted. Excessive crankcase under-pressure (vacuum) can occur if the fresh air inlet becomes restricted or the wrong PCV valve is used.

Turbos and crankcase ventilation

When a turbocharger is added to the engine, the crankcase ventilation system becomes somewhat more complicated due to the fact that the routing of crankcase blow-by gases has to change when the engine is under boost pressure due to a lack of intake vacuum. I will use a case study from a turbocharged BMW to illustrate this issue.

Speaking of BMWs, these vehicles clearly display the need to measure



LEAKING VALVE COVER GASKET on right bank of engine causing air leak into crankcase.



THIS IS THE VACUUM READING after replacing the valve cover gasket — quite a difference!

crankcase pressures when drivability problems arise. Unlike many vehicles, late-model BMWs with Valvetronic intake valve lift control have a regulated intake manifold vacuum. The target vacuum level on any BMW Valvetronic engine is only 50 millibar or about 1.5

inches of mercury. With this small amount of vacuum available, crankcase pressure is closely regulated and can have a major impact on how these engines run at idle.

I use a Dwyer series 475 digital handheld manometer to measure



SNAP-ON BLOW BY METER connected to a Chevy V8 engine.

crankcase pressure on most European cars and any BMW vehicles (**Figure 7**). The tool measures pressure in inches of water column, but this is easily converted to millibar, which is the spec given by BMW. The adaptor seen in the picture is available from a company called AGA tools, or you can make a test adaptor from an old oil cap. There is a service bulletin, #11 05 98, which details testing crankcase pressure on BMW vehicles. I highly recommend printing this out and keeping it handy if you work on these vehicles.

Not only can you measure crankcase pressure with a vacuum gauge or manometer, you can also use an accurate pressure transducer such as a Pico WPS500 to measure crankcase pressure

with a scope. A scope and pressure transducer may also be able to show pressure pulses inside the crankcase that can be caused by excessive cylinder wall to piston compression leakage that escapes into the crankcase.

Figures 8 and 9 show a crankcase pressure test performed on a 2016 BMW X-5 with the N55 turbo-charged six-cylinder engine. The bottom waveform is crankcase pressure, and the upper waveform is cylinder #1 ignition coil firing so you can see when the engine was started and shut off. The time base is quite slow at 10 seconds per division. When the engine is shut off it takes an amazing 75 seconds for the pressure to return to atmospheric in the crankcase. That is a tightly sealed crankcase!



CRANKCASE PRESSURE MEASUREMENT on a BMW X-3, N52 engine.

I must also mention here that while the BMW TSB is mostly concerned with too much pressure, or a lack of vacuum in the crankcase that indicates a leak, there is also the problem of too much vacuum! Many engine faults on a BMW Valvetronic engine can put the



USING A PICO SCOPE AND PRESSURE TRANSDUCER to measure crankcase pressure on a 2016 BMW X-5 with the N55 engine.

engine in throttle control mode and the intake manifold vacuum will be very high, like a conventional engine. The crankcase ventilation system is not designed for high manifold vacuum, so the crankcase negative pressure will be very high as well. If you encounter an oil fill cap that is nearly impossible to remove with the engine running, or a high-pitched whistle while the engine is running check for faults that are preventing normal Valvetronic operation.

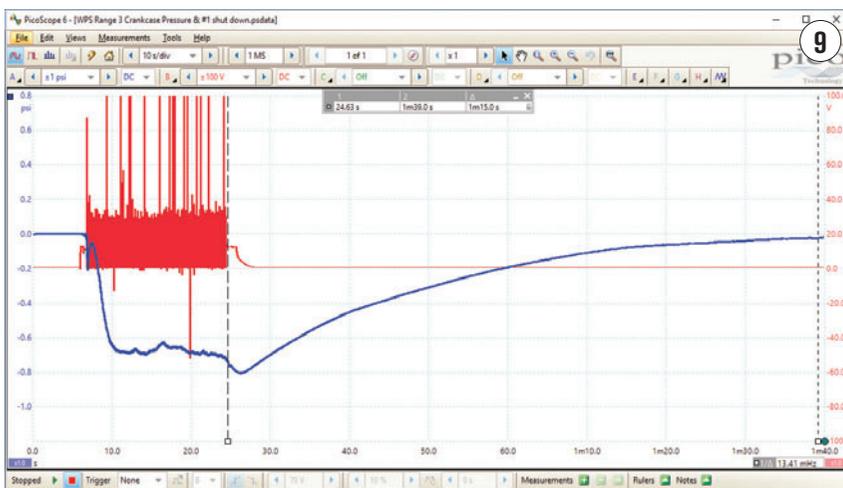
A few BMW case studies

An interesting problem vehicle was brought to the shop that clearly illustrates the need to check crankcase pressure. The vehicle was a 2007 BMW X-3 with the N52 six-cylinder, Valvetronic equipped engine. The complaint was a severe idle surge that would also cause the engine to stall at idle randomly. The engine would run alright when driven at cruising speeds.

When first checked there were 14 engine control related codes. All four oxygen sensor related codes, there was a Valvetronic servomotor sluggish movement code, all six cylinders set misfire codes and there was an air mass system code and a cold start idle speed plausibility code. With so many codes it is difficult to determine where to start. Codes were cleared, and a Valvetronic limit learn procedure performed and then the engine was allowed to idle for several minutes. There was no change in engine idle and codes reset quickly and can be seen in **Figure 10**.

After looking at Valvetronic eccentric shaft data it was noticed that the eccentric shaft position was wandering back and forth; this will most certainly cause the engine speed to surge. The question is why can't the DME control idle speed properly?

An air leak can certainly have an effect on idle speed control, but before pulling out a smoke machine to check for intake



SCOPE CAPTURE OF CRANKCASE PRESSURE PULLING into a vacuum after the engine is started. When turned off there is a slow rise back to atmospheric pressure.

Code	Description	Component Structure	Test Search
00000	DME: Combustion misfire, several cylinders	251144	
00001	DME: Combustion misfire, cylinder 1	251144	
00002	DME: Combustion misfire, cylinder 2	251144	
00003	DME: Combustion misfire, cylinder 3	251144	
00004	DME: Combustion misfire, cylinder 4	251144	
00005	DME: Combustion misfire, cylinder 5	251144	
00006	DME: Combustion misfire, cylinder 6	251144	
00007	DME: Oxygen sensor heater before catalyst converter: Activation	251144	
00008	DME: Oxygen sensor heater 2 before catalyst converter: Activation	251144	
00009	DME: Oxygen sensor heater after catalyst converter: Activation	251144	
00010	DME: Oxygen sensor heater 2 after catalyst converter: Activation	251144	
00011	VTD: Stator current in coupling force too high	251136	
00012	VTD: Oil level	251136	
00013	ESR: Oil level not clear	251136	

SCREENSHOT OF CODES

that reset on the X-3 after running several minutes.

system leaks, a crankcase pressure measurement is performed first. The result is a failed test — the crankcase pressure wanders between -2.5 to 4 inches of water column. This is a range of -7 to 10 millibar, well below the specification for this engine, which is -30 millibar, plus or minus 5 millibar. If there is less vacuum in the crankcase, this would be an over-pressure condition, which means air is leaking into the crankcase.

This false air is not measured by the mass airflow sensor. A smoke machine was connected to the same test fitting used to measure crankcase pressure and smoke began to pour out from behind the engine crankshaft pulley. Upon pulley removal, the damaged front crankshaft seal was obvious. The seal was damaged due to a serpentine drive belt failure, which is a common problem on these platforms, but no-

Code	Description
28A0	DME: Intake pipe absolute pressure, plausibility, Pressure too high

Fault description

The diagnosis monitors the plausible position of the throttle valve in relation to the applied intake pipe vacuum.

Malfunction monitoring conditions

The fault is recognized when the monitored mass flow rate rises above a limit value.

Condition for fault identification

- Voltage precondition
- Vehicle voltage between 9V and 16V
- Temperature condition
- Coolant temperature less than 60 °C
- Time condition
- 10.5 s
- Other preconditions
- Engine ON
- Speed dynamics (speed window) greater than 333 rpm
- Load dynamics (load window) greater than 19%
- Terminal status
- Terminal 15 on

BMW 28A0 CODE DESCRIPTION INFORMATION

found in the factory scan tool.

body bothered to tell us the belt had recently failed. After replacing the crankshaft seal, the engine ran normally even though the oxygen sensor heater issue was not repaired! The customer simply had enough and was told the engine may suffer catastrophic failure if there is more drive belt material still inside the engine. Of course, they stated they were trading the vehicle in.

A very interesting problem was seen on another BMW car that was diagnosed for another shop who stated the 2011 BMW 335xi was brought into their shop due to a failed OBD state emission test. The shop was chasing down a generic code P112F, or a BMW code 28A0 (**Figure 11**). The BMW code is for intake pipe absolute pressure, plausibility, pressure too high — the generic code description is a throttle angle to

manifold pressure correlation problem (Figure 12).

These code descriptions do not lend themselves to a quick understanding of what is wrong with this vehicle. After changing the throttle body and intake pressure sensor the codes remained. A tech hotline told the shop to perform a re-learn by running the engine at idle for 15 minutes with the vapor canister purge valve disconnected. This did not cure the issue. At this point I was asked to come take a look at the vehicle.

The factory ISTA scan tool description for a 28A0 code stated an interesting bit of information that had so far been overlooked.

The statement underlined mentions that the fault is recognized when the monitored mass flow rate rises above a limit value. This means that there is too much airflow being measured for the commanded throttle position. This statement effectively rules out any false air leaks into the intake system, such as a leak in the intake manifold or any turbocharger plumbing. If there is too much airflow, the mass airflow sensor has to be able to measure it, so I am looking for how this could be possible. As you should suspect by now, I decide to perform a crankcase pressure test.

The pressure measures -7 IWC or -17 millibar. This pressure is too high and indicates a leak into the crankcase. A crankcase ventilation hose connects to the turbocharger inlet pipe. This is downstream from the mass airflow sensor, and airflow through this pipe can be measured by the MAF. The scan tool test plan for this code mentions to check for air leaks first and check the crankcase ventilation system next, see Figure 13.

After carefully removing the breather hose at the valve cover and plugging the hole with my thumb, the



CRANKCASE PRESSURE TEST on 2011 BMW 335xi with code 28A0. Reading is equal to 17 mb, too much pressure in crankcase meaning a leak is present.

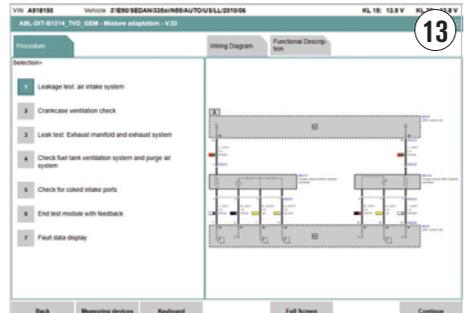


PLUGGING OFF CRANKCASE BREATHING HOSE used when car is under boost conditions.

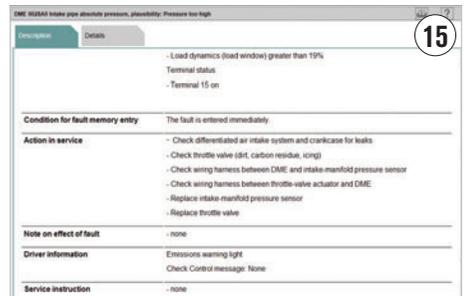
crankcase pressure drops significantly. The pressure can be seen in Figure 14.

This hose connection is used to vent crankcase vapors into the incoming airstream when the engine is operating under boosted conditions. There should be no airflow through this tube at idle. A look at the crankcase ventilation diagram found in a BMW training book shows how the system operates in normal load and boost conditions when pressure is present in the intake manifold instead of vacuum. Item number 12 in the diagram is a non-return valve that opens during turbo boost operation. This is a normally closed valve, but it is stuck open on this BMW.

The repair on this BMW was replacing the valve cover with a new part; the valve cover contains most of the components of the crankcase ventilation system. One last item to mention about this issue can be seen from the



SCAN TOOL TEST PLAN SCREENSHOT listing items to test for code 28A0. Number 2 is a crankcase ventilation check.



SCREEN CAPTURE FROM BMW LISTING THE "ACTION IN SERVICE" items and the fact that the effect of the fault is "none." Note that the "Driver Information" is the illumination of the emissions warning light.

test plan information about this code seen in Figure 15.

The bottom two items mention replacing parts — this is what will draw the attention of most technicians. The top item states to check for air leaks in the intake system and crankcase. If you do not have a means to test the crankcase for leaks, this step is most certainly overlooked or bypassed entirely. I hope this discussion of crankcase pressure measuring helps you to diagnose some troublesome drivability issues and adds another test to your diagnostic toolbox. **TM**



SCOT MANNA is the owner of MB Automotive Inc. He is a contract trainer for the State of Illinois Emission Program, WORLDPAK and Autowares. He is ASE Master Certified with L-1 and L-2.
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A HALLOWEEN HONDA KILLS ITS BATTERY!

A NEW METHOD OF PARASITIC DRAW TESTING IS WHAT IT TAKES TO FIND OUT WHAT'S RESPONSIBLE FOR THE MANY BATTERY DEATHS.

JAIME LAZARUS // Contributing Editor

While employed as a sales representative for a diagnostic tool manufacturer, I remember coming across a particular gentleman to whom I was trying to express how important it was for us to keep changing along with the vehicle technology confronting us. In a way that I thought he would comprehend, I strived to express how doing things the old-fashioned way on modern vehicles simply doesn't work. I mentioned computer-controlled alternators and then he interrupted me.

He took offense to what (I believed at the time) was an educational opportunity and let me know with a reply of "Are you calling me stupid? You think I AM stupid, don't you? I've been doing it this way all my life! I don't need to be spending my hard-earned money on your high-priced equipment!"

Of course after that there was no point in continuing to convince him that sometimes employing the old-fashioned ways may not be a wise choice, and they may actually cause more problems than they solve. There was simply nothing I could say to him that would help him understand he could improve the way he was diagnosing vehicles or to get him to consider other ways that would accurately and



efficiently diagnose today's vehicles.

As I was leaving his shop, I remember him trying to tell me that "no equipment could tell [him] the alternator was faulty any better than" the method he uses. He said if he "disconnected the battery cable while the engine was running, then he'd know one way or the other." Yes, I cringed when I heard that. Hopefully, you did too when reading it.

What would you do if someone told you there's an easier, more efficient way to do something that you have done the same way for a long time with excellent results? I'd say "prove it!" In most cases there's no reason to change the way we are doing things as long as they work and provide us accurate information. There are circumstances, however, that make you have to change — maybe against your will!

It really doesn't matter what brand of vehicle you are working on when you

are trying to address a "parasitic drain" (also called a "parasitic draw" or just a "draw"). The problem is usually that the vehicle's battery has gone dead with no reason, within an unreasonable amount of time.

This may be that day!

In the old days, to diagnose a parasitic draw — on a vehicle with the key off — we would disconnect a battery cable and put a non-powered test light in "series" or in other words, between the cable end and the battery terminal. If the light lit, we knew we had a draw. If the light didn't, either the problem was intermittently occurring or we knew that something was probably left on and has now been turned off. Once sure there was a draw, we would disconnect one fuse at a time until the test light didn't shine anymore. A long time ago the fuse blocks were fairly simple and usually

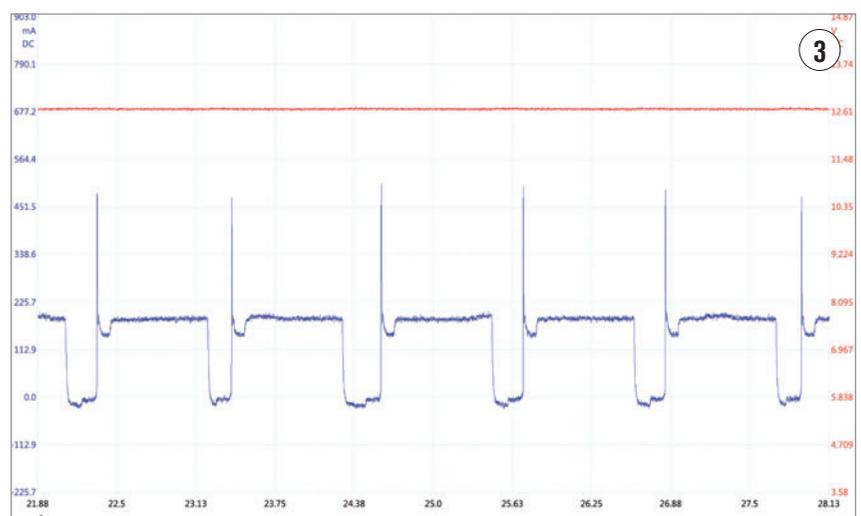
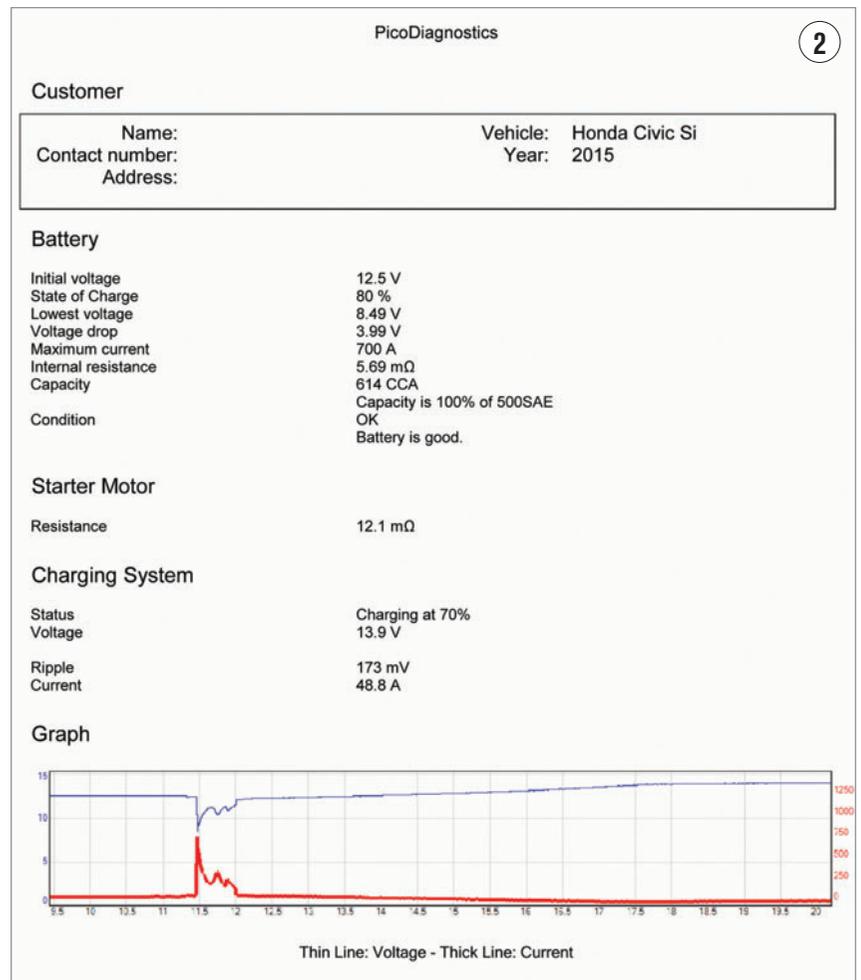
identified the whole circuit each fuse protected so we knew which system was affected and would start working towards the component at fault — isolating items that fuse fed.

After electrical systems became more complex it became imperative we had to have accurate service information that included electrical wiring diagrams. With the advent of “Maxi” fuses providing many smaller fuses with protection then came the time when multiple circuits could be protected by one larger-capacity fuse. We would begin the tests the same way (test light attached at the battery), but then we’d disconnect the high amperage rated fuses one at a time. Once we identified which of the higher amperage fuses were carrying the parasitic load (draw) then we’d pull those lower amperage fuses that were protected by it one at a time.

Some of the more nerdy among us folks would install an ammeter in series instead of a test light. I found knowing how many amps draw I had helped me eliminate some circuits that could have been suspect. For example, a draw higher than one amp could not be caused by a glove box light staying on. However, do you know what problem I found when employing an ammeter into a circuit with an unknown amount of amperage flow? Yes, sometimes my meter’s fuse would blow, and those weren’t cheap! Alas, I learned to use an inductive ammeter I repurposed from a farm tractor, attaching it to one of the battery cables prior to disconnecting it, and then I had a good idea how many amps I was probably dealing with before attaching my ammeter. I blew far fewer meter fuses when I did that!

Drain caused by computers?

In addition to the higher number of circuits being added to the vehicles were also computers. The “standard



procedure” we were following to diagnose parasitic drains at that time was found to sometimes result in us having to write on the work orders “NPF”

(which stood for “No Problem Found”). Unfortunately, very soon thereafter we had to recheck the same vehicles again and again. What was happening was a

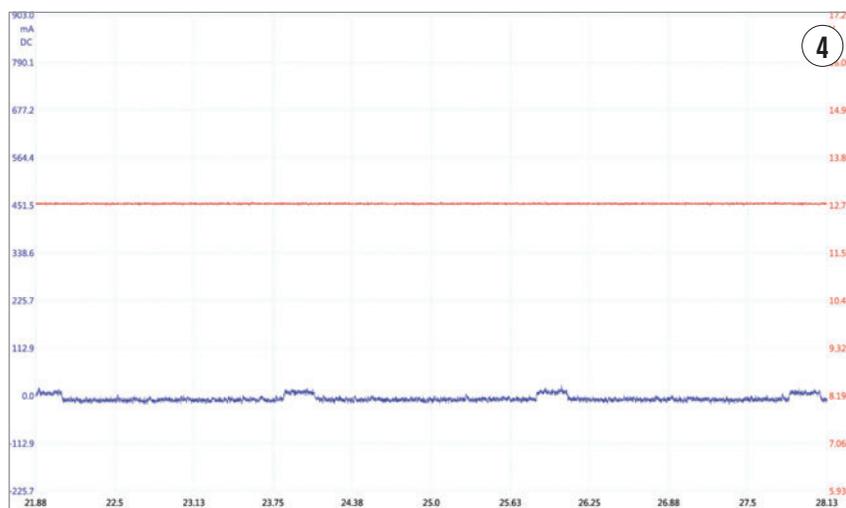
module or component was causing a draw until the battery was disconnected! They would “reset” and work as designed for a while. As soon as we placed our test lights in series, the problem was gone. Sometimes we were fortunate enough that the problem causing the draw could be recreated while the test light was still connected — most times we couldn’t.

This phenomenon was the reason we had to change our method. From that time until today, anyone who has to address a vehicle that has a parasitic drain would typically grab a DVOM (Digital Volt and Ohm Meter) and an inductive Low Current Probe (LCP). The probe is used so that a battery cable doesn’t have to be disconnected and fuses do not need to be removed to find an affected circuit. If an excessive current draw is detected at a battery cable on a modern vehicle, the combination of DVOM and LCP greatly reduces the potential for a circuit to be disturbed, thereby ensuring if the draw is caused by a module, it will continue to do so until we isolate it. We can use the LCP on circuits protected by any size fuse and work our way from the battery to the component just like we did in the “old days” using a test light.

The Halloween Honda story

I was recently called into a mechanical repair shop because a vehicle’s battery was unintentionally discharging so quickly that the vehicle would not restart if it sat overnight without a charger. The vehicle owner did not correlate this problem to the collision shop repair, because that had been done several months prior without any problems occurring like this since.

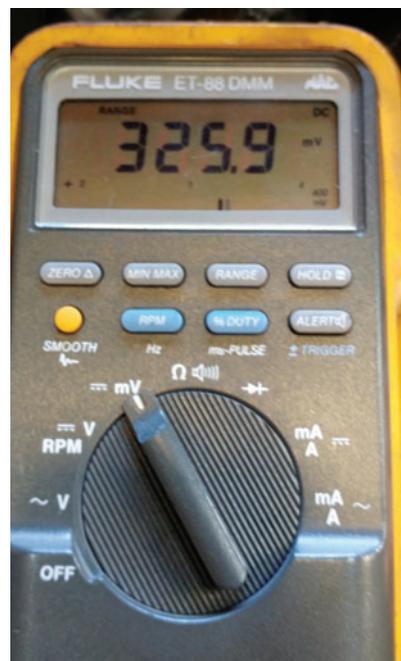
As if it were timed for Halloween, this 2015 Honda Civic with a Rice Burner 2.0L I4 DOHC engine and manual five-speed transmission (**Figure 1**) had been repainted the “perfect” color.



Several months prior to seeing the vehicle for my first time, this vehicle had been in a collision resulting in extensive body work. At first I was unaware why it had been repainted that color, thinking to myself it may have been a combination of things — that the owner must be color blind and the body shop doing the job wanted to get rid of a bad purchase (lol). Turns out that “Pumpkin Orange” was the color the owner actually wanted! Well, as the saying goes, to each his own.

Anyway, I begin all of my parasitic draw diagnostic routines by checking the state of health of the vehicle’s battery first. I have been burned in the past by testing systems that were acting unusual only to find their voltage was right at the border of being acceptable. Modules have a way of acting unusual without proper voltage or ground.

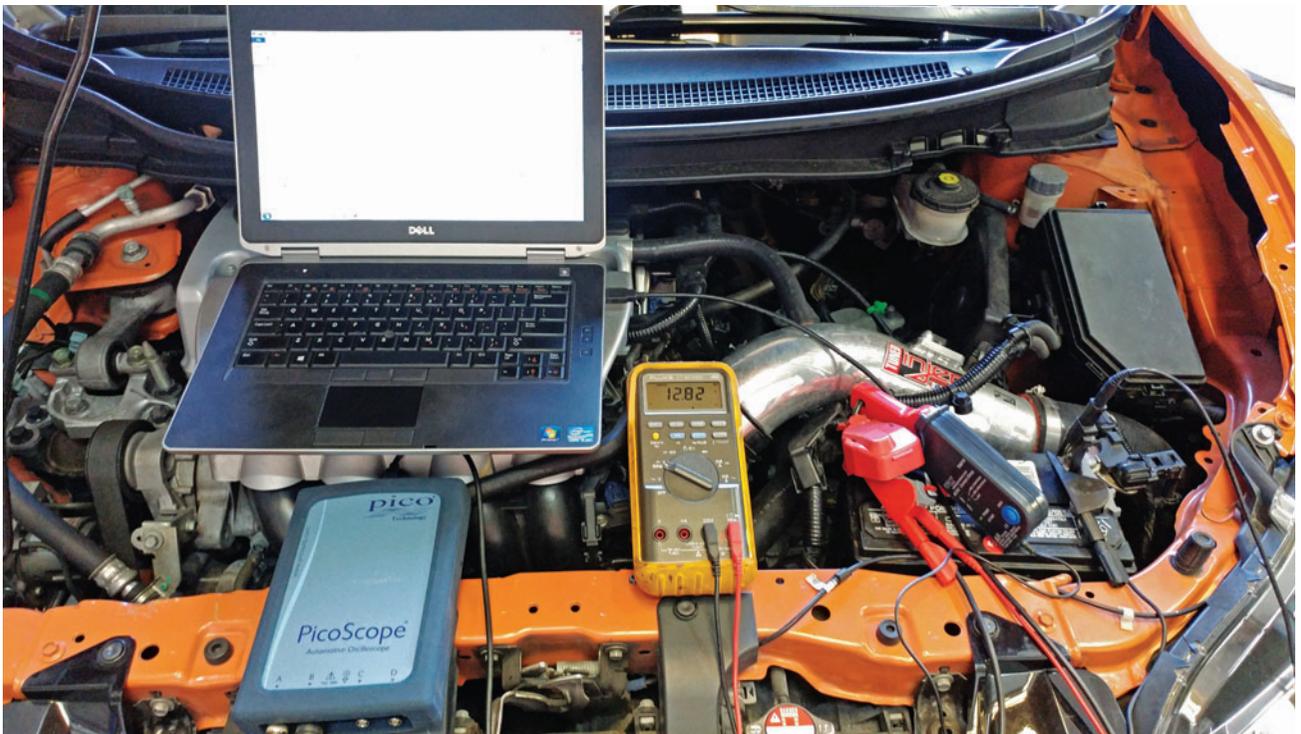
Having confirmed the battery state of health was at 80 percent (**Figure 2**), I deemed it acceptable for further testing so long as a battery charger was attached. I proceeded to connect my DVOM and LCP to check for the draw. Seeing a 200 milliamper draw made me start considering things like a small light and other small draws. I stared at my DVOM display long enough to see a momentary display of close to 500



EVERY NOW AND THEN the DVOM would momentarily display a higher current draw than usual. Such a reading helped me decide to use a scope instead of a DVOM for this diagnosis.

milliamperes. It was that momentarily higher display that caused me to use the min-max function to see whether or not there was something surging in the circuit. And yes, there was.

I thought it best for me to use the Pico scope to graphically depict the amperage in order to help me analyze this parasitic draw. I’m very thankful



SOMETIMES THERE ARE MORE TOOLS than engine in the engine compartment!

that I did. The image captured (**Figure 3**) looked almost like an injector voltage waveform!

The image displayed made me somewhat confused at first. Realizing I was up against some sort of a controlled circuit, I decided to sit inside the vehicle and just observe. I was expecting something to turn on or give me a sign. Initially, none of the courtesy or dome lights were turning on, none of the gauges were flickering and the instrumentation was not displaying anything unusual.

The thought occurred to me to cover the windshield to stop the outside light from coming in. That was the key in diagnosing this vehicle's problem. I was able to see flashes of dim light displayed on the driver information center/navigation system! It was then I decided to head for the radio fuse and put my low current probe on that circuit. That was exactly the same image as what was displayed at the battery. I'd found the culprit. Now what?

I found in the Service Information a procedure for a "Self-Test" that could be run on the infotainment system. Surprisingly, every part of all the very extensive tests passed!

I felt it was time for a visual inspection of the unit and removed it from the vehicle. On the bench it was evident — water damage! Once the problem was identified, the customer acknowledged the windshield had been broken in the crash several months ago, and the vehicle was left exposed to the elements for many days with that condition present. We concluded the navigation audio/infotainment system had been subjected to water damage after the windshield had been broken during the collision but wasn't showing signs of damage until rust had set in and affected certain circuits internally. A replacement unit resolved the parasitic draw. After the navigation audio/infotainment system had been replaced with a used unit, the security light is the only draw (**Figure 4**).

So, in this case, as happened to me

several decades earlier, I learned of a new way to help me diagnose a parasitic draw. By using a DVOM I was only supplied a digital representation of the fault, which proved to be woefully inadequate. Using a scope instead of a DVOM, I graphically displayed the circuit condition, which completely changed the direction in which my diagnosis was headed.

Again, I cannot stress enough the importance of having accurate service information when attempting to diagnose this condition (parasitic draw). A wiring diagram and sometimes a wire routing diagram, as well as component location information, can make diagnosing a parasitic draw much easier! 



JAIME LAZARUS has regularly presented technical seminars since 1985. He recently taught instructors at the North American Council of Automotive Teachers conference and the NASCAR Technical Institute.
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IS THERE A WRITER IN YOU?

THIS MONTH, I RESPOND TO A QUESTION I GET ASKED OFTEN — HOW I GOT STARTED WRITING FOR *MOTOR AGE*. HEY, IF I DID IT MAYBE YOU CAN, TOO!

PETE MEIER // Technical Editor

You may have heard me say before how thankful I am to be able to do what I do. After spending most of my working life turning a wrench, the opportunity to now help those still in the bays is something I never take for granted. Along

the way, I've met hundreds, if not thousands, of techs, shop owners and educators from every corner of the globe.

I like to think I'm on a first-name basis with all of you.

And I also like to think that the relationship I have with our readers is one thing that makes *Motor Age* unique among automotive trade magazines. No

matter where I go, what event I attend or presentation I make, there are always a number of you that take the time to say "Hello" and share your stories with me. In addition to hearing from you in person, I also receive your emails, social media messages and YouTube comments. I am humbled whenever a reader shares that something he or she saw in



MY JOB WITH THE MAGAZINE allows me to travel quite a bit and take part in projects I otherwise would never have the opportunity to participate in — like this A/C training I hosted for the servicemen at MacDill AFB in Tampa.

the magazine, our YouTube channel or in one of our webinars has provided a means to perform a job easier, tackle a diagnosis more productively and, in the bigger picture, make a better living for themselves and their families.

So how did you get started?

A common question I'm asked is how I got started writing for *Motor Age*, and many of you have followed up by asking how you could follow a similar path. Let me start off this month's column by addressing the first question.

It all started with a Lexus EVAP fault that was kicking my backside while still working in a shop for a living. Even then, I believed in continuing my education and attended training classes in my local area as the time and opportunity allowed. I also kept up with the industry online by participating in the International Automotive Technicians Network (iATN) and reading the trades.

For some reason, I just couldn't make any sense out of the system operation description the shop's service information system had on the Lexus. Using the resources I had, I put together a tool box reference that outlined the operation of the four different EVAP systems Toyota/Lexus were using through that time. I also made notes about known issues and their fixes, all with the idea of throwing it in my toolbox.

My wife, God bless her, had other ideas. She suggested I take what I'd spent all that time at the dining room table assembling and submit it to "one of those magazines you're always reading." So I did!

That first article was published, but not by *Motor Age*. As I've since learned, the content you're reading today was planned nearly a year prior and there were no open slots for an EVAP article. However, both the managing editor and technical editor at the time thought enough of my writing style to ask me to write for *MA*, starting with case studies and lessons learned that would be shared in the "Garage" column.

The rest, as they say, is history. As time with the magazine grew and opportunities became available, I began to do more and more on a freelance basis. And from there, the chance came to join the group fulltime, and here I am.

But, as I share every chance I get, I always try to stay grounded and remember where I came from. I go to work every day with the primary goal of finding new ways that I, and the magazine, can help you succeed and grow in this ever-challenging profession.

Can I write for *Motor Age*?

I am thankful and proud of the contributors that grace the pages of this magazine every month. Every one of them is an accomplished technician and most are nationally recognized

trainers. Even so, I am always on the lookout for the "next generation" — those who will grow to lead this industry long after I, and others, have closed our toolboxes for the last time. And I've found a few. Talented technicians like Brandon Steckler, Mike Miller and Mike Reynolds — just to name a few.

Some still write for me and some have moved on to bigger and better things. And some have yet to be introduced in these pages. But not to worry — you'll get to meet them in 2020!

Are you one of those next-generation leaders?

Writing for a national trade publication requires more than being a competent technician. You also have to be a competent researcher, decent writer and storyteller.

Most importantly, your desire to write for us should be based on helping others. Writing and teaching others because you want them to succeed is a trait shared by every contributor on our team and it is obvious when you see and talk to them in person. Writing just to see your name in print will be obvious in the content you submit.

Be warned! Mentally prepare yourself to have your articles dissected by nearly half a million technicians who will read that article in these pages or online. Make a mistake in your theory

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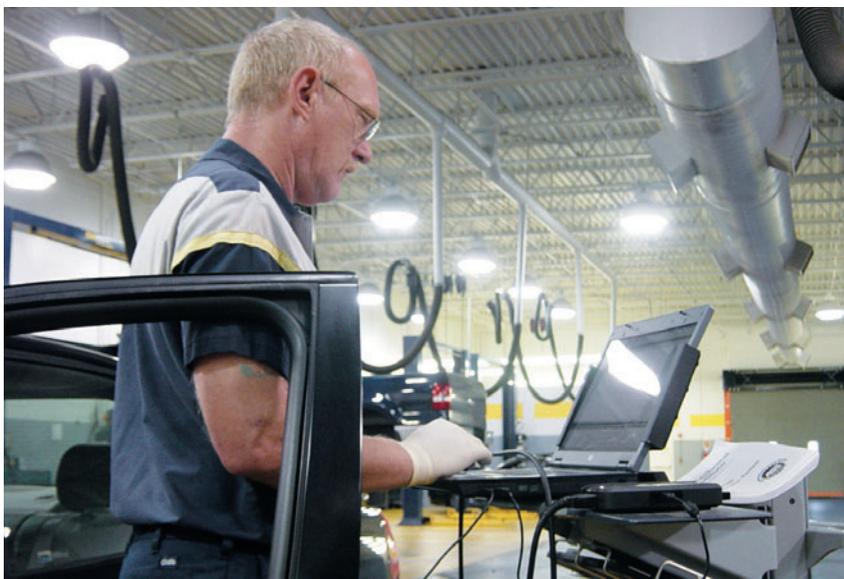
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SEE! I did work as a full-time tech once upon a time!



EVEN THOUGH I DON'T WRENCH full time anymore, I still try to “stay dirty” so I can keep up with all of you!

or process and you can be assured you'll be hearing about it in your inbox!

I don't look for perfect writers. I do expect submissions to the magazine, though, to at least be spellchecked and formatted somewhat properly before I get it, just to cut down the workload on my end!

I start every new writer out with “Garage.” This monthly feature is a cornerstone of our magazine and a feature I used to look forward to every month. It's more than just a case study — it's a story of a challenge faced and overcome, and

the lessons learned in the process. One of my personal favorites is a challenge faced and nearly lost, but the lessons learned in the process were invaluable.

We all have those kinds of stories — the ones we share with our fellow techs over a cold beer at the end of the day. The ones that start with “that (fill in the OEM of your choice here) nearly kicked my a--!” I'm betting you have one or two of your own, don't you?

If you'd like to submit a story idea, here's a few tips for you.

1. The submission, for our print

issue, has to be between 2,000 and 2,500 words. The Word program tracks this for you in the lower left of the open document window.

2. Avoid reusing common phrases. Reading “as well” at the end of every other sentence is a bit tiring to the reader and especially tiresome to the editor!

3. Write it like you'd speak it. Don't try to be too formal — be yourself!

4. Illustrations have to be more than screenshots and **MUST** be high resolution. This is one that trips up even experienced contributors. Low-resolution images work fine online but will not reproduce well in print. Illustrations should be 300 DPI OR a larger image size (like cranking up your phone or camera to record the highest file size image it is capable of). Each story requires 6 to 8 illustrations that are independent of the story and the more, the better.

Oh, and if you include a photo or image that you, yourself, did not create, be sure you have permission to use it!

If you do decide to send me a submission, send it to pete.meier@ubm.com. Be prepared for it to take a bit of time for me to read it over and send you my critique. And don't take offense if your first few tries don't make the cut. I'm betting your first few oil changes or brake jobs weren't perfect either.

Who knows? You may be invited to contribute regularly to America's oldest trade publication — *Motor Age!* **TM**



PETE MEIER is an ASE certified Master Technician with over 35 years of practical experience as a technician and educator, covering a wide variety of

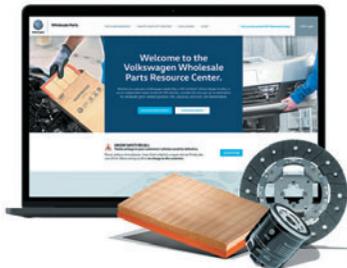
makes and models. He began writing for *Motor Age* as a contributor in 2006 and joined the magazine fulltime as Technical Editor in 2010. Pete believes in the mission of the magazine to “advance the automotive professional” and provides resources to working techs around the country through print, social media and YouTube.

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EVERYTHING YOU WANTED TO KNOW ABOUT GASKETS!

IN THIS MONTH'S "THE TRAINER," LEARN TIPS ON GASKET REMOVAL, SELECTION AND INSTALLATION. BASIC STUFF, YOU SAY? YOU MAY BE SURPRISED!

PETE MEIER // Technical Editor

Nearly every component that attaches to another in an engine has some form of gasket to ensure the seal between the two parts. From the smallest O-ring to complex MLS (Multi-Layer Steel) head gasket designs, choosing a quality gasket is one step in ensuring the overall quality and longevity of your repair.

But even if you do choose the best gasket available, the ability of the gasket to do its job still hinges on the proper preparation of the two mating surfaces and the installation procedure you use

during assembly. How do you prepare the mating surfaces? What is the proper installation procedure? When is a gasket sealer needed and if it is needed, what type of sealer do you use?

Are the methods I learned long ago still applicable or are there new processes I need to learn?

These are just a few of the questions you need answers to before attempting your repair. Make a mistake along the way and it could cost you a comeback and a dissatisfied customer at the least. Worst case? You could be buying an engine!

As with so many other topics we've tackled in "The Trainer" series, performing a repair professionally is dependent on paying attention to the details. From removing the old to installing the new, gaskets are no different — and we'll focus on those particular details in this month's video. 

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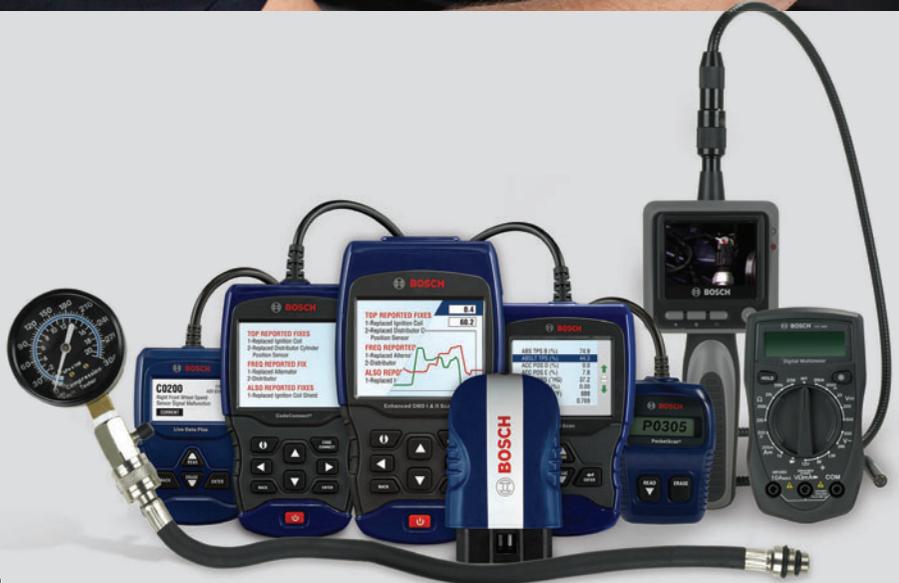
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