AUGUST 2016
VOL. 135, NO. 8 // MOTORAGE.COM

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KIA QUALITY CONNECTION

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FINALIZING TIMING BELT REPLACEMENT

The second part in our look at how to take care of these noisy issues

GOING BEYOND THE VOLT METER 58

Electrical theory has not changed much, but including thermal imaging in your process has.

ONE MEETING YOU MUST HAVE 18

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SECTION 3C

THE FUEL THAT GIVES YOUR ENGINE LIFE IS ALSO RESPONSIBLE FOR SLOWLY KILLING IT.

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Fig. 1–Valves

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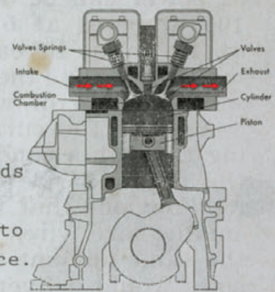

Fig. 2–Engine Fuel System

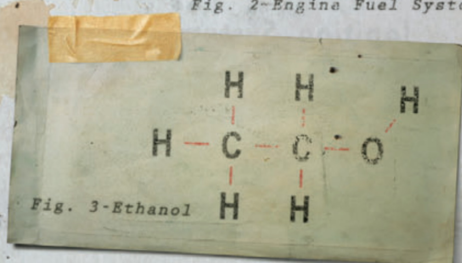

Fig. 3-Ethanol

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IN EVERY ISSUE

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Brought to you by Kia, this special section updates you on trends and techniques with these vehicles. *Packaged with this month's issue.*

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EDUCATORS GATHER FOR NACAT 2016 CONFERENCE

BY PETE MEIER // Director of Training

Eductators and their families from across the United States and Canada converged on Pasadena, Texas, to attend the 2016 North American Council of Automotive Teachers (NACAT) conference and trade show July 18 through 21.

The conference was hosted by San Jacinto College's automotive program. Many instructors will note the name of the college, as it was one of — if not the — first state college to offer an automotive track. The facility covers over 90,000 square feet and offers a foundational program called "F.A.S.T.," which stands for Future Automotive Service Technician. In addition to the basic curriculum, the school also offers OEM specific certification programs for GM, Ford, FCA Chrysler, Honda and Toyota.

The purpose of the conference is primarily to offer attendees the opportunity to earn their required continuing education credits at one shot. More than 144 sessions were offered over the four-day event, ensuring that attendees would have several choices that covered everything from advances in EV technology to new teaching methods for the classroom. Many of those attending, though, foot their own bills to make the event and double up the time by turning it into a mini-vacation for their families. The organizers always make sure there are things to do for the spouses and kids while the teacher of the family is in a classroom.

NACAT is an organization with a rich history and boasts membership in the United States and Canada. It has been in existence since the early 1970s, marking more than 40 years in service to the men and women charged with training our next generation of technicians. To learn more about NACAT or their 2017 event, visit its web site at http://www.nacat.org.

BREAKING NEWS

MPA LAUNCHES INDUSTRY-FIRST WARRANTY-REDUCTION PROGRAM

To help alleviate the automotive aftermarket's incessant, pervasive and burgeoning returns problem, Motorcar Parts of America (MPA) has launched an industry-first, warranty-reduction program for starters and alternators.

Designated "Call Before You Return," the program features a tested and proven method of reducing returns for MPA's Pure-Energy™ and Quality-Built™ new and remanufactured starters and alternators by borrowing some of the best practices from other industries and developing them into a preventive returns procedure specifically for the aftermarket.

"Misdiagnosis is common with the installation of starters and alternators even though the units are good," says Rick Mochulsky, MPA's Senior Vice President of Sales. "There are literally a multitude of tricky faults that may occur that have nothing to do with the integrity of the starters or alternators. With starters, the problem can range from a bad battery to poor wiring connections. With alternators, the problem can range from a defect in the control module to a slipping drive belt."

In order to prevent technicians from returning good units, which

>> CONTINUES ON PAGE 6

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wastes their time and their customers' time, MPA attaches prominent red "Call Before You Return" tags that have to be removed before installation can proceed. If a starter or alternator appears to not be working, customers are instructed to call a dedicated, toll-free tech line rather than return the part to the reseller. The tech line is manned seven days a week by ASE certified technicians.

"By making a simple phone call, our ASE experts can quickly guide technicians through the system diagnosis processes and pinpoint the cause of the issue so that they can wrap up a job and move on to the next," says Mochulsky. "Additionally, our staff can assist with installation questions, verify application information, supply cross references and answer vehicle-specific issues."

Selwyn Joffe, MPA Chairman, President and Chief Executive Officer, thinks the program could start a trend in the aftermarket because it addresses the problem proactively. "The best way to reduce returns — that siphon profitability from the entire distribution chain and, worse, destroy consumer confidence — is to prevent them in the first place. From a shop's most practical point of view, why tie up a service bay waiting on another part when you already have a good part in hand?"

Joffe adds, "Our 'Call Before You Return' program has been field tested and test marketed proving that intended repairs can be completed successfully rather than getting entangled in the time-consuming web of return logistics and the hassle of handling and servicing unnecessary warranties."

DEMAND FOR TECHS HEATING UP IN SILICON VALLEY

BY JAMES E. GUYETTE //
Contributing Editor

Within just a few short years, the auto-oriented rivalries and differences between Detroit's Motor City manufacturing might and the Silicon Valley's software expertise have become wafer-thin as collaboration and investment are booting up to establish the San Francisco/San Jose region as a key center of vehicle design developments — opening significant industry job opportunities in the process.

While it might be helpful for an aspiring Silicon Valley technician to have the term "engineer" included somewhere within their list of qualifications, employment listings indicate that hands-on knowhow is in high demand to actually execute the technological innovations.

"Silicon Valley's hot startups employ an increasing number of test drivers, automotive installers and auto mechanics," says Alison Chaiken, who writes software for advanced, semi-automated cars and trucks along with hosting monthly meetings of the Silicon Valley Automotive Open Source Group.

"We need a lot of them at Silicon Valley startups. As the automotive industry grows here, the need will increase," Chaiken says. "New sensor technologies will mean more technicians for areas like radar, LIDAR and cameras. If EV research continues to be hot, then experience with all-electric powertrains will also be valuable."

In April, China's LeEco cut the ribbon on an 80,000-square-foot North American headquarters and autonomous driving research center in San Jose, prompting the prospect of up to 800 new hires.

A LeEco joint venture with Faraday Future aims to advance EV development under the leadership of executives recruited from Tesla, BMW, Lotus, Jaguar and Ford.

Some of the employee benefits proffered by Faraday include:

- Competitive salaries
- Stock options
- Generous healthcare, vision and dental care – free to employees and discounted for partners and families
- 401k retirement plan
- Paid relocation
- Engineering orientation and on-boarding program
- Employee referral program
- Engaging internship program
- Modern workspace incorporating the latest technologies
- Opportunities to work alongside some of the most accomplished minds in the industry
- Daily catered lunches and food trucks
- Free snacks, fruit and refreshments
- Free parking – with carpool reimbursement
- Casual dress code and relaxed work environment
- Culturally diverse, progressive atmosphere
- "Soul of Faraday" community outreach team
- Frequent social events, happy hours and team parties
- Foosball and pingpong tables — including tournaments

Help wanted: ASE techs

"We are hiring great people for many positions," reports Jocelyn Rivera, an executive at the Bay Area-based Beepi online used-car buying and selling site. Vehicle inspection specialists with Automotive Technology degrees and ASE

>> CONTINUES ON PAGE 8

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>> CONTINUED FROM PAGE 6

certifications are especially in demand.

"In some areas, we're also hiring apprentices — entry level technicians who want to get their foot in the door and grow into the vehicle inspection specialist role by taking on operational responsibilities at our different warehouse locations," she says. "In addition, we hire car haulers for both long and short distances to move our Beepi cars to and from our different operations centers."

Mercedes-Benz's original workforce of 20 employees when its R&D facility first opened 20 years ago has now grown to more than 240. The center develops technologies such as Autonomous Driving, Advanced User Experience Design and Machine Learning. "We are finding intelligent solutions to synchronize the development cycles of the web and consumer electronics with those of the automotive industry," according to the company. "This means we are bringing new technologies to the road even faster and more efficiently."

"As an industry, we are on the verge of some major transformational changes brought on by the convergence of what have been, to this point, largely disparate technology disciplines," concurs Honda R&D Americas President Frank Paluch, reflecting on last year's unveiling of its new Silicon Valley research and development facility. "Honda will embrace and help lead this convergence. Our operations in Silicon Valley are a testimony to our focus on this new direction in our product and technology development efforts."

General Motors' recent purchase of San Francisco's Cruise Automation will further accelerate GM's development of autonomous vehicle technology. "Cruise provides our company with a unique technology advantage that is unmatched in our industry," says Mark Reuss, GM executive vice president of global product development, purchasing and supply chain. "We intend to invest significantly to further grow the talent base and capabilities already established by the Cruise team."

Twenty new industry job postings are already in place to attract interested candidates. "We are excited to be partnering with GM," says Kyle Vogt, Cruise's founder, "and believe this is a groundbreaking and necessary step toward rapidly commercializing autonomous vehicle technology. GM's commitment to autonomous vehicles is inspiring, deliberate and completely in line with our vision to make transportation safer and more accessible."

Continue reading at MotorAge.com/SiliconValley.

WORKING WITH LOCAL SCHOOLS

Getting involved with automotive tech programs is an investment in your future

BY BRIAN CANNING // Contributing Editor

Cars today are very complicated with systems and sub-systems that require in-depth training, special equipment and skills way beyond anything we saw in the 1980s or '90s. The good news is that cars are much more reliable than they ever used to be. The bad news is that when they break you have to have specialized knowledge, skill and experience to fix them. The current shortage of qualified technicians is a critical issue facing repair shops in the U.S. and a significant risk to the automotive repair industry, particularly away from the dealership world.

One of the most consistent and pervasive challenges facing repair shop owners and service managers is keeping their shops fully staffed with technicians who are up-to-date on their training and capable of working on late-model vehicles. Finding a technician at all can be a challenge in many parts of the country, but finding capable, productive, quality technicians in many cases is a near impossibility. The reasons for this are many and varied, but big factors in all of this are our lack of a game plan in training and recruiting, as well as negative perceptions of the industry. If we do not put automotive repair out there as a viable career option early, making training opportunities highly visible, attractive and available to young people graduating from high school today, we might find ourselves in an ever-tightening staffing crunch that will begin to impact our business and our ability to compete or even survive. Come to think of it, this kind of sounds like where we are today.

I think all of us dream about that perfect tech, with that perfect combination of knowledge, skill and experience walking in off the street and rescuing our service operation. While we are waiting for that unlikely event to occur, I am going to suggest something a bit more constructive: Contact an appropriate high school, technical school or community college in your area and see what they might have to offer. Get on their industry advisory board, donate some of your time or buy them a piece of equipment and take the time to meet some of the students. All of this is an investment in your future. Even though we still can hope and pray that perfect tech walks in and saves us somewhere along the way, beginning to partner with a local school gives us the

PHOTO: GETTYIMAGES/MONKEYBUSINESSIMAGES

opportunity to engage and interact with both students and teachers and gives us the very real opportunity to use that real-world experience we have been gaining all these years and advise on curriculum and training priorities.

Most importantly, we get to engage and interact with the technicians of tomorrow and get first crack at the training, knowledge and experience they represent. Identify promising students and set up internships for them — get to know them while they get to know you. Give them a career path while investing in your tomorrow. Begin to solve your staffing problem instead of waiting for that solution to walk in your door because that wait will likely be a long one.

As I am sure is the case in your town, within 20 miles of my front door there are three high quality automotive technology programs (The Gudelsky Institute for Automotive Technology in Rockville, Md.; Northern Virginia Community College Automotive Department outside Washington, D.C., in Northern Virginia; and Lincoln Tech: Automotive, with a couple of locations in the area) packed to the gills with young, highly motivated students who are learning the latest trends in automotive repair and technology but need the time and opportunity to gain experience. Each of these programs reaches out to high schools and has at least one car manufacturer and several new car dealers listed among their sponsors.

New car dealers have long faced the challenge of staffing their service departments. Unlike the automotive aftermarket, which can refer a customer back to the dealer when they can't or don't want to work on a particular vehicle for a particular problem, dealerships have to be ready to handle whatever shows up at their doors. They have long aligned themselves with high school, technical school and community college automotive technology programs and have long had the benefit of well trained technicians graduating with career paths laid out.

There are automotive technology programs across the country that are dying for sponsors, and though forming these types of partnerships can be time consuming, we are talking about our viability and survival as an industry. Being a sponsor is not a marriage or financial obligation, but it is us getting involved in the direction the automotive repair industry goes and doing something very constructive in shaping what that future industry would look like. Having access to an emerging generation of technicians in this effort is a great side benefit to sacrificing a few hours of your time each month.

BEING A SPONSOR IS NOT A MARRIAGE OR FINANCIAL OBLIGATION. BUT IT IS US GETTING INVOLVED IN THE DIRECTION THE AUTOMOTIVE REPAIR INDUSTRY GOES AND DOING SOMETHING VERY CONSTRUCTIVE IN SHAPING WHAT THAT FUTURE INDUSTRY WOULD LOOK LIKE.

Why should the dealers have all that exposure and why should they have access to all of those new technicians? What do dealers know that we don't?

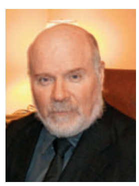
The Auto Care Association (formerly the Automotive Aftermarket Industry Association, or AAIA) knows that with a rapidly changing global economy, customer make-up, technology, legislation, environmental issues and competition, there is an urgent need for education and training programs. It responds to this challenge by providing the industry with resources and opportunities to enhance continuous learning.

The association understands the value of education, training and professional development. An important goal of the association is to create an industry-wide, broad-based initiative to "recruit and retain the best and brightest to grow the industry." Its purpose is to advance the ability of aftermarket companies and organizations to recruit young people, recent college graduates and returning veterans, among others.

Too often the automotive repair industry — and the automotive aftermarket in particular — lose out to other service- and skills-based industries because other industries have been much quicker to recognize the incredible and desperately needed resource represented by the young people registered in those high school, technical school or community college trade and technology programs. Other industries and new car dealerships know that human capital is limited and central to any industry with expectations of a sustainable future. Not willing to bet that future on the hope that knowledgeable, experienced and motivated staff members will walk in off the street, many industries are fostering those relationships early and providing viable paths toward the future and attracting the technicians and service advisors of tomorrow.

That young man or young woman looking for a career may have heard things about life as a technician in the automotive repair industry but they will not be working for the industry, they will be working for you. What view of the industry are you giving them?

Maybe it's time we thought about our future. Maybe it's time we thought about our industry. Maybe it's time we became a sponsor. MA



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Analyzing your business correctly is time well invested

Consider measuring these items to better manage your business

Too many shop owners spend their time working "in" their business and not "on" the business. There really is a difference between working hard and working smart.

The question that many people are asking these days is what should I be measuring in order to ensure I am maximizing productivity and profits of my shop?

The following are items for consideration to be measured each and every month. Keep in mind that if you can't measure it, you can't manage it. Get focused and measure your business properly so you can make competent management decisions to move forward and achieve what you want to achieve.

1. Labor rates — Maintenance rate, diagnostic rate and re-flash rate. What multiples are you achieving between the amount paid hourly to the technician and the rate charged to the customer/client?

2. Effective labor rate — What are you really achieving in your labor rate after it is measured against the shop's potential?

3. Number of invoices/ROs written each month — Are you controlling your volume or are you missing potential revenue because the shop is too busy?

4. Average labor hours billed per invoice — Are you measuring productivity or just sales?

5. Average Sales and Gross Profit per invoice — What are you really making on that average sale in your shop? Is it growing or shrinking?

6. Average labor produced per technician — Are your people above or below average? Are they improving as their knowledge increases?

7. Daily operating expense of the shop — What does it cost to turn that key in the morning? Are you giving more thought to the "common sense" expenses of the shop?

8. Current ratio — Is the business getting more liquid? Can the bills be paid in full when due?

9. Age of the receivables — How long is it taking to collect the average receivable from the customer? Is progress being made to eliminate receivables? What is the true net profitability of each account? Should this account be retained or fired?

10. Age of payables — Are you paying bills when due and taking advantage of discounts offered for prompt payment?

11. Labor billed to total wage package ratio — The wage package must include 100 percent of the shop's wages, including management and all benefits and payroll costs. It helps measure the effectiveness of management's ability to make the shop productive.

12. Gross profit by revenue category — What is the contribution to your business of each revenue category? Are you focusing on the important issues that drive net profit?

13. The shop's sales mix — What is the breakdown that, when analyzed properly, can tell what type of customer/client base is in the shop? Management can make competent decisions on the type of staff, equipment and training needed with this information.

14. Inventory turn/earn index — Is the shop carrying the right level of inventory in each category or are we under or over stocked in certain lines?

15. Shop efficiency — This seems to be the most misunderstood term in the industry, and yet inefficiency is the biggest cost per hour in running a shop. Is the shop meeting the right percentage for the customer/client it is serving?

These are a number (but not all) of important measurements to be examined each month. Math does not lie, and it is a very precise science. By following the trend in your business (analyze the year to date numbers at all times), one can start to maximize profitability, enhance business relationships and really move their shop to the next level.

Make the time to learn business management techniques and get focused on your future. One of the biggest factors in success today of any automotive shop is the courage to understand something. It is easy to book time off for fishing or hunting, but why not book two days off to enroll into a shop specific business management class and really start the process to understand your business? Have you bought yourself a job, or are you enjoying a career?

BOB GREENWOOD, AAM, is president and CEO of Automotive Aftermarket E-Learning Centre Ltd. (AAEC), a company focused on providing business management resources and development for the independent sector of the automotive aftermarket industry utilizing the Internet environment. *greenwood@aaec.ca*

How do you know when the price is right?

Charging the right price for parts is crucial to staying in business

What should you charge for the parts you are putting on someone's car? Too many shops just don't charge enough. When I talk to shop owners and this subject comes up, many times I hear, "I can't charge more than list price in my area." Let's listen to Head Coach George Zeeks explain how to solve this problem.

When I point out that other shops in the same market are charging consistently more, I'm met with disbelief. All the time you hear the saying, "Well that's apples and oranges — you can't compare them." Some of the time, it's true. However, let's say you have an apple and I have an orange — which is worth more? Well, it depends where we are, the time of year, etc. If we are in Florida and it's orange season, is the apple worth more? What if it's the time of year to harvest apples in Florida? Be careful here, since they don't grow apples in Florida. Surprised? I was.

The point is that the stores that sell the apples or oranges charge what they have to charge to make money and stay in business. So should you.

List price

The most common thing that we hear is, "How can I charge more than the list price?" I learned early that the list price was an illusion. Who even paid the list price? Many times a DIY consumer will walk in and get the part for the same price you pay. I have talked to tons of different parts vendors, and if you call different parts houses you can get different prices depending on who you are talking to. In your pricing, the thing that matters is what you are paying for the part. What do you need to charge for that part to make a profit? How much profit do you need to keep the doors open?

In many ways we don't even think about the pricing of things we consume every day. An 18-oz. soda in a fast food restaurant costs them only 16 cents but sells for around $1.99. You don't really care; you want a Coke with your burger. A single rose, at wholesale, starts at around 82 cents but could sell for as much as $8.33 on Valentine's Day. I can't speak for you, but I pay the price. Why? I know that I'm hard to live with. I know what my wife wants. I know what has happened in the past when I failed to deliver the goods, so to speak. At this point, I don't care what it costs, I care what it is worth to me. We are talking about value to the consumer and that is where you need to be focused.

Defining value

How value is defined varies from customer to customer. There is definitely a segment that wants only a cheap price and does as little as possible to maintain their car. If price is your major selling point, I would tell you that you are going after the wrong customer. There is no relationship, no loyalty and no future for you in that customer's mind. You can't build a business to support retirement using that model. You have a job, not a business,

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and it's probably a job that doesn't pay very well either.

The more value you build into the experience, the more you move from a transaction to a relationship. What is your warranty? How good is your crew? What does the shop look like? Do you have up-to-date equipment? All these things cost money — you know that. If you're not making enough money you can't have a great crew; you just can't afford it.

It's getting harder to find a good tech and they want more benefits. Comebacks will kill a shop — try to explain that while we didn't fix the car the first time, you did get a great price on the repair. Really? How great is the price of no repair? The real sale is about you and your shop. Why are you the best? Why can they trust you? Why should they spend money with you and then come back again and again? Give them value for their money and price becomes very flexible.

Use different parts matrix values

Almost all point-of-sale systems have a parts matrix built into them. How are you using that? What is your matrix based on? What is the average weekly parts margin or parts profit? Most of them have a step system that gives you, usually, 10 different levels that you can set different values for the parts markup. Are you using all 10 levels? How are you determining the margin value for each of the levels? Have you run a parts detail report to see the price point that you are selling the most parts at and making adjustments from there? Do you have different matrix values for jobber, warehouse and dealer? All of the ATI clients, past and present, use a parts matrix that helps them charge properly and consistently. Will you end up charging your customers more than you are now? You may.

IF PRICE IS YOUR MAJOR SELLING POINT, I WOULD TELL YOU THAT YOU ARE GOING AFTER THE WRONG CUSTOMER.

Let's take a look at what that would really be. For the sake of discussion, let's say you are running a 35 percent parts margin. That means that you are making 35 cents of profit for every $1 that you charge in parts. If you were running a 55 percent margin, then you would keep 55 cents of every $1 charged. On a bill of $200, $100 in parts and $100 in labor, you would only charge an additional $20 to the $200 bill. Build value in what you offer and it's no big deal. Most of you need and deserve that extra $20 to be able to provide the right type of service and warranty to attract and keep the best customers. This gives you the money and opportunity to improve your shop and offer more value.

One of the key things here is that increasing value to the customer is key to being able to charge properly. This boils back down to values and the type of shop you want. If you want to be able to take time off from the business, then you need the right staff to run the shop while you are not there — not just any person that can fog a mirror, but the people that will care about your business the way you do. You want staff that will treat your customers the right way, like you do. That type of employee costs more money. Working in your business without a break is a sure recipe for disaster. If everything revolves around you having to be there, then you have a job, not a business. You took the risk of starting a shop — you deserve to benefit from it.

It boils down to apples and oranges. If we say that the apple is the price-based shop with little customer loyalty and you working in the business every day and that the orange is the shop with great visual appeal, great technicians who want to work there and you are not stuck in the business but are working on it, which shop would you want to have? Which shop do you need to have to survive the next 10 years? Are you an apple or an orange?

If you would like a copy of the ATI Parts Matrix, for a very limited time simply go to www.ationlinetraining.com/2016-08 and download a copy of our most recent parts matrix.

CHRIS "CHUBBY" FREDERICK is the CEO and founder of the Automotive Training Institute. ATI's 115 associates train and coach more than 1,400 shop owners every week across North America to drive profits and dreams home to their families. This month's article was written with the help of Head Coach George Zeeks. *cfrederick@autotraining.net*

THE MOST IMPORTANT MEETING YOU SHOULD HAVE

Keep your finger on the pulse of the shop with daily meetings

BY DAVID ROGERS // Contributing Editor

Imagine a day when your shop continues to be profitable and run smoothly without you there. No micromanaging, no babysitting — simply a stress-free shop.

Running a successful shop means you have the freedom to run the business from afar. But when you leave the shop, how can you be sure things will continue to run smoothly?

Terry Keller hasn't had to step a foot into Keller Bros. in years, except when he wants to. I spend most of my time coaching owners of other shops across the country, which means I'm not even in the same state most of the year. And yet, together we run one of the most successful shops in Colorado.

I'm not bragging — I'm sharing this to show you that you can have it, too.

The key? You must keep your finger on the pulse of the shop and hold your team accountable every single day. The best part? You can do it in only 10 minutes.

Terry Keller and I manage our shop completely remotely, and one of the biggest keys to getting here was establishing what we call the 10 Minute Meeting™.

It's the reason the service writers and techs in our shop and our clients' shops start off every day knowing exactly what they need to do that day to lower their stress and intensify their focus. This 10-minute investment leads to increased sales and gross profits, boosted production and a happier, bigger shop.

Don't waste time

Did you ever play with a magnifying glass in the sunlight? One of my strong-

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NAPA KNOW HOW

est childhood memories was spending hours outside of Grandma's house using a magnifying glass to chase ants or light scraps of paper on fire.

If you hold the magnifying glass too far away and the focus is too wide, there's no heat, no results. When it's too tight, you could burn your name into the sidewalk.

When you have that focal point just right, you have precise control over the heat from the sun.

Meetings are like that magnifying glass. When used incorrectly, they can burn through the trust in your team, create more problems than they solve and turn into an unfocused complaint session. But when used correctly, meetings can turn up the heat to motivate the entire staff towards the same goal. The key is finding that focus.

Many other shop owners I talk with have negative feelings towards meetings. They say things like, "They are boring and a waste of time" or "You never resolve issues or decide anything."

Why do they feel that way? There's no follow-through. Follow-up is where most organizations fail. Without proper follow-up, the meeting will be a waste of time. Your time is too valuable to waste even 10 minutes on something that won't benefit your shop.

That's why it is so important to have this meeting every day, so you can hold your team accountable every day.

When you have that meeting each day, you are empowering your team to make lasting change. Each day they must report back on their progress toward the goal of the last meeting. This eliminates excuses and gives you direct insight to catch and fix problems.

It's a small routine, but it makes a huge difference. It allows you to keep track of your employees' goals and motivation. It enables you to identify opportunities and fix broken systems. It lets you synchronize your team toward the same goal. It gives you the freedom to manage the shop remotely with confidence knowing exactly what is happening at your counter and in your bays even when you are not physically there.

Remote management

The biggest factor keeping owners tied down and stuck in the shop every day is fear; fear that the moment you leave town, the shop will turn to chaos, fear that employees will take advantage of you, fear that customers will disappear overnight.

This fear stems from a deeper truth: shop owners often don't know what they don't know.

How can you know what is going on in the shop when you are not physically there? If your only optics into your shop come from calling your manager and asking for an update or a report from your point-of-sale system, you can only know what they tell you.

Ask a general question like "How's the shop today?" and you'll probably get a general answer like, "It's good" or "A little slow."

But what does that mean exactly? Is car count down by one or two cars? Are the techs performing thorough inspections and the service advisors filling your pipeline for the next day? Is the team goofing around or pencil whipping inspection forms?

If you wholeheartedly trust your general manager, maybe their answer is good enough for you. But are you willing to settle for good enough?

When you ask the right questions, you can get the answers you need to take care of your shop, even from afar. But, again, most shop owners don't know what they don't know.

If you don't know what you don't know, how do you even know what questions to ask?

That is why it is so important to be measuring, tracking, training and following up every day in the shop. When you know exactly where your shop stands every day, you know exactly where you need to go the next day and you know exactly the right questions to ask to find out if you're headed the right direction.

If that sounds like a ton of work, it doesn't have to be. You don't have to go through the trials, tribulations and years of struggling we did to learn the most important numbers to measure and develop the tools to measure them. With the right system in place, you can have access to all of the most important numbers at your fingertips when you need them.

By bringing your team together each day, the daily meeting becomes a tool to refine your focus, create synergy and keep track of the performance of your shop. It only takes 10 minutes to get everyone, including the owner, synchronized and focused together to run an efficient and productive shop so that you don't even need to be there to be sure that it's working.

Whether you are day dreaming about early retirement, a beach vacation or simply not having to worry about the shop, you can successfully manage your shop remotely when you are armed with the right tools.

In our shop, it's the 10 Minute Meeting, and it's how we measure and hold our team accountable every day. You can do it, too — take 10 minutes to ask the right questions and get more productive, focused employees who do exactly what you expect.

Make this the year you can go fishing, play with your kids or grandkids and relax knowing the shop is full, techs are productive and customers are well-served. MA

DAVID ROGERS is COO of Keller Bros. Inc., and president of Auto Profit Masters. *contact@autoprofitmasters.com*

SMART STRATEGIES FOR A CHANGING LANDSCAPE

Shifting settings require altered business practices

BY TIM ROSS // Contributing Editor

If you've noticed your car counts shrinking, you're not alone. The automotive repair industry has undergone a seismic shift in the last decade.

Thanks to a slew of manufacturer incentives, new car sales have exploded since the recession. New car sales set a record in 2015 with 17.5 million vehicles sold — a 5.7 percent increase over 2014. Today's cars are more technologically advanced, safer and more reliable than their older counterparts and thus require fewer repairs.

Not only are cars better built, but the competition for automotive service customers has increased. Specialty chains, such as Jiffy Lube and Midas, that used to focus simply on oil changes or muffler repairs have become full-service shops and are often open longer and on weekends. Dealerships have also become more aggressive in courting service business to supplement the one-time revenue generated by sales.

These changing industry dynamics have made it difficult for many mom and pop shops to post the sales they once did. To stem the decline, shop owners will need to ask themselves if they are providing the services their customers want in the way they want them delivered. The new landscape provides an opportunity for shop owners to evaluate their practices and embrace new ways of doing business.

If you're serious about turning the tide, consider adopting the following strategies. Even after just a few months, you should see a significant improvement in car count and sales.

Focus on maintenance, not simply repairs

Long gone are the days when a shop

PHOTO: GETTYIMAGES/CREATAS

could survive on big repairs alone. Those big jobs are fewer and farther between and with more competition in the marketplace, there's no guarantee that a customer is going to call you first when a car breaks down. Make oil changes and other regularly needed services the bread and butter of your business.

To achieve this goal, you'll need to make it clear to your customers that you're more than just the place to go when a big problem occurs. Start advertising offers for oil changes with vehicle inspections, seasonal services (such as air conditioning checks or holiday tune-ups) or free safety inspections. These types of offers provide the opportunity to establish yourself as a full-service shop and allow you to detect issues before they become big problems.

The other key to changing your shop's perception is to back up your work with a warranty. This practice builds trust between you and your customers, increases credibility and improves your standing against competition.

Become a 'yes' company

Many shops are confused by the concept of being a "yes" company. Being a yes company simply means putting the customer at the center of your business. If a customer needs an oil change and wants to bring in his car this afternoon, say yes rather than asking them to work around your schedule. That might mean moving a major repair job to the side temporarily, so you can accommodate the oil change. You may also have to start scheduling service based on when a customer needs a car rather than based on when the car was dropped off. Your goal is to make the service experience as easy and convenient as possible.

Here are some other features that will help position your business as one that puts customers first:

- **Extended hours** — The large chains are built around providing service when a customer needs it, whether that's 10 a.m. on a Tuesday or 5 p.m. on Saturday. You may need to adjust your hours to compete effectively.
- **Shuttle services or rental cars** — For most customers, being without a car is a major inconvenience. By providing a rental car or shuttle service, you're enabling your customers to get back to where they need to be with as little disruption as possible.
- **Accommodating waiting rooms** — If customers choose to wait for their cars in your shop, you should try to provide them with a pleasant environment. Free Wi-Fi, clean bathrooms, sufficient seating and free coffee and water all should be standard.
- **Payment financing options** — It's not uncommon for customers to put off repairs if they can't afford the cost. In a 2014 survey, AAA found that one in eight Americans couldn't afford a car repair of $1,000 or more. Partnering with a financing program will allow you to service these cars and again makes you a more attractive option for service in the eyes of your customers.
- **Pick-up service** — If a car is drivable, but the customer can't make it in to your shop, consider picking up the car and bringing it in. Going that extra mile will help you stand out from the competition and engender loyalty.

Market more strategically

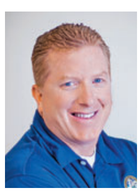
When it comes to marketing, it's easy to get into the habit of simply throwing a lot of offers out there and seeing what sticks. A better approach is to tie your offers to the services your customers need most. When it comes to attracting new customers, a coupon for an oil change is a great way to get customers in for what is a fairly common maintenance item. Offering a dollar amount off of a service rather than a percentage is also a better option because it gives the customer something more tangible to consider.

For retention efforts, make your offers based on what services your customers have purchased in the past as well as for services that might be coming due. For example, if a customer needs an annual inspection to renew his car registration, it would be wise to send a reminder via direct mail with a coupon for the service a few months in advance.

The other mistake many shop owners make is to market to their existing database rather than the population of potential new customers. You're going to lose a certain number of customers each year simply due to attrition – some will move, some will buy new cars and some might just switch shops. Keep in mind, that although that customer may appear to represent just one car, you're actually losing two to three visits a year. For that reason, it's crucial to focus on new customer acquisition.

And finally, don't restrict your marketing efforts to digital-only avenues. Technology is wonderful, but there are still some drawbacks to relying solely on email blasts or SEO to promote your shop. Direct mail has better response rates than email, which consumers have come to view as spam. Direct mail also provides the ability to target by income, zip code, household makeup and even vehicle make. These are all important characteristics to factor in when conducting a customer acquisition campaign.

Change is never easy. But sitting idly by and running your business the way you always have is not an effective response to an increasingly challenging environment. Instead, seize the moment and adopt new strategies to better serve your customers and grow your sales. MA



TIM ROSS is president of Mudlick Mail, a provider of direct mail services for the automotive service industry. He has been with Mudlick Mail since 2008. *info@mudlick.com*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Staying connected

Family-owned shop reaches out to community, online customers

BY ROBERT BRAVENDER // Contributing Editor

V&F Auto began with a firm foundation. Vinny and Frank Palange, father and son, founded V&F in 1988 by taking the added step of buying an acre of land in Agawam, Mass. While most shops start off making do with rented property, the Palanges built a 4,000-square foot facility, which they've expanded and refined over the years to the establishment it is now.

"They were actually just going to do some detailing and sell some basic parts," Nicole Palange says of her grandfather and father. "From there they started doing some oil changes, but my dad likes to tell the story of when a woman came in and asked if they did brakes. My dad said we didn't, my grandpa kicked him behind the counter and said we did. 'No, we don't.' 'Yes, we do.'"

"My dad had become a licensed electrician when he was in school, so he didn't quite have a complete automotive background," she explains. "Finally they told her that they would figure out how to do it. (After that) service grew faster, so we ended up with many different additions." Over the years it would grow to include retail and wholesale parts and eventually even an auto sales firm across the street in 2002.

"I would say repair is roughly 50 percent of our business, if not a little bit more, with parts being about 30 percent and car sales about 20 percent," Palange reports. However, it's somewhat unusual to be both a parts supplier and consumer. "It's difficult," she admits. "With service being our dominant business, it took us a long time to build a reputation in the parts industry where people could trust us and not look at us as a competitor."

V&F AUTO, Agawam, Mass. // www.vfauto.com

Frank Palange
Owner

1
No. of shops

27
Years in business

9
No. of employees

7,500
Total square footage of shop

12
No. of bays

$494
Average repair order w/o state inspections

$284
Average repair order w/ state inspections

108
No. of customer vehicles per week

$1.6 million
Annual gross revenue

However, V&F recently had occasion to physically separate the two businesses when they purchased a building next door to their auto sales and refurbished it as an independent Carquest store. "Over time we've proven ourselves to our parts customers that we're not giving our service business any kinds of deals," relates Palange. "It's definitely challenging, but we've learned a lot through the years, and I believe we're at a point now that we can feel confident about where we stand with our parts business."

Honesty being the best policy, "be sure that you're being ethical," offers Palange. "My dad was somebody who was always open with (other shops); if we ran a marketing campaign and they wanted to know how we did it, he would gladly sit down with them and let them know. He's a very smart man, and he lets them know he wants them to grow. The reality of it is if they do well, they buy more parts and we do better. In the end, that helps all of us."

Palange herself handles the company's online marketing. "We tried farming it out, but that takes away the purpose of doing it," she explains. "Instead of a generic presentation, we want to share who we are and reach our customers in a way that shows them we're not just a business; we want them to learn more about who we are as people so they feel comfortable patronizing us."

Part of that is through V&F's extensive involvement in the community through various local and national programs: Hoof for Roof, a program for veterans where they donated a car in conjunction with Cars for Freedom; the ALS Strikeout; Keep Education Rolling; Paint the Town Purple as part of Relay for Life; Toys for Tots; and the Festival of Trees, just to name a few.

"It's just something we enjoy doing," Palange concedes. "It makes the work day more lively, more fun than just the typical nitty-gritty business. It's an opportunity to meet more people after all the hard work we put into the business, an opportunity to share that with others. Being able to do that and having those different relationships you obtain from going to do these different events, it's definitely rewarding.

"In my experience, Facebook is definitely the most successful avenue for businesses," she declares. "Instagram is basically Facebook without posts, only pictures. It works to some degree, but we haven't found it to be very successful in the automotive industry. Sometimes we do promotions, but we try to keep it a social media outlet, interacting with customers versus pushing marketing on them. A lot of it is branding who we are as people, so whenever we do community events, we're putting those kinds of pictures up. Whenever we see something cool at the shop, we share that."

Having hired a company that maintains their website and search engine optimization, Palange has also picked up a lot by working closely with them. "How do you learn all of that information?" she poses. "It's just about reaching out and asking questions. They host webinars all the time, so I might end up calling our account rep and say, 'I just saw that they did the penguin update in Google — what the heck does that mean?' I'll probably send them an email a week."

Their recent expansion across the street opened up a lot of square footage, allowing V&F to renovate and dramatically increase the size of their waiting room and service writing area. "We also increased the size of our used car lot from a 21-car license to a 51-car license," Palange reports. "And we tremendously amped up our parts inventory by about $250,000, so we've just done a huge overhaul. But we're always growing, and every day we look to grow more, whether it's through additional customers or sales goals.

"At this time there's no plan for expansion, but whenever an opportunity opens up we don't shy away from it," beams Palange. "That's the fun part about being in business and the way you're going to be successful; you have to weigh out the risks and opportunities. Always keep your eyes and ears open." MA

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 how-to guys Sam Memmolo and Dave Bowman.
rbravender@comcast.net

Commit to the '8 Before 8' strategy for better days

ESTABLISH A POSITIVE MORNING ROUTINE TO START YOUR DAY THE RIGHT WAY

MIKE JONES // Contributing Editor

Over the past 30 years, I have come to see mornings as the foundation upon which I build my entire day. I also came to recognize that how I feel mentally, physically and spiritually all day is directly connected to how I start my day.

I have found that when I begin my day by utilizing the concepts and principles I will share with you in this article, I am more productive, happier, more energetic, more positive and more focused during my entire day.

Having a morning routine will create positive new possibilities for you. I like to call my routine '8 Before 8.' Take a look at a scenario of two different mornings.

Morning No. 1 — You need to be at work by 8 a.m., and you need to be out of the house by 7:15 a.m. due to your commute. The alarm sounds at 6 a.m.; you push the snooze button. By pushing the snooze button, you have already begun your day with negativity, and now it is 6:15 a.m. and the alarm sounds again. You begrudgingly turn it off and drag yourself out of the bed as you continue the negative conversation with yourself about all of the things you must get done before and after you get to work.

You recognize that you need to speed up this process to be out of the door by 7:15. You wake up the kids, and they are dragging out of bed. Since you are in a hurry now, you get frustrated at them, never recognizing that you have likely been the creator of the negative chaos you are experiencing in your home.

You rush off to shower, grab a bite to eat, get the kids out the door and then rush to work and arrive in that funky energy.

Morning No. 2 — You need to be at work at 8 a.m., and you need to be out the door by 7:15 a.m. You have deliberately moved the alarm clock across the room with a commitment to yourself that when the alarm goes off, you will get up and turn it off, never hitting the snooze button again. You set the alarm to sound 15 minutes earlier than you normally get up.

The next thing you do is deliberately read something positive. You have created your list of eight specific tasks that you will perform before 8 a.m. At this point, two of them already have been accomplished. The eight tasks should be focused on having a positive start to your day because of you rather than because you waited for life to happen.

This second scenario is a story only you can write for your situation. Some of the things that have been on my list that were successful in getting to my positive outcomes were choosing to have my four sons participate in selecting what they would wear to school the night before. Other activities that have appeared on my list were listening to motivational music, meditating and drinking a specific amount of water each morning.

I encourage you to create your list of '8 Before 8' and make a commitment to do them daily. Establishing a positive, deliberate morning routine will ensure that you start the day in a positive attitude that will produce new constructive opportunities at work and at home.

MIKE JONES is the founder and president of Discover Leadership Training, a next-level leadership development solutions company in Houston, Texas. He encourages others to create a better version of themselves by realizing their untapped potential.
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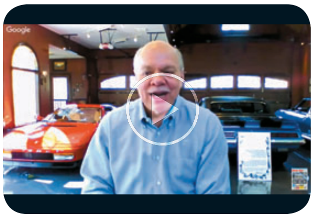

The importance of continuous learning

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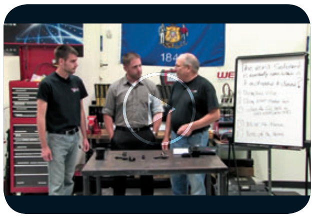

Testing for EVAP system leaks

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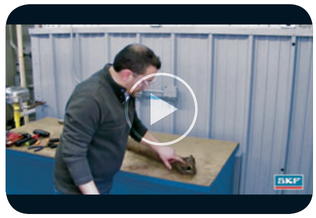
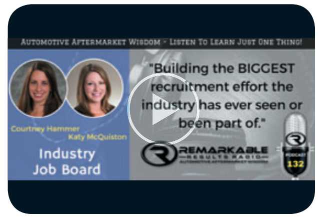


How to properly install u-joints

MOTORAGE.COM/Ujoints



Recruiting new talent for your shop

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SOCIAL INSIGHTS

FINDING THE RIGHT DIAGNOSTIC PATH

The boss hands you your first diagnostic ticket — a customer concern that the “Check Engine light is on” — and he tells you he wants to see what you can do. Four hours later and you still have no clue why the light is on or what to do about it. Before you cry “Uncle” and throw in the towel, let’s talk about the process you’re using in your diagnostic method. That is, if you’re using one at all. ***Continue reading here:*** ***Motorage.com/FindYourPath***

GET WITH THE PROGRAM

Now more than ever is the time to “get with the program.” Almost all modules on most OEMs require some sort of configuration, coding, adaption or programming of some sort. Gone are the days of the removable EPROM and here to stay is the Electronic Erasable Programmable Read Only Memory or EEPROM. ***Learn more about the EEPROM here:*** ***Motorage.com/program***

WELCOME TO THE AUTOPRO NETWORK

This summer, we relaunched the AutoPro Network, a SearchAutoParts.com community for automotive professionals. In this how-to video, Technical Editor and Director of Training Pete Meier introduces the AutoPro Network and offers helpful tips on how to use it. ***Check it out now:*** ***Motorage.com/AutoProNetwork***

BILLY COLOMBINI USES ADENNA DARK LIGHT GLOVES

Billy Colombini from Blacktop Media suggests that you add Adenna Dark Light Gloves to your toolbox. Billy likes to use the Dark Light gloves to protect his hands while working in the garage on his Harley Davidson, his cars and while pushing his wheelchair. These gloves are strong enough that Billy doesn’t have to worry about them breaking or tearing easily no matter how he uses them. ***Check out the Adenna Dark Light Black Nitrile Gloves here:*** ***Motorage.com/DarkLightGloves***

WORKING WITH TOYOTA’S UHSS

Automobile manufacturing continues to advance when it comes to weight savings. The materials used are lighter and sturdier than ever before. It is common to find UHSS (Ultra High Strength Steel) where previous models used HSS (High Strength Steel). ***Continue reading to learn how Toyota is using UHSS:*** ***Motorage.com/UHSS***

TRAINING EVENTS

AUGUST 9-13
2016 NACE/CARS Expo; *Anaheim Convention Center*
Anaheim, California

SEPTEMBER 16-18
2016 CAN Conference; *Westin Chicago Northwest*
Itasca, Illinois

OCTOBER 8
AERA Conference; *Speedway Motors Museum of American Speed*
Lincoln, Nebraska

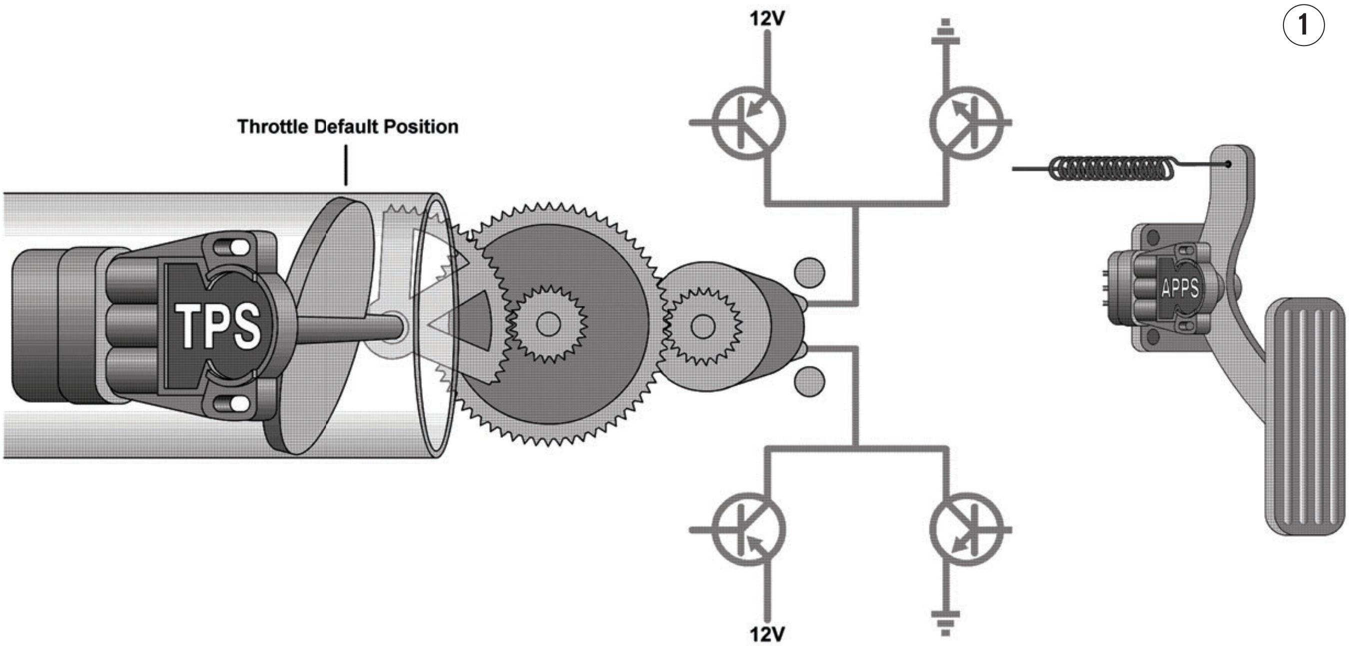
OCTOBER 15
Automechanika Chicago LIVE – Training Event; *Fox Valley Technical College*
Appleton, Wisconsin

OCTOBER 24-28
Advanced Selling Skills for the Service Advisor; *RLO Training*
Seattle, Washington

NOVEMBER 1-3
AAPEX; *Sands Convention Center*
Las Vegas, Nevada

NOVEMBER 1-4
SEMA; *Las Vegas Convention Center*
Las Vegas, Nevada

NOVEMBER 19
Automechanika Chicago LIVE – Training Event; *Joliet Junior College*
Joliet, Illinois



TROUBLESHOOTING 'DRIVE BY WIRE'

DEALING WITH CUSTOMER CONCERNS RELATED TO ELECTRONIC THROTTLE BODIES

BY BERNIE THOMPSON // Contributing Editor

In order to regulate the power produced from the gasoline internal combustion engine (ICE), a restriction is used to control the airflow into the engine. This restriction is known as the throttle blade. The throttle blade will change the throttle effective area, which will regulate the air volume that is moving from the atmosphere into the cylinder.

Traditionally, this restriction is controlled directly from the accelerator pedal through a mechanical linkage system that the driver will actuate. This relation between the accelerator pedal and the throttle valve is therefore fixed at one rate of opening and closing. Thus, the driver will directly determine the power output of the engine. If more power is required, the driver simply will push the accelerator pedal closer to the floor, which, in turn, changes the throttle effective area.

This will directly allow more atmospheric air volume to flow into the cylinder, which increases the fuel delivery. This additional fuel will release its chemical potential, which will heat the nitrogen (working fluid), creating an expanding gas phase that will push the piston down, thus creating greater power at the crankshaft. The throttle blade directly controls the power output of the engine.

With the need for higher control of the power output, better fuel economy and lower tail pipe emissions, this age-old system of accelerator pedal, linkage and throttle blade has been modified. This modified system is referred to as Electronic Throttle Control (ETC). ETC was first used on vehicles in 1986. These early ETC systems were limited by cost, so only high performance vehicles with traction control were equipped with this system. Some 14 years later, ETC systems became common place on the modern vehicle. ETC replaces the mechanical linkage between the accelerator pedal and the throttle valve. Additionally, ETC eliminates the idle speed control and the cruise control by directly using the throttle blade for the control of these systems.

PHOTOS: BERNIE THOMPSON

ETC systems are used to control the power output from the engine more precisely. ETC is used for emission controls such as catalytic converter lite off compensation, torque output control for traction control, engine speed governor, vehicle speed governor, altitude compensation, launch control compensation and driver selectable performance. ETC accomplishes this not by having to react to the driver input, as would occur with a direct linkage to the throttle blade, but by determining through the data input what the best throttle blade angle would be for the current condition and then controlling the throttle blade to allow for the best solution.

ETC was modeled after flight-by-wire. Flight-by-wire is a safety critical system in which redundant operations provide for a higher level of security. In order to eliminate the throttle linkage, several things must occur. The first and most important is to accurately determine diver intent. This is accomplished by using a sensor on the accelerator pedal as seen in Figure 1. This sensor is referred to as the Accelerator Pedal Position Sensor (APPS). This sensor will convert the mechanical input from the driver to an electric output from the sensor.

In order for a microprocessor or Central Processing Unit (CPU) to control a system, an interface is needed. The interface on your personal computer (PC) may be the mouse or keyboard. With the use of an interface you can directly request a task to be carried out by the CPU. On the modern vehicle the interface between the driver and the power plant is the APPS. The APPS conveys the driver intent as a request to the Engine Control Module (ECM) in which the task can be carried out. The APPS signal is only a request; the ETC program determines if the request is granted, altered or denied.

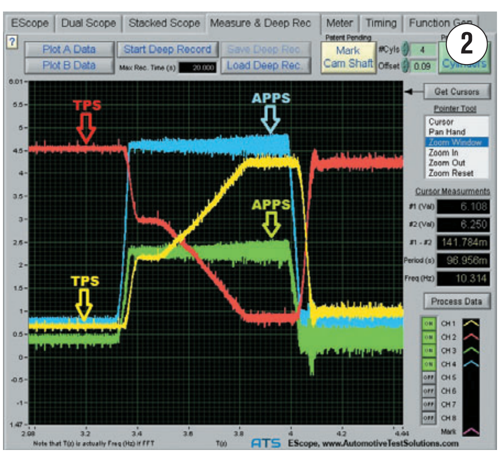
Because this is a safety critical system, there will be more than one sensor within the APPS. Early systems have three sensors while later systems have two sensors. These sensors have isolated circuits, so when comparing the APPS signals, there will be a higher level of reliability. Additionally, if one were to fail, the other sensor could still provide information for the system. The APPS will have at least two isolated 5 volt regulators to provide reference voltage, two isolated ground circuits that will terminate in different locations and two isolated signal output circuits. These two isolated signal output circuits will always be different, so if they were to short circuit together the system could identify this problem and carry out the appropriate action (the appropriate action or ETC mode operation is given below).

These APPS signal outputs can be seen in Figure 2, and are from a 2005 Nissan Altima. The APPS signals are located on Channel 3 (green) and Channel

4 (blue). It can be seen that these signals are on two different voltage levels. This is a very common scheme where one of the APPS voltage outputs is lower and one of the APPS voltage outputs is higher. When this voltage scheme is used both voltage outputs will be rising from a lower voltage level. Regardless of whether this is the voltage scheme used on the vehicle you are working on or not, the thing to remember is that the voltage outputs will always be different.

The CPU will receive the signals from the APPS and evaluate the driver intent. Once the driver intent is known, the CPU will command an output to the throttle motor seen in Figure 1. The throttle motor used in these systems will be very powerful and can draw up to about 10 amp. Even with a powerful electric motor the system uses a two- stage gear reduction drive system. This is to amplify the torque produced from the electric motor.

This is a safety aspect of the system. If the throttle is commanded closed, the system will have additional power to force the throttle valve closed. With this in mind, never put your fingers between the throttle blade and housing with the key on or even with the key off and jumping the starter. These systems were designed to force the throttle blade closed! Additionally, if the key is on and you manually move the throttle blade, the system will enter into a default mode. On some vehicles you will need a factory style scan tool to get it out of this default.

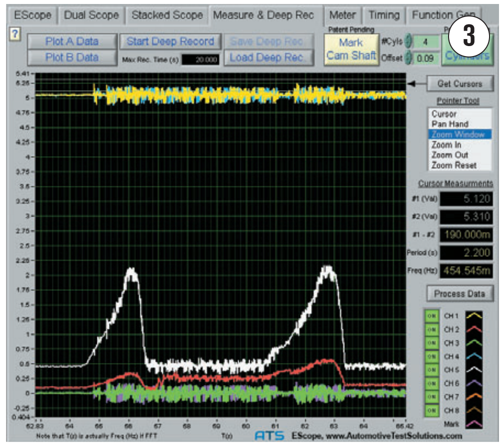


In Figure 1, the throttle blade is shown in the default or neutral position. With ETC systems if the system determines that it is not safe to continue controlling the throttle blade it will stop supplying current to the electric motor. When this occurs the throttle blade will be held slightly open by the default spring. This will allow the engine to be in a high idle state at about 1,800 to 2,300 rpm. With the default spring holding the throttle open,the ETC motor will need to close the throttle blade as well as open it.

The electric drive circuit for the throttle motor is referred to as an H bridge. With this circuit configuration the electric motor can rotate in both directions. This occurs by changing the voltage polarity on the motor's electrical windings. With one leg of the electric motor having a positive charge and the other leg having a negative charge, the motor will have a rotational movement in one direction. When the H bridge reverses these polarities the electric motor will rotate in the opposite direction.

In order to hold the throttle blade at one position, the current to the motor will need to be pulsed. To accomplish this the current will be pulsed at about 1,000 times a second or 1k Hz. With this fast current pulse the magnetic field will not fall between the pulses. This allows for the electric motor to hold the throttle blade steady without movement. With the H bridge pulse set at 1k Hz there is a high-pitched sound emitted from the throttle body. In order to eliminate this audible sound on newer models, the pulse is moved to a higher frequency of 20k. This moves the sound waves produced to the ultrasonic level which is above human hearing.

The current pulse to the ETC motor is controlled by the command from the CPU to the driver,



such as transistors or MOSFETS. The CPU monitors the current to the ETC motor. If this current is not what is expected, whether high or low, the ETC will take the appropriate action. Usually only one of the two wires will pulse and one of the two wires will be held steady. Either of the wires can pulse the ground or the power. In some applications both wires will be pulse. These are common control strategy for the throttle control circuit.

Once the motor is in rotation, it in turn moves the throttle blade. In order for the CPU to control this movement it will need a feedback circuit. This is accomplished with the Throttle Position Sensor (TPS). The TPS is used as an input to the CPU so the program can determine the throttle blade angle and throttle blade velocity.

Because the throttle angle sets the power output of the engine, this is a safety critical component. Thus, there will be two individual sensors that will produce two different signal outputs. The power and ground circuits may be isolated like the APPS or they may use common circuits. These voltage outputs from the TPS can be seen in Figure 2. This is a very common scheme where one of the TPS voltage outputs is high moving to a lower voltage and one of the TPS voltage outputs is low moving to a higher voltage.

With this scheme, the voltage levels will cross at about the 2.5 voltage level. This will make it much easier to program and check these two sensors. Whether it is the APPS or the TPS, the voltage

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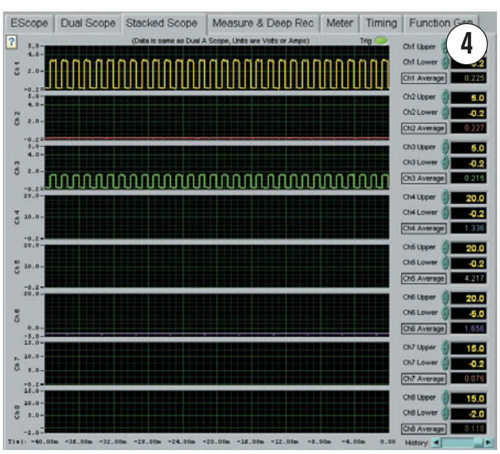
between the sensors will be checked. In the case of the TPS output voltages, the voltage from each sensor will be added together. So when these voltages cross at 2.5 volts, you would add TPS 1 = 2.5V and TPS 2 = 2.5V, which is equal to 5V.

At any throttle position the two sensors' voltages should add to approximately 5 volts. The CPU will have a threshold percentage programmed so that if this TPS voltage percentage is greater than the threshold, then the system will take the appropriate action. This percentage is usually between 12 percent and 20 percent depending on the hardware (throttle body) and the manufacture. An example is if TPS 1 = 2.95 volts and TPS 2 = 2.7 volts, the sum is equal to 5.65 volts. This would be 13 percent over 5 volts. If TPS 1 = 2.2 volts and TPS 2 = 2.15 volts the sum is equal to 4.35 volts. This would be 13 percent under 5 volts.

Because this is a safety critical system, there will also be two CPUs. One CPU is used for the operation of the ETC system and the other CPU is used as a watchdog. The watchdog CPU is used to provide redundant confirmation of the key ETC inputs and to perform checks on the main CPU. Both CPUs will receive the same input data. However, each CPU will use different software to evaluate this data. The outcome of each program will then be compared. If the outcomes are different, then the appropriate action will be taken. If the system determines there is a critical fault within the system, then either the main CPU or watchdog CPU can shut the engine operation down. This is accomplished by shutting down the fuel injectors and ignition coils.



Modes of ETC operation

• Normal Mode: This mode is selected at power up and will remain active until a problem is detected. Once a problem is detected, the appropriate action will then be taken.

• Limit Performance Mode: This mode is activated when the driver intent cannot accurately be determined or when the output of the engine power is impaired. In this case maximum power is lowered, throttle blade control is slowed and the warning lamp is activated

• Forced Idle Mode: This mode is activated when no driver intent is available. This mode is caused by the accelerator pedal position sensor connector not being connected to the Engine Control Module or no or faulty APPS data is present. The engine will start and run, but will not respond to the APPS, which is the driver intent.

• Power Management Mode: This mode is activated when the ECT system cannot reliably control the engine power using the throttle. The throttle is disabled so it can return to the default position. The engine power is controlled using the fuel and spark only. This mode is generally caused by an inability to position the throttle blade to the command value or a complete loss of TPS information has occurred.

• Engine Shut Down Mode: This mode is activated when the ETC system is unable to reliably process the control algorithms or cannot control the engine power. This mode is generally caused by a severe internal processing problem in the ECM or an inability of the intake air system or throttle body to restrict engine airflow. The fuel, spark and throttle will shut down.

Now that we have a basic understanding of the ETC system, let's diagnose a vehicle. The vehicle is a 2006 Pontiac G6 with no power, no throttle response and DTC APPS circuit 1 low. The first thing to do is to check the symptom, which is "no throttle response." The engine was started and run; the throttle was depressed with no throttle response occurring. With no throttle response, the system is in "Forced Idle Mode." This means the problem will be with driver intent or the APPS. The APPS circuit is a simple circuit with two powers, two grounds and two output signals that will be different.

A scope was installed on the APPS and the voltage outputs are shown in Figure 3. The Channel 1 yellow and Channel 4 blue are showing good power supplies. The Channel 3 green and Channel 6 purple are showing good grounds. Channel 2 red and Channel 5 white are showing the APPS output signals. The first thing you might notice is that the voltage waveforms on all of the channels have noise riding on them once the APPS is depressed. This is due to the H bridge operation opening the throttle blade and is normal.

You might ask how the throttle blade is opening when the system is in "Forced Idle Mode." This is a good question. When the engine is running the throttle blade will be forced closed, but if the engine is not running the throttle blade will follow the APPS. This is an important thing to understand when you are diagnosing any ETC system. The next thing you might notice is that the APPS voltage level shown on Channel 2 red is much lower than the APPS voltage shown on Channel 5 white trace. These are at different voltage levels. However, the red trace is only showing a little less than a .5 volt change from the APPS at rest to the APPS on the floor.

With the signal being based on a 5-volt supply, the signal output change should be greater than .5 volt. Since the voltage is low, your first thought should be "why?" You know the powers and grounds are good so the next question is, "Is the sensor bad or is the circuit being pulled down (loaded)?"

Before you disconnect anything, you will need to test the circuit for loading. This is accomplished with a sensor simulator. With the sensor simulator, send a TTL signal, zero- to 5-volt pulse, into the circuit. The scope already is connected to the APPS circuits, so just touch where the scope is connected to the APPS circuit for the Channel 2 red connection. You should see the square wave produced from the sensor simulator on the scope. If the square wave is pulled down or is not present, the circuit is loaded. On this Pontiac G6 the square wave was significantly pulled down indicating the APPS circuit is being loaded.

Now that you have clearly determined the circuit has a problem, you will need to determine where the problem is located. The first step is to disconnect the ETC CPU. This is usually contained within the ECU. On early ETC systems, there will be two different control modules, one for the ETC and one for the ECU. On later ETC systems, they will both share the same module housing.

Now you have disconnected the ECU connection. Connect the signal generator to the APPS circuit. Since the APPS circuits are now in an open circuit condition, any of the wiring will work. In Figure 4, the 5 volt feed on Channel 1 yellow is used. Notice that the voltage on Channel 1 is low at 3.5 volts and Channel 3 green is only at 2 volts. The problem circuit on Channel 2 red is at 0 volt, indicating that this has continuity to ground.

Because you have a second circuit on the other APPS sensor, simply touch the sensor simulator to the 5-volt supply wire on the Ch2 blue wire. The test revealed that all the APPS circuits are at 5 volts. This is the way it will work when the circuits are in an open circuit condition. Remember that to the point of the open circuit there will be source voltage; in this case, your source voltage is the TTL signal. Now you have identified that the circuit on the Channel 2 red is bad, you will need to cut this wire at each end and run a new wire between the APPS and the ECU. Once this is completed you will need to confirm the repair. The voltage from APPS sensor on Channel 2 red now has over 3 volts of change. The engine now has throttle response and is properly repaired.

BERNIE THOMPSON is an automotive diagnostician and trainer, and co-founder of Automotive Test Solutions in Albuquerque, N.M. He is an expert at diagnostics and repair strategy and designs award-winning diagnostic tools and software for the automotive industry.
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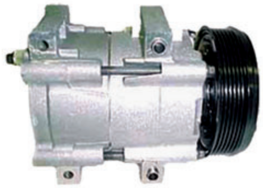

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ASSORTED ISSUES

THIS MONTH, WE EXPLORE A VARIETY OF CHALLENGES ASIAN MODELS HAVE BROUGHT TO OUR DOOR

BY G. JERRY TRUGLIA // Contributing Editor

Our first vehicle is a 2010 Honda Odyssey 3.5L, V6 that came in with a complaint of a dead battery. The vehicle owner already had replaced the battery himself and still was experiencing a dead battery if the vehicle was not started twice a day. The first order of business was to charge the battery to make sure we started our diagnosis with a full charge. We followed this by checking the charging system that was working as designed. The next step to perform was a parasitic draw test that is done by installing a current clamp on the negative battery cable. As you can imagine, there had to be a large draw if the battery was being drained in less than one day. The amp clamp was reading 0.389 milliamps current draw, and that is way over the specification of 0.030 milliamps.

Our objective was to locate the circuit drawing the current; that was easier said than done. Our usual first step would be to perform a voltage drop test on all available fuses, followed by pulling fuses while observing the current draw on a meter. Because this Honda has a few power distribution boxes, we started with the easiest first — the one located under the hood. Unfortunately, this testing did not yield the circuit that was killing the battery. The next place we tested was at the power distribution box under the driver's dash. There we hit pay dirt. When we pulled fuse 7, the current draw dropped to a normal level assuring us that we found the problem.

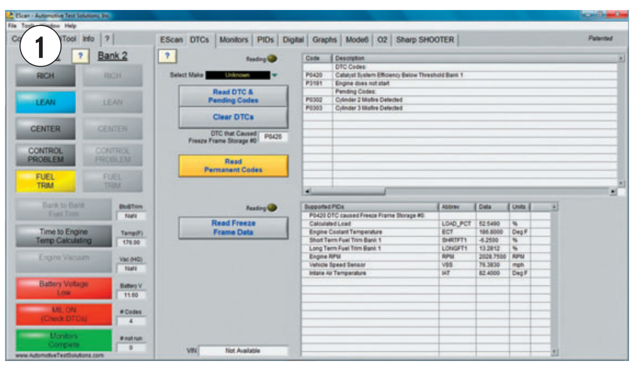
When we looked at the wiring diagram, we learned that fuse 7 powered everything from power mirrors to the immobilizer, numbering more than a dozen potential culprits that could be causing the battery drain. We've been using thermal imaging as a diagnostic tool for a while now and thought that would save us time going through the vehicle and unplugging each load. The thermal imager led us to the right rear side sliding door motor assembly and the right rear body panel was removed. At first we thought that the problem was just the right sliding door motor and latch assembly, but even with both disconnected we still had a current draw of 0.146 milliamps.

Because there was still a good size draw on the battery, we performed another scan with our thermal imager and located the last draw. Even with the door motor and latch unplugged, our thermal imager still showed a heat source (current flow) in the control module. The yellow/light color indicated current draw even after the load (right side sliding door motor and latch) were removed. The fix for this vehicle was to install a new right side sliding door motor, latch and control module.

Next, a Toyota Prius

The next vehicle is a 2003 Toyota Prius that was towed in with two hard Diagnostic Trouble Codes (DTCs) and two Pending DTCs. This no start Prius had two DTCs (Figure 1), a P0420 that indicates a Catalyst Efficiency Below Threshold (Bank 1) and P3191 that can indicate everything from an air induction problem to running out of fuel. In this case, the P3191 was caused by the vehicle running out of fuel that is common with both GEN 1 and 2 Prius vehicles since they both have bladder fuel tanks. The problem is covered by Technical Service Bulletin (TSB) EL008-03, and is caused by the bladder fuel tank that is installed on these vehicles.

The recommended thing to do is to reset the fuel gauge inclination sensor if the fuel level reading is inaccurate. Here's the procedure I followed to reset the indicator:



1. Park the vehicle on a level surface.
2. Turn the ignition switch to the "ON" position.
3. Place the odometer display into the "ODO" mode.
4. Turn Off the ignition switch.
5. Depress and hold the "ODO/TRIP" button while turning

PHOTOS: G. JERRY TRUGLIA

the ignition switch to the "ON" position. Hold ODO button for two seconds.

6. Release and press the ODO Button three more times within five seconds until the leveling information is displayed on the odometer.

7. Release the button.

8. Depress and hold the "ODO/TRIP" button until the odometer display confirms that reset has begun (odometer reads 1).

9. Once reset is complete, the odometer returns to normal.

10. Release the button.

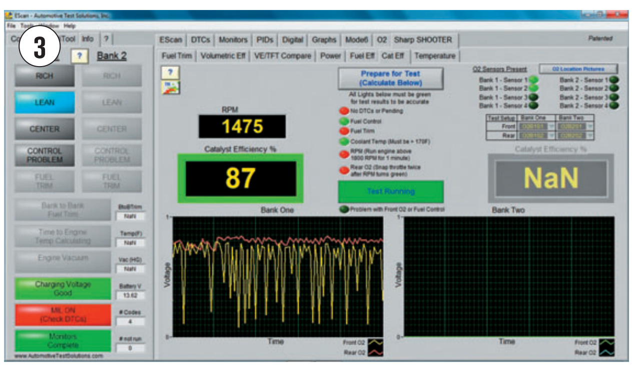
11. Turn off the ignition and the procedure is complete.

With that DTC out of the way, it was now time to turn our attention to the P0420 DTC. We performed a catalyst efficiency test that passed at idle (Figure 2) and at 1,500 rpm (Figure 3), but at 2,000 rpm (Figure 4) it failed the test. You can find the reason why it failed at 2,000 rpms but pass at idle and 1,500 rpms in the Freeze Frame data. Notice that the LTFT was at 13 percent and the engine rpms were at 2,028 when the DTC for P0420 was set.

Never clear or erase Freeze Frame data since it holds a great deal of information that can be helpful. Erasing Freeze Frame is like pouring bleach on a crime scene, thus removing all the evidence that would be helpful in solving where, when and why the DTC was set. I have found that in many cases if the converter test is not performed at idle along with two higher rpms, I would miss one or more of the tests that failed.

We backed up our converter test by using our thermal imager to see what is really going on in the catalytic converter. Unfortunately, the vehicle owner did not allow us to repair the vehicle. But if he did we would have first diagnosed and repaired both cylinder 2 and 3 misfires.

This would be followed by a quick converter load test, by first warming the engine up to operating temperature, shutting it down and removing one sources of ignition (ignition wire (grounded) or remove power to COP), followed by raising the idle to 2,500 rpms for two to three minutes while looking at Mode 6 data before and after this test. If after performing the procedure Mode 6 data drops (test drive needed) indicating an improvement, then I normally recommend a fuel system cleaner that in most cases brings the cat back to life.



Next, a Hyundai

The 2012 Hyundai Elantra 1.8L had a complaint of a high idle issue along with a P0507 (Idle Air Control System – RPM Higher Than Expected). This

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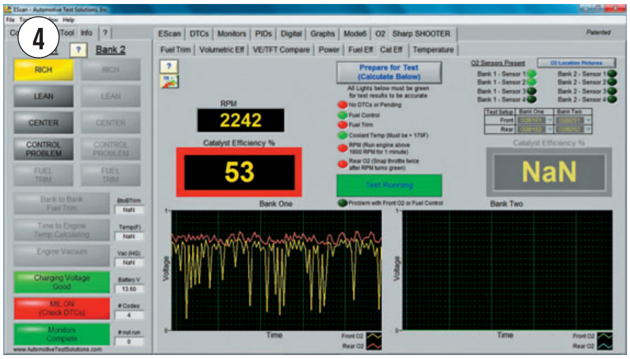
vehicle came in from our local used car dealer that had a problem diagnosing this odd condition. In fact, they had another vehicle exactly like it where they swapped the complete throttle assembly to see if it would lower the idle.

When we started to diagnosis the vehicle, we checked all the basics along with checking cam and crank sync signal. Because information on the normal waveform reading was so different from what was being displayed on the engine that was running OK except for the high idle, we had a hard time deciding if there was a problem or not.

We asked the used car dealer if they could drive over the other 2012 Hyundai Elantra so we could have a vehicle with good reading to compare it to. What we found was the cam and crank signal was the same as the problem vehicle, so there was no problem with the vehicle's waveform even though three different repair information systems suggested otherwise.



Because the idle was about 1,700 rpms at times, we checked for a vacuum leak and found that the intake manifold was porous. We discovered this by using our ATS Bulls-Eye leak detection tool connected to the oil dipstick tube. With the system pressurized to 25 in./H_2O (inches of water – a pressure measurement common in low pressure systems like EVAP), the low pressure (approximately 1 psi) in the system helped us located the leak. Applying the special foam to the leak site confirmed that we'd found the problem.

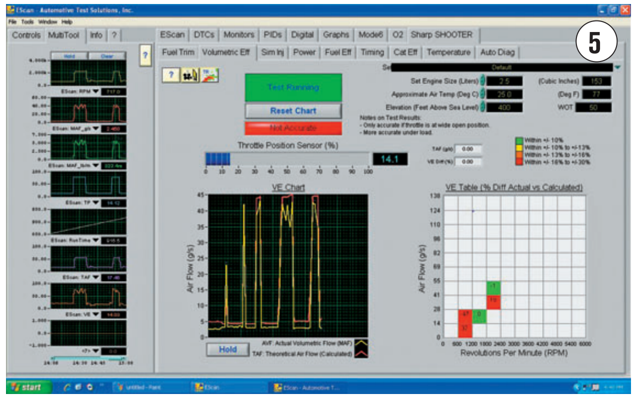
The next problem we noticed on the vehicle was that both the intake and exhaust VVT solenoids were clicking with the key on and engine off. Since we had never heard this before on these vehicles, it was good to have an exact vehicle match in the next bay.

We decided to remove the solenoids that were clicking from the problem vehicle and install them in the vehicle that was running good and not making a clicking sound. With the solenoids swapped, the bad car still had the same problem, while the good vehicle did not make any sound. You might be thinking that's an amateurish way to test the engine, but since it was so simple and available we swapped the VVT solenoids to confirm that they were not the problem.

With the results of our testing we told the used car dealer that the intake was porous and that we believed the PCM was also bad. Thinking carefully about what can cause the idle to be higher than normal besides the vacuum leak left me believing that the PCM was the problem. If you carefully think about what can cause the VVT solenoids to click when the engine is not running with just the ignition on, you will come up with the same conclusion: the PCM.

The used car dealer had already sold the vehicle prior to us diagnosing it, so they were in a jam to get it fixed fast. They decided to take the vehicle to the dealer, as the dealer was able to get the PCM faster than we would. This is another vehicle that I wish we could have had more time on so we could have fixed the vehicle. Remember, it's not always up to us.

A Forester presents a challenge



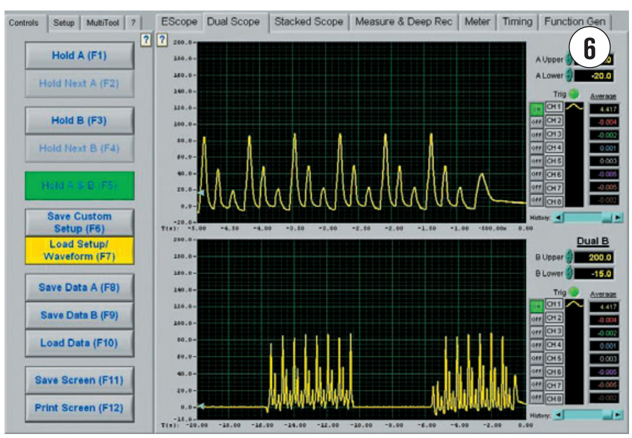
A 2005 Subaru Forester came in with a drivability problem that a Volumetric Efficiency test detected. Because this vehicle was not running right and had no DTCs, we started with testing the battery, starter, alternator, relative compression, 5 gas analysis and scanning of the computer system. When we test for a drivability problem, we connect the EScan scan tool because it will allow us to check many different areas quickly.

As we were testing the Mass Air Flow (MAF) sensor, we found the problem. Take a look at the MAF test (Figure 5) and you will notice that not only did it reach the proper height but at the top of the yellow graph there is a frequency that looks like Bart Simpson's hair. The frequency on the yellow graph indicates a clog in the exhaust system such as a clogged catalytic converter. Using this test saves time since we do not have to remove any AF or O_2 sensors and perform a back pressure test.

If you don't own the EScan don't worry — the test can be performed on any scan tool that has Global OBDII and graphs. Take your scan tool, select and graph Calculated Load along with TPS and rpm only (that way you can get the fastest update rate watching the relationship of the throttle position, rpm and calculated load). The Calculated Load graph should reach 90 percent without having a Bart Simpson hairdo. If the calculated load does not reach the 90 percent area take a look at the air filter and MAF sensor. If it's a type that can be cleaned, try some CRC MAF cleaner and retest. The problem with this vehicle is that it had a clogged converter.

A rare rotary

Our final vehicle is a 2004 Mazda RX8, Wankel Rotary engine with 93,128 miles. The customer complaint was that the engine was running rough but the Check Engine light was not illuminated. The vehicle owner thought that the rough running engine was a result of it needing a tune-up, so he was surprised when we told him that it was caused by a compression problem. This RX8 engine had low compression that was common on the older RX7 and sometimes it would cause a no start condition due to an engine sealing problem.

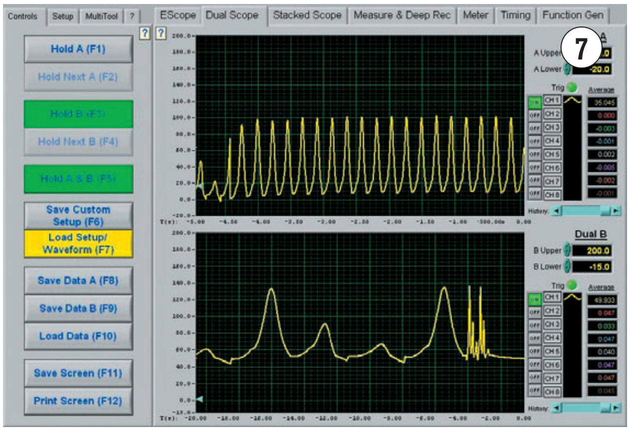


One of the important steps to follow on this engine is to make sure the engine is always warmed up to operating temperature

before turning the motor off. If the engine is shut down when it is still cold, the fuel will affect the operation of the apex seals, preventing good compression. If the seals are washed with excessive fuel, the engine will not start. The only way would be to remove the spark plugs from the Leading (lower) and Trailing (upper) Rotor Housing of the engine. This would need to be followed by disconnecting the Eccentric Shaft Position Sensor to prevent fuel from being injected in the leading and trailing rotors. The next step would be to squirt 5W20 or thicker motor oil in all of the Leading and Trailing rotors.

Our problem engine was able to start, so our next step would be to perform a compression test. That being said, we still tried squirting oil in the engine since the apex seals are such a problem, but it made no difference. If the oil squirt made no difference the only other issue that can cause the rough engine running is most likely carbon build up. We proceeded to perform a compression test and looked up the specifications; compression pressure recommended standard 120 psi at 250 rpm or a minimum of 98.6 psi with no more difference in the chambers of 21.8 psi and a difference between rotors is 14.5 psi.

Mazda recommends using its pressure transducer compression tester to perform the test. Using a standard compression test might not come up with an accurate reading. In fact,



when my technicians Kevin and Craig first performed the compression test, it looked good on our compression gauge. A different story would be told as we used the Automotive Test Solutions pressure transducers. Take a look at the compression reading of the Leading (Figure 6) and the Trailing (Figure 7) rotors that indicate there is indeed a problem. The Leading pressure transducer waveform look like it has high and lowers without reaching the minimum specification of 98.6 psi. Meanwhile, the Trailing rotor looks even and hits 100 psi.

With the results at hand we decided to perform a Run Rite fuel induction cleaning from the power booster hose after the engine was warmed up. The cleaning went well as a bunch of smoke exited the tail pipe, and the engine was sounding better. When the cleaning procedure was completed the motor ran real smooth.

We decided to run another compression test after a good test drive to make sure the engine was not shaking anymore. Take a look at the Leading pressure transducer waveform that no longer has high and lows in the waveform but rather a compression reading of about 92 psi. Even though the compression was not up to the minimum standard the vehicle ran well with no idle or power issues. Looking at the Trailing rotor waveform, we noticed the compression was up to about 100 psi with a difference better chambers of 8 psi that did not cause any problems.

We thought as the vehicle was being driven more carbon would be broken down with the Run Rite / Techron fuel additive that was added to the full tank of fuel. This vehicle ran so well and the owner was very happy that he offered free dinners at his restaurant. MA

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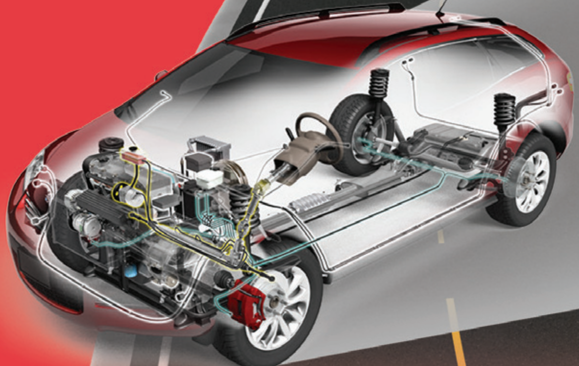

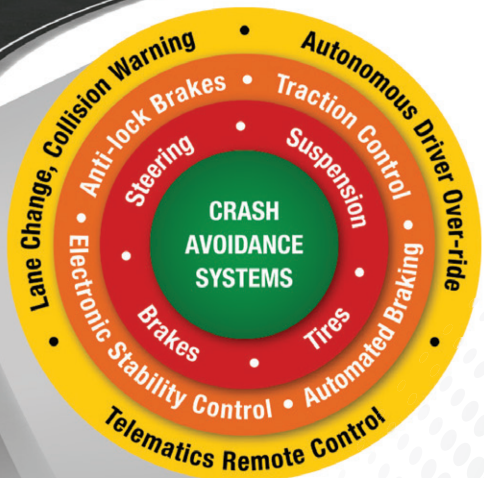

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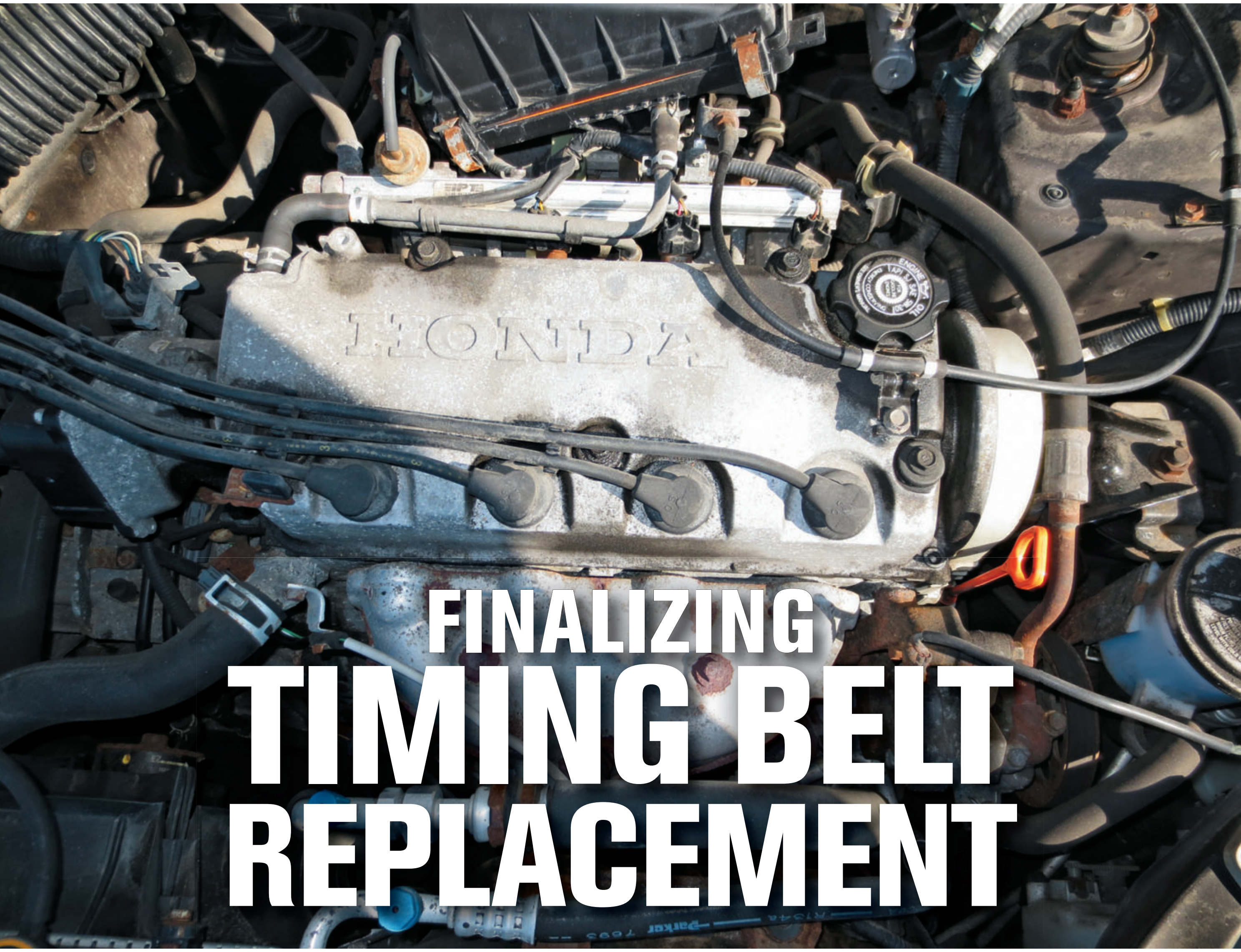

FINALIZING TIMING BELT REPLACEMENT

A CONTINUED LOOK AT HOW TO TAKE CARE OF THESE NOISY ISSUES

VANESSA ATTWELL // Contributing Editor

In July's issue of Motor Age, we started the process of diagnosing timing belt concerns and the steps leading up to replacing the belts. In this article, the second part of the two-part series, we dig further into timing belt replacement with step-by-step guideance any technician can use.

Replacing the belt

Once the components and covers are off and the timing belt itself can be accessed and replaced, you'll likely be instructed by service information to rotate the engine and line up the timing marks, then lock anything critical in place, then release the tension and then remove the belt. However, there are a few things to be aware of at this stage to prevent problems from occurring.

Generally any timing marks will align when the engine is at top-dead-center (TDC) — but not always, so checking the repair manual for direction is critical. From experience, some timing marks align with the cylinder head, some align with marks on the timing cover and some even align with marks on the other gears. Some replacement timing belts come with timing marks printed on them to align with marks on the gears, making it even easier to correctly line up the engine. If so, look for any information leaflets that came with the new parts to indicate how to do this critical step correctly.

But even though manufacturers usually supply timing

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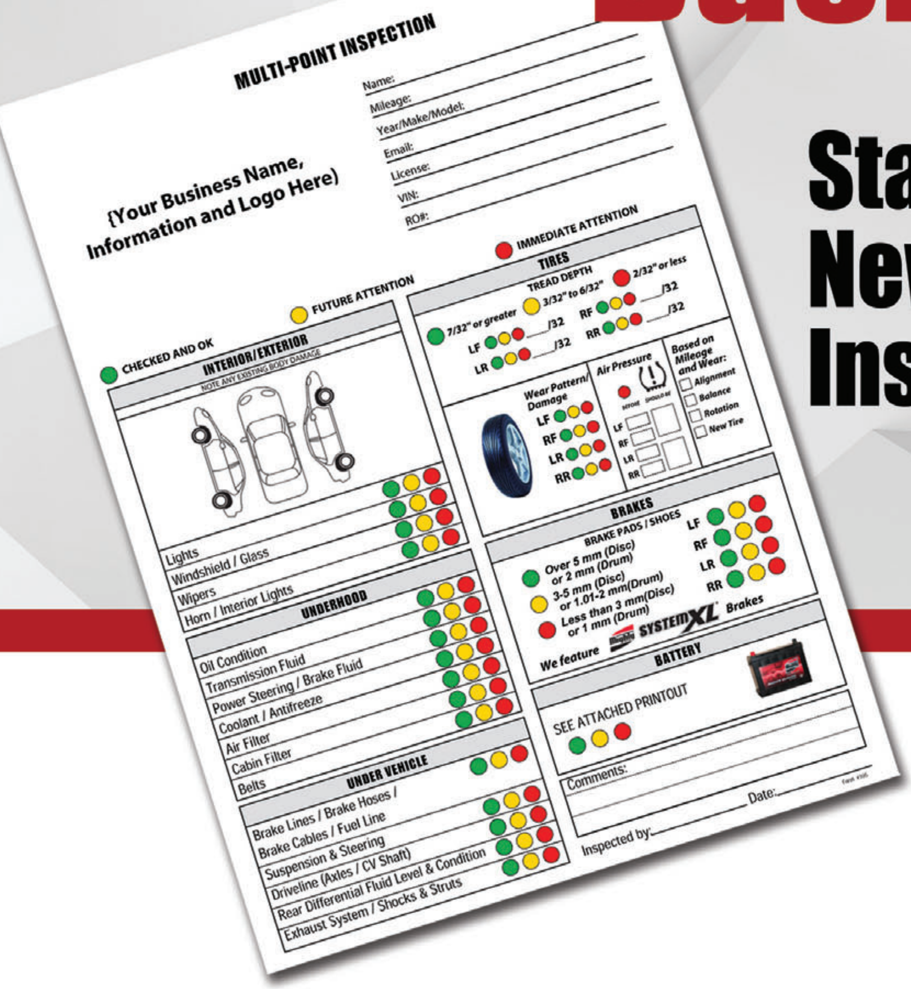
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Email:
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RO#:

CHECKED AND OK
FUTURE ATTENTION
IMMEDIATE ATTENTION

INTERIOR/EXTERIOR
NOTE ANY EXISTING BODY DAMAGE
Lights
Windshield / Glass
Wipers
Horn / Interior Lights

UNDERHOOD
Oil Condition
Transmission Fluid
Power Steering / Brake Fluid
Coolant / Antifreeze
Air Filter
Cabin Filter
Belts

UNDER VEHICLE
Brake Lines / Brake Hoses / Brake Cables / Fuel Line
Suspension & Steering
Driveline (Axles / CV Shaft)
Rear Differential Fluid Level & Condition
Exhaust System / Shocks & Struts

TIRES
TREAD DEPTH
7/32" or greater
3/32" to 6/32"
2/32" or less
LF ___/32
RF ___/32
LR ___/32
RR ___/32
Wear Pattern/Damage
LF
RF
LR
RR
Air Pressure
LF
RF
LR
RR
Based on Mileage and Wear:
Alignment
Balance
Rotation
New Tire

BRAKES
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marks and service information can tell you where they are located, timing or index marks may not always be visible or easy to use, especially on older engines, engines that had oil leak onto the marks or engines that were exposed to the elements.

In those cases (or even in all cases if you're paranoid like I am), White-Out or touch-up paint can be used to make your own index marks. Actually, marking components in two places can prevent problems and ease reassembly. This should be done before releasing tension or removing the belt — it's not fun to try to do this afterwards.

Also, it's also worth taking a moment to feel the tension on the belt before you loosen it off so that you're more likely to notice problems or irregularities when you set tension on the new belt. One very old tech I used to work with told me that if a timing belt had correct tension you shouldn't be able to twist the longest length of the belt 90 degrees, which is definitely not the way to set belt tension (always refer to the repair manual for specific belt tension and set it accordingly), but it is a guideline to know if the belt is far too loose. By checking the existing tension before removing the belt you'll at least have an idea of what to expect as you set the tension on the new belt.

When the old belt is off and the new one is installed, tension on the new belt needs to be set correctly. A very common pitfall of timing belt replacement is allowing camshaft gears to slip or

TRUE, SOME PEOPLE TAKE A SHORT CUT and pry the top section of the cover from under the valve cover, but taking the time to remove the valve cover and install a new seal is worth the extra effort and fixes the leak.

QUICK TIPS

Worried? Don't be

Before starting the engine, make sure that:

- Pulley bolts are tight (including crank).
- Engine turns over by hand and timing and tension are still OK.
- All camshaft and crankshaft pulleys are correctly aligned
- Tension and tensioner are set and secured.
- Timing cover is installed squarely; seals are securely in place.
- Engine mounts were retorqued if removed.
- Coolant level is OK
- Splash shields are free of oil and coolant.

Before releasing to the customer ensure:

- Fan comes on, coolant level OK in reservoir.
- No pinging or hesitation on test drive.
- No DTCs stored.
- Replacement date and mileage recorded.
- Radio stations are set (if battery is disconnected).

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jump out of place when the tension is set, so it's important that nothing be allowed to jump out of place at this stage. Check with the service information, but generally rotating the engine by hand a few times after setting tension and locking the tensioner (if needed) then rechecking that tension is still correct and the timing mark are still lined up correctly can save a world of problems. If they're correct, that's good. If not, find out why before proceeding any further.

Catching problems at this stage is preferable to catching them when everything has been reassembled.

Actually, there are a few things to be aware of when setting the tension to prevent problems. For systems with automatic adjusters, unless the manufacturer recommends otherwise, making sure the adjuster is in good condition, works well without binding and rotates freely should be all that's required.

But for those with manual adjusters, there's a bit more to it. Setting the tension too tight may cause the belt to whine when the engine is running and may also cause idler or tensioner bearings to wear out prematurely — and possibly the belt to fail causing engine damage. Setting the tension too loose will cause the belt to hit the timing belt covers and may even cause the engine timing to be slightly off, resulting in engine performance or drivability problems, which may worsen over time. So tension needs to be set correctly to prevent problems, according to the manufacturer's recommendations.

One last tip: No matter the vehicle configuration or drivetrain orientation, replacing the timing belt is usually a labor intensive process, so while everything is apart, that's the time to replace any leaking seals, worn timing belt idler or tensioner bearings and anything else that can affect the belt not lasting to the end of the next replacement interval.

THE COOLANT RESERVOIR in particular needs to be topped up after replacing the timing belt and water pump because when the engine cools down any air trapped in the passages will displace and coolant level will drop.

Don't let something small ruin all of your good work.

Reassembly and finishing touches

When everything is back together and you've started the vehicle — and it seems to run well — be sure to test drive the vehicle and bring it up to operating temperature (in other words, until the fan comes on). You may want to do this in an area without much traffic since you'll need to get back to the shop quickly if there is indeed a problem.

There are two reasons for this test drive. First, just as on the preliminary test drive, you want to find out if the vehicle pings or hesitates under load and then check for any stored DTCs to verify that the job was done correctly or to find any problems before the vehicle is released to the customer.

And second, as the vehicle cools down after the test drive, the engine will draw in coolant from the coolant reservoir and displace any air pockets that may have developed when the water pump was replaced. You'll want to be sure the level in the reservoir is within specifications since the coolant reservoir is definitely an "appearance item" that the customer can see.

For that reason it's wise to top the reservoir up with the correct coolant and ensure that it's at the correct strength to reinforce that a professional worked on the vehicle and left it in great shape. A small mistake here can leave a bad impression.

Another tip along those lines is to be sure to clean any fluids like coolant or oil off of the engine splash shields so the car doesn't stain the customer's driveway or parking spot — that's just bad advertising for your business and it can easily be avoided.

Finally, as a professional courtesy and nice touch, record when the belt was replaced in a place that is obvious so that the countdown to the next replacement can be accurately planned. No one likes to guess if a belt needs to be replaced, and after taking everything apart, to find the belt is still in great condition.

Conclusion

Engines and vehicles vary among manufacturers, but there are still problems and pitfalls common to all routine timing belt replacements, such as not noticing pre-existing problems, mixing up critical bolts, setting timing or tension incorrectly and even just leaving a highly-visible mess by not topping up fluids or cleaning oil and coolant off the splash shields.

By knowing a few tips and being careful to avoid common pitfalls, you can keep the job trouble-free and profitable and look like a pro doing it — and keep your customers happily returning to you for repairs. MA

VANESSA ATTWELL is a Master Technician for two major manufacturers and has also worked on the bench of an independent shop. She has developed and delivered training for both vehicle manufacturers and independents, and helped develop government training and regulations standards.

ELECTRICAL DIAGNOSTICS: GOING BEYOND THE VOLT METER

WHILE THE BASICS OF ELECTRICAL THEORY HAVEN'T CHANGED OVER THE YEARS, THAT DOESN'T MEAN YOUR ELECTRICAL DIAGNOSTIC PROCESS SHOULDN'T BE CHANGING

JEFF MINTER // Contributing Editor

Thermal imaging cameras have been coming down in price significantly over the last several years. With the entry level price point of true thermal imaging devices starting around $350 and full featured units starting around $700, thermal imaging cameras are now a much more viable option to consider adding to your tool box. If you've ever wished you could just see where the electrical problem was, this may be your wish come true. This article will focus on the following:

• How thermal imaging can visually show you the location of electrical problems,

• Differences between IR thermometers, visual IR thermometers, and thermal imaging cameras,

• Features to look for in a thermal imaging camera,

• Principles of thermal imaging, including thermal emissivity, thermal reflectivity and thermal transparency.

While I'll do my best to relay as much information as possible in this article, if you are looking for more depth on this subject I'd highly recommend checking out the Thermal Imaging Training Center's website at MotorAge.com/infraredtraining. They have some great free online training available as well as an in-depth comparison of temperature measurement tools.

To understand how thermal imaging can visually show you the location of an electrical problem, we have to discuss basic electrical principles. Whenever I'm talking about the foundation of electrical knowledge I'm always reminded of a great OEM training instructor I had years ago. He started his electrical training classes by telling technicians that electricity is simple — it can only do two things.

Those two things were to make things hot and to make magnetic fields. While that may be somewhat overly simplified, it does cover a lot of the electrical applications in the automobile. The one that lets thermal imaging help with diagnostics is the fact that electricity makes heat. Any time a circuit has electrical current flowing through it, heat is generated. How much heat the circuit generates is dependent on the amount of current flowing in the circuit.

So what types of electrical problems could this technology help you find? Because we are relying on heat to help locate the problem, the circuit has to be able to operate. That means this is not going to help you find the location of a blown fuse, a completely open circuit or any failure that would completely prevent current from flowing in the circuit. It can, however, help you find problems like circuits with excessive resistance, open leg(s) of a parallel circuit or a parasitic draw to name just a few.

Probably the most likely application for using thermal imaging to find automotive electrical problems is a circuit with excessive resistance. If you are involved with electrical diagnostics, you're likely already familiar with the term voltage drop. In a properly operating circuit such as a headlight, power window motor, etc., nearly all of the available voltage should drop (source voltage in, near 0V out) across the electrical load (bulb, motor, etc.).

SIMULATED HIGH RESISTANCE light circuit with 2.25V Drop in 6' harness

If you have a circuit with excessive resistance it will prevent the electrical load from operating properly because it doesn't have enough voltage available for the load to use. This is because the excessive resistance is now using a portion of the available voltage.

Using a volt meter, you can check the positive and negative (ground) portion of the circuit to determine which one is dropping voltage due to the excessive resistance. However, cnce you determine which half of the circuit is

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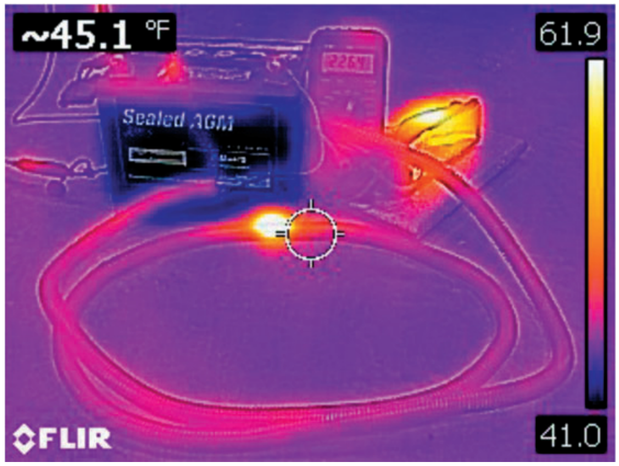
causing the problem, you still have to locate the actual location of the fault.

You could start taking apart the wire harness hoping to find a visually damaged wire or loose connection. You could bypass that entire part of the circuit or, if you have a thermal imaging camera, you simply could look for the part of the circuit that is generating excessive heat. Because resistance in a circuit generates heat, the portion of the circuit with excessive resistance will be hotter than the rest of the circuit. This concept isn't limited to just wire harnesses either — think of applications such as hybrid vehicle batteries, electrical junction blocks, etc.

In a parallel circuit (such as a rear window defroster) with one or more open legs, the principles will be slightly different. In this case, you'd be looking for the portion of the circuit that is cooler than the rest. Because the open leg(s) can't flow any current, they won't be generating any heat. Again, this is just one example circuit. This could also apply to things like seat heaters, etc. depending on how they are wired.

Finally, let's look at parasitic draws. Remember, all electrical current flow generates heat. That means when a vehicle is shut down, the electrical system as a whole should start to get cooler because current flow has been stopped.

Any circuit still flowing electricity when the entire vehicle should be shut down will either not cool down at all, or will cool down less than those circuits that are fully shut down. Of course, since parasitic draws tend be small even when they are causing problems, the amount of heat being generated will be minimal. That means this must be handled slightly differently. Leaving the vehicle overnight and allowing the temperature to stabilize in the rest of the vehicle can help make that low current draw stand out as a warmer spot in a thermal image.



HIGH RESISTANCE SECTION of harness shown with thermal image (C2 Camera with MSX)

Right about now you may be thinking, "Why can't I just use my infrared (IR) thermometer?" or "What's the difference between the visual IR thermometer I saw and a thermal imaging camera?" The bottom line is that while both IR thermometers and visual IR thermometers have their purpose, they are much more limited than a thermal imaging camera. For the purpose of this article, I'll just focus on the two major limitations that both of these IR thermometer options have.

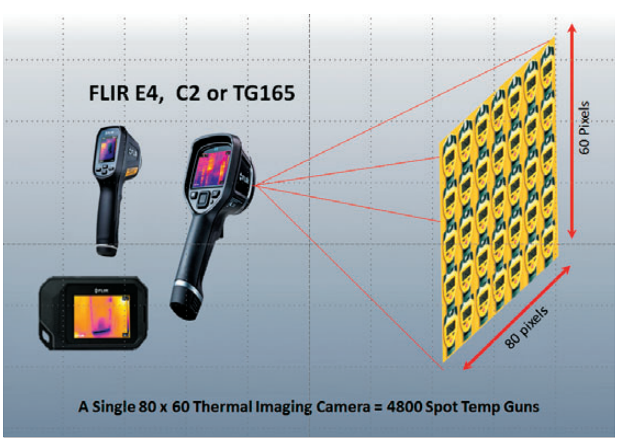
The first limitation is related to something known as the Spot Size Ratio (SSR). SSR refers to how large of an area the temperature measurement is looking at based on how far away from the object the measurement tool is. Typically the SSR on the lowest cost IR thermometers is around 6:1.

That means if the thermometer is 6 inches away from the object being measured, the area being measured by the thermal sensor is 1 inch in diameter. Many of the IR thermometers have a laser guide, or even possibly two. It's important to understand that while the laser helps you see where you're aiming, the measurement is still limited by the SSR.

The second limitation of the IR thermometers is that they typically only have one temperature sensor. That means the measurement displayed will be an average of the temperature within that 1-inch diameter area being measured. When trying to measure the temperature of a wire, a small fuse, etc. that simply won't provide an accurate enough measurement.

If you step up to a more advanced visual IR thermometer, things do get a little better; however, exactly how much better can be a little hard to determine given the published specifications. One of the more well-known manufacturers of visual IR thermometers currently has two models available. One of those units has a 6:1 SSR, and the other one has a slightly improved 9:1 SSR.

What makes it somewhat difficult to compare this unit to traditional IR thermometers and thermal imaging cameras is the lack of information provided about the temperature measure-



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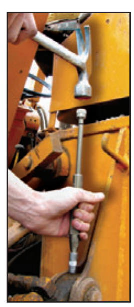

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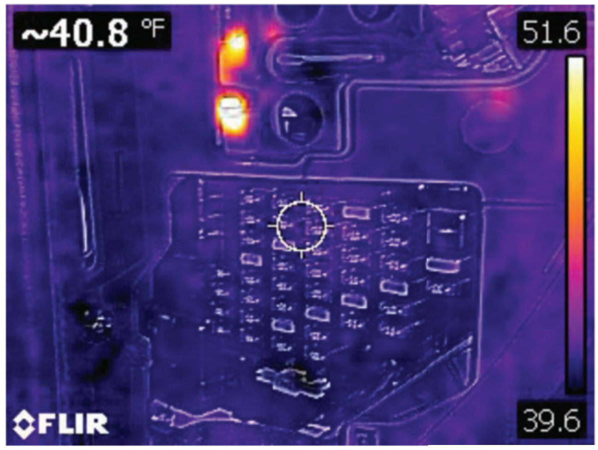
Also Available: KCHG-241001 **5 AMP CHARGER** ment sensor being used. The published specifications provide pixel ratings for the visual camera, but not for the thermal measurement array being used.

Upon further research, I was able to find some information published by the Thermal Imaging Training Center that discussed thermal sensors typically used in visual IR thermometers. According to their data, visual IR thermometers typically use a "two dimensional 15x15 array" which would correlate to 225 pixels. Their test results showed that this configuration required the tool to be within 1.5 inches of the object being measured to get an accurate reading on a ¼ inch conductor. Obviously that isn't very practical for most automotive electrical applications.

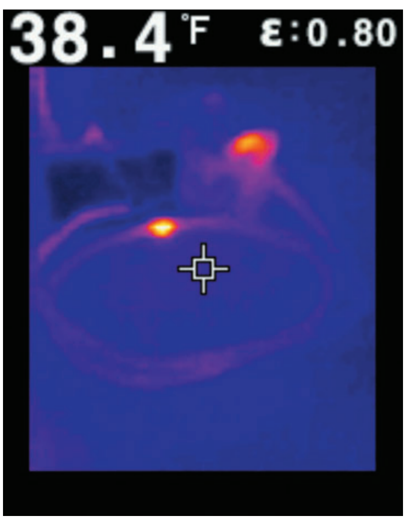
Let's take a look at how this all relates to thermal imaging cameras and also discuss the big question about how much you'd have to spend to get one. I've been using FLIR brand thermal imaging products for about five years now, so I'm most familiar with their product line. Currently their lowest cost unit with a true thermal imaging sensor is the TG165. Current pricing for that unit from online retailers is right around $350. The TG165 has a sensor array with an 80 x 60 resolution, which correlates to 4800 pixels.

To put it in perspective, that means every time you take a measurement with the TG165, or any other thermal imaging camera with similar specifications, it is the equivalent of using 4,800 IR thermometers or about 21 visual IR thermometers (4,800 pixels/225 pixels). That increased resolution definitely makes it much easier to see temperature variations of small components from a reasonable distance. However, the TG165 doesn't use the thermal imaging sensor to take the actual temperature reading.

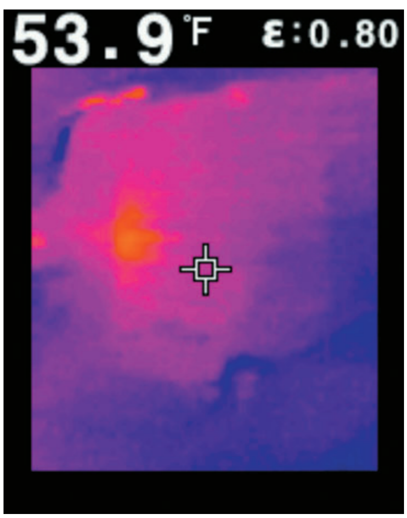
While this is a true thermal imaging camera, the thermal sensor isn't calibrated. Because of that the TG165 relies on an IR thermometer with a 24:1 spot size ratio for the numeric temperature that is displayed. The lowest cost FLIR model with a calibrated sensor that I'm aware of currently is the C2, which is selling online for around $700 followed by the E4, which is around $1,000.



FUSE BLOCK WITH no current draw (C2 Camera with MSX)



HIGH RESISTANCE SECTION of harness shown with thermal image (TG165 Camera -no MSX)

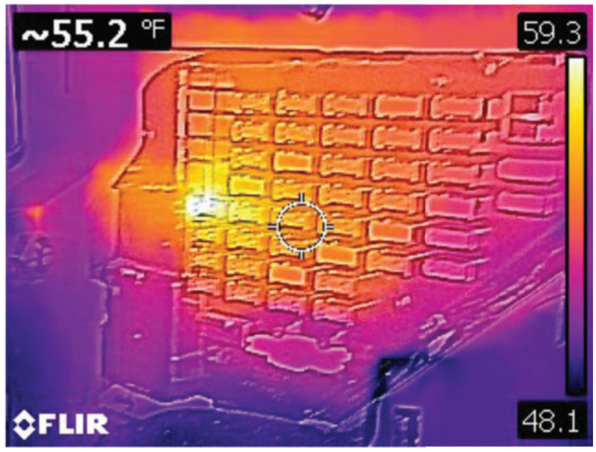


WARMER FUSE ON THE LEFT indicates current draw (TG165 Camera – no MSX)

If you start to research thermal imaging cameras online you may be overwhelmed by the number of models available, the wide price range, various features available, etc. To help narrow your search here are a few things that I'd consider focusing on:

- **Resolution of the thermal imaging sensor (not the visual camera).** Bigger is better, but may not be necessary. For most automotive applications anything at or above the 80 x 60 of the TG165 will likely suffice.
- **Temperature measurement range.** Lower cost cameras typically can't measure as high of temperatures. For automotive electrical diagnostics this typically isn't an issue but if you want to measure catalyst temperatures you'll likely need a higher cost camera.
- **Visual display capabilities.** Some thermal cameras now have the ability to combine a digital photo and the thermal image. This makes it much easier to see edge definition of components and even read labels. FLIR calls their version of this "MSX," which is included in the C2 and E4 models mentioned above but isn't on the TG165.
- **Image portability and file format.** If you want to be able to include these images as part of a repair order, be sure to get a camera that allows you

to export the image in a useable format. You may also want to consider the ability to further analyze the image using specialized (and in many cases free) software from the camera manufacturer. This software also typically allows you to add notes to the image and generate reports. As they say, a picture is worth a thousand words, so when selling the electrical diagnosis and repair to the customer this could be your best sales tool.

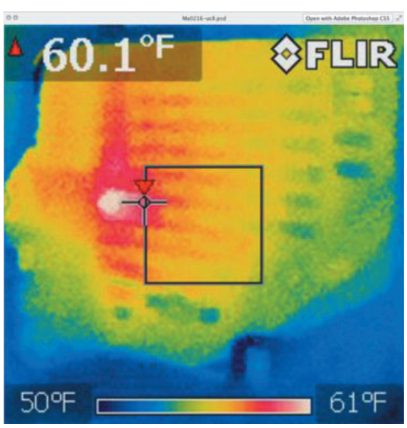


WARMER FUSE ON THE LEFT indicates current draw (C2 Camera with MSX)

Training remains

If you decide to make the leap and get a thermal imaging camera, make sure you also take the time to attend some training on the topic. A basic understanding of thermal imaging principles is critical to avoid potentially misinterpreting the data.

At a minimum, I'd recommend looking for information on thermal emissivity (ability of an object to give off heat energy), thermal reflectivity (ability of an object to reflect heat from other sources) and thermal transparency (ability of thermal energy to pass through an object without significant loss). Understanding those aspects of thermal energy will help ensure you get accurate results and will help you explain any anomalies that may show up during your testing.



WARMER FUSE ON THE LEFT indicates current draw (i7 Camera – no MSX)

Remember that while this article focused on the use of thermal imaging as an electrical diagnostic tool, there are numerous other potential applications in our industry. My experience has been that once technicians get a thermal imaging camera in their hands they come up with all sorts of potential uses for it.

Also remember to keep your eye out for new tools coming up in the future. With the rapid changes in technology we're likely to continue to see great new options. Just this past fall FLIR released a new electrical clamp meter with an integrated thermal imaging sensor which was geared toward industrial applications (model CM174). Who knows what might come out that could be geared more toward our industry in the coming years as more technicians embrace the technology. MA

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IN RESPONSE TO YOUR EMAIL

WHERE CAN I FIND GOOD TECHS FOR MY SHOP?

BY PETE MEIER // Director of Training

At least a couple of times a month, I get an email from a shop owner asking me where he can find good technicians for his shop. The last one I received was just a few days ago and is the catalyst for this month's column.

Is there a shortage?

There has been a perceived "shortage" ever since I can remember. But what is the reality? Not too long ago, I did some research on this and found out a few interesting things.

Every industry faces attrition as their workers get older and move out of the business and into retirement. As long as capable replacements are feeding in as fast, or faster, than the rate of loss, everything is OK. In our industry, the average age of the technician "fleet" is on the rise, skewed by the fact that fewer young technicians are entering the field.

Older techs are not waiting for retirement, either, before hanging up their impact guns. We all know that this business places a physical toll on our bodies, and older techs simply cannot bend or contort as easily as they could when they were still in their 20s. So when opportunities come along that will allow them to move out of the shop, they are taking them. We lose not only the body in the bay, but also the hard-won experience.

Now, as I mentioned, there are fewer young technicians entering the field. Would you be surprised to learn, though, that our vocational schools are producing more graduates than our attrition rate needs to balance out? If that sounds like a contradiction, read on.

Shooting ourselves in the foot

So, the short answer to the question is ,"Yes, there is a technician shortage." I should qualify that by saying there is no shortage of bodies we can put in our service bays, but there is a shortage of individuals that actually know how to properly repair a modern automobile. There is an even greater shortage of technicians coming into the business that have the skill sets necessary to become true diagnostic techs, capable of understanding the latest technology and applying those skills to accurately diagnose these systems for a "right the first time" repair.

PHOTO: ELYSSA RESPAUT FOR TST

TRAINING IS NOT ALWAYS EASY to afford or to get to. But every technician knows they need it.

Let's start this portion of our discussion with our older techs. They aren't leaving just to gain some physical relief. They are leaving for financial opportunities better than their current position can offer. Many have no problem leaving our industry entirely to seek out opportunity in another tech-related field. After all, the skills they have developed as a competent tech makes them very enticing to corporate headhunters with positions of their own to fill.

The same is true of graduates that enter our business. They spent more than two years learning their craft and invested a lot of money to do so. They leave on graduation, with the help of a smiling job placement professional, for their first job interview. The offer of a starting role at minimum wage is not exactly enticing to them, nor is the idea that most of their time will be spent taking out trash, cleaning bathrooms and acting as the shop "go-fer." Do you blame them? Especially when those same headhunters looking to steal your existing "good guys" are offering them $50,000 a year and a five-day work week in an air-conditioned facility with tools provided.

For many of us in our late 40s and early 50s, we can relate to the old-school method of busting the new guy's chops and having him do all the dirty work. But back then, our lead techs taught the youngsters on-the-job, passing along their experience and knowledge. We didn't have college degrees in automotive repair when we started, and we certainly didn't spend thousands of our own dollars on that education.

The other end of the spectrum is the shop owner that expects that young graduate to perform as an "A" technician. Even if the new tech graduated at the top of his class from the best school in the country, he lacks one important element: experience. He (or she) may have all the book knowledge, but doesn't know a belt squeal from a bearing chirp, may never have felt a misfire in the seat of his pants or know the difference between a vibration caused by a tire issue or a driveline one. In addition to the early learning curve, he's not going to be as fast as an experienced tech either.

Yes, we have a shortage of capable technicians, but it's not because there aren't enough trying to get in. In my personal opinion, we are chasing the good ones away.

How do we fix it?

Let's start with our existing technicians. And let me also be upfront with you and explain that I admit to having a singular view here, never having been a shop owner. Shop owners, though, please listen to my own thoughts and consider what I'm saying.

MOST TECHNICIANS ARE hardworking men and women who want to be the best they can be.

I've worked for dealers and independents, big chains and "mom and pops." I never left a shop because I didn't like work environment, the people I worked with or the owner. (Well, OK, once. The new manager was a thief and I was not going to be associated in any way, shape or form with someone that used deceptive practices on his customers just to make a buck.) I left for one reason and one reason only: I could no longer support my family.

Now, I'm not a rich guy and knew going in that I'd never be rich as a tech. My dad taught me that a man who could work with his hands would always have a job, and he was right. I've always been able to provide for my family and I've always been happy with that.

But as a commissioned employee working in your shop, I'm handicapped. Essentially, I'm a subcontractor paid by the job but I have no control over your marketing or the competency of your sales staff. I can find (and have) thousands of dollars of needed repairs on the cars you give me, but if you can't sell it, I can't do it. And I lose in the process (as do you). When I find myself sitting on my backside with no work to do, and it isn't even lunch yet, I start reading classifieds to pass the time.

So, shop owners, you want to keep your techs longer? Then remember they are dependent on you to provide them with the ability to make a living. Your marketing has to be effective, your sales people need to be held accountable for closing legitimate business and your techs need the tools and training to perform those repairs properly the first time. Treat your employees as people and not as inventory. And if you have staff that is constantly causing you headaches over comebacks and botched repairs, get rid of them; they are costing you more than the empty bay is going to.

THESE YOUNG MEN AND WOMEN are among the best public vocational education has to offer. Get involved in your local program. Who knows? The next SkillsUSA champion could be your next technician.

As for attracting the new technicians, the first question I'd pose is this: When was the last time you attended your local vocational school's industry advisory council meeting? This is your opportunity to influence what is being taught, to see the talent pool in its infancy and to provide on-the-job experience to what might just well be future employees.

When you do get them, treat them as knowledgeable apprentices. Mentor them, assign them to an understanding lead technician for training and supervision. Some of you have already learned how to incorporate this in your own businesses. Match up a good diagnostic tech, for example, with two or three techs who are proficient at performing repairs and let the diagnostic guy be your in-house mobile guy — he troubleshoots and instructs the others on what to replace, then verifies the repair before signing off on it.

Move your management attitudes to the 21st century, and your business will quickly follow. MA

PETE MEIER is an ASE certified Master Technician and sponsoring member of iATN. He has over 35 years practical experience as a technician and educator, covering a wide variety of makes and models. His primary goal is to bring working techs the information they need.
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LOGICAL DIAGNOSTIC PROCESSES

MAKE THE PROBLEM COME TO YOU BY USING A COMMON SENSE TROUBLESHOOTING PLAN

BY ALBIN MOORE //
Contributing Editor

Day in and day out, vehicles come to service bays with problems. These problems could be anything from an illuminated Check Engine light, an electrical problem or even a vibration or noise in the vehicle. How do you get these problems to come to you, to tell you where that elusive problem is and what the real cause is?

In all my years of working on machinery, I don't think I have found any one single test that was best for all electrical problems or one single way that is best to find an NVH (noise, vibration or harshness) problem or even to find a mechanical problem. There are times when you just need to play it by ear, but one thing is for sure: every problem I have ever found had a logical explanation. Following the logic of the system is by far the quickest and most accurate path to the solution of the problem.

Stop and think for a bit — if we are working on an electrical problem, the electrical circuit will have some sort of logic involved in its design. If the problem is a hydraulic problem, the hydraulic system will be designed with some sort of logic, and the same can be said about a mechanical problem. Many times the quickest way to find the solution to the problem will be to gain an understanding of the logic of the system you are working with.

In this article, I will use two different types of problems to demonstrate what I mean. The first problem is a charging system concern on a 2005 F250 Ford pickup. The vehicle is powered with a 6.0 diesel engine, is using an automatic transmission and generates its electrical power with a single generator charging system. There are 225,000 miles on the odometer and the vehicle is no cream puff. The other vehicle is a 2002 Mercedes Benz ML 320. The ML320 is a nice, clean vehicle with 137,000 on the odometer. The Mercedes has a noise complaint that sounds like a wheel bearing noise.

First, the Ford

The Ford vehicle has had a problem with the battery going dead, so a new generator was installed as a first attempt to fix the truck. This didn't take care of the issue, so the owner installed two new batteries. This second attempt also failed to fix the concern, and the vehicle was brought to my shop.

The vehicle owner reported the battery light would come on at times and sometimes the light would be dim, other times the light would be bright. Many times when I hear stories like this, I will make note, but most times, I want to deal with the logic of the system, how it works and be able to use

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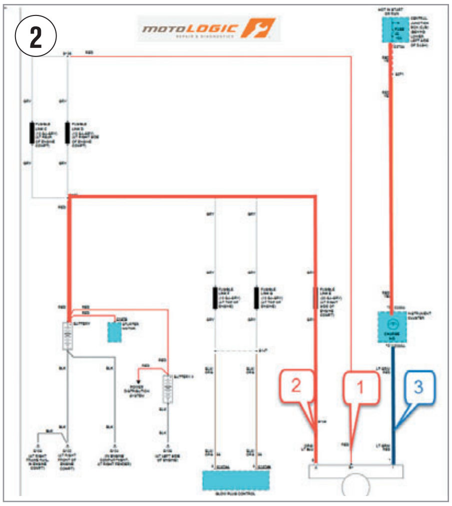
sound diagnostic principles to come to the resolution of the problem.

Before any work is started on a project like this, the first step should always be to learn how the system works. Without this critical piece of information, time easily can be wasted and good parts easily can be replaced with no fix for the problem.

There are two ways to get this important information. One way is to use your service information and read the description of operation on the system — in this case, the charging system. The other way is to print out a wiring diagram and do a little studying. Many times a picture (the wiring diagram) will be worth a thousand words and will be of more value than doing the reading.

Figure 1 shows the wiring of the charging system. From the wiring diagram it is easy to see this generator is not computer controlled. This only leaves three different places to test: the B+ terminal, terminal I and terminal F. Step one was to test the battery voltage with the engine running. The voltmeter read 12.2V, indicating that the generator is not charging the battery. If another new generator were installed, the charging problem would most likely be fixed, but let's spend a few minutes figuring out why this generator is not charging. I want to know if the problem is with the genera-



tor or in the vehicle wiring.

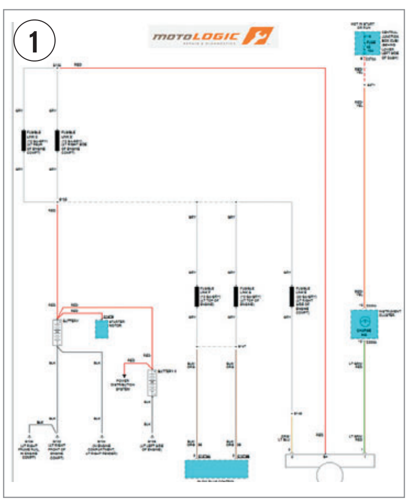
To make the wiring diagram a little easier to understand, in Figure 2 I added some colors to the different wires in the system. This makes it easy to see the different voltages that should be present. If the system is tested with KOEO (key on engine off) the two wires colored red should be system voltage (B+) and the wire colored blue should have a voltage close to 0 volt. By identifying the voltage with colors, it can make the testing process quicker and more accurate. This circuit is quite simple, but if you are working on a more complicated circuit, the use of a few different colors becomes of great value in time savings.

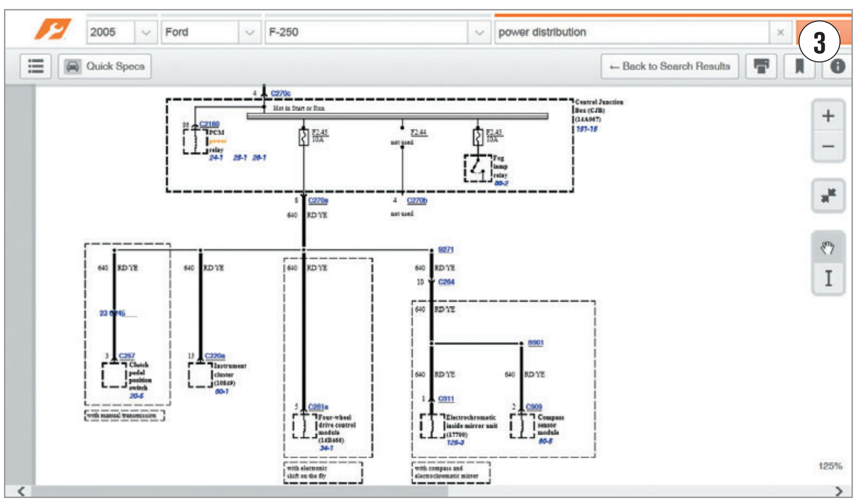
Back to the charging system problem. When I went to start the vehicle to bring it into the shop and was waiting for the glow plugs to warm, I did not notice the battery light on. That leads me to wonder if the bulb burned out in the cluster, if the fuse that powers the light burned or if there is a problem with the generator. How can this problem be tested quickly without pulling the cluster? Do we want to hook up a scan tool and command a cluster bulb check or can we use the wiring diagram to lead us to the problem?

Don't make it harder than it has to be

Because the battery light does not come on when the key is turned on, I wonder if the fuse that powers the light is burned. The wiring diagram shows the instrument cluster light is powered by fuse 45, a 10-amp fuse in the power distribution box located under the left end of the dashboard. You can get a test light, pull the left hush panel from the dash, find the fuse and test it, but there is a quicker and more accurate way to accomplish this task.

Take a look in your service information power distribution wiring diagram for fuse 45 and find out what other things are powered by that fuse. In Figure 3, I used an OE wiring diagram of this circuit. Several things are shown





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powered by this fuse and of these, the 4-wheel drive control module is the easiest to find and operate. With the key on, just turn the 4-wheel drive knob one click to the right and see if the 4x4 light comes on. If it does, you are finished with your fuse testing.

Another way to find the fuse integrity and to test the whole circuit, fuse, bulb and the wiring is to turn the key on and then test for voltage at the light green/red wire (terminal F) at the generator. This wire is very easy to access since it is right on top of the generator. By testing this way, we will know if the fuse will flow current, the bulb in the instrument cluster is not burned out and the wiring is capable of flowing current all the way to the generator. All the system needs to light that bulb is a ground. There is no one correct and best way to do this sort of testing. Use a logical testing method and you will be good.

By applying some logic to the wiring diagram, we know the charge light needs a power and ground to work. In this case, the voltage regulator housed in the generator is supposed to supply the ground to the light. My voltmeter shows system voltage at the light green/red wire. Figure 4 is showing I have used insulation piercing probes to attach my meter leads to the wires. I do this instead of back-probing the plug because I do not want to disturb the circuit by pushing on the plug. I want my test equipment to find the problem for me, instead of me doing a temporary fix when backprobe pins are pushed into the back of the plug.

Any time an electrical problem mysteriously goes away, or seemingly fixes itself, I always wonder what I have done, and how long it will be before the problem rears its ugly head again. I want the electrical problem to come to me, instead of me chasing the problem around.

With a voltmeter hooked to the light green/red wire and the key turned on, my voltmeter showed system voltage and the charge light was not lit. At this point, what I know about this circuit is more important that what I don't know. Because I have B+ voltage at the I terminal wire (light green/red), I know the circuit is intact and working as designed. The only thing missing is the ground through the voltage regulator. I'm wondering if the wire is broken at the generator plug or if the pin fit on the plug has been compromised.

With one stiff push on the generator plug, I heard the nice sharp "click" of the plug snapping into its place. With the KOEO, the volt meter reads 0 volt and the battery light is now illuminated When the engine was started, the battery light went out and the battery voltage showed above 14 volts. The problem is fixed.

On to the Mercedes

The next vehicle problem is a Mercedes-Benz ML 320, which has a complaint of a noise in the rear of the vehicle. The vehicle owner thinks the noise is caused by the rear wheel bearings.

When test-driving the vehicle, the vehicle has that distinct humming of a noisy wheel bearing — even going around corners causes the noise to change. With the vehicle on the hoist and all wheels turning, I used a stethoscope to listen to the wheel bearings, and the right rear bearing is the one with the most noise. Am I sure this is a wheel bearing, or could it be something else masquerading as a rough noisy wheel bearing? There are tools that make finding noises and vibrations like this very accurate, but there are times when a sharp eye and sharp ear will accomplish the same job.

Because every vehicle going through my shop gets a vehicle inspection, I found a few interesting things. Many times when doing an undercar inspection, I will have the engine idling so I can listen for vibrations and exhaust noises. This time while doing the inspecting, the engine was idling and I moved the exhaust pipe a little while checking for things like proper exhaust mounting, and I heard a slight rattle, sort of a buzzing sound. A closer look found the exhaust from the passenger side engine bank was rubbing on the front suspension torsion bar, as seen in Figure 5. Is there a possibility the noise that seemed to be rear wheel bearings is caused by

this exhaust pipe and the sound is being transmitted through the frame and suspension to the rear wheel bearings?

Search for a logical answer

As I have mentioned before, every problem has a logical answer, so looking for the logic in this problem will lead to the fix. While inspecting the exhaust system I did not see where any repair had been done to the exhaust pipe. There were also no rusted exhaust pipes, as well as no damage from the vehicle being backed into something, which can ram the exhaust pipes forward and bend them. Since there is no physical damage to the exhaust, why has it been lowered to the point of rattling on the torsion bar?

In front of the exhaust pipe is an engine mount. The right side engine mount is the one that gets compressed when the engine makes power; the left side engine mount is the one that gets torn apart from the engine torque. Inspecting the right side engine mount, I found the mount was compressed to the point where the steel pieces of the engine mount were hitting each other. Figure 6 shows the engine mount with less than 1/8 inch between the steel top and bottom parts of the mount. Keep in mind that this engine mount is out of the vehicle with no weight load on it. Looking at the bottom of the engine mount, I saw a shiny spot where part of the steel had been bumping on the vehicle frame. The collapsed engine mount was the cause of the exhaust pipe hitting the front torsion bar. By using a logical inspection process, the process led me to the collapsed engine mount.

A new engine mount has about 1/2 inch between the two parts of the engine mount. With a new engine mount installed, the noise was gone and the exhaust pipe had about 1/2 inch clearance between the pipe and the torsion bar.

In talking with the vehicle owner, both rear wheel bearings had been replaced a few months ago trying to get rid of this noise. I was glad to find the real cause of the seemingly rear wheel bearing noise. This made the cost of the repair a lot cheaper than replacing the rear wheel bearings, and it actually fixed the real problem. There are times when taking your time on both your vehicle inspections and your analysis of electrical problems will be a great investment in both our time and money. MA

6

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

HIGH CARBON BRAKE DISCS

Textar, the world's leading manufacturer of OE brake pads, offers a range of German engineered, high carbon brake discs for European applications. Engineers have developed a brake disc to ensure ultimate braking performance, and the brake discs are available at WORLDPAC.

WWW.WORLDPAC.COM

AIR COMPRESSORS

BendPak introduces its Elite Series air compressors. V-Max Elite models have 7.5 or 10 horsepower motors with 4-cylinder 100 percent cast iron pumps on 80-gallon or 120-gallon tanks. The smaller TS-5 Elite has 5 hp motor with twin cylinder pump. All Elite model pumps deliver air in almost total silence, and forced-air after-coolers chill the air for reduced heat and condensation.

WWW.BENDPAK.COM

AUTO REPAIR SHOP SOLUTIONS LINE

Mitchell1 In your shop, at your side

Mitchell 1 offers an industry-leading family of products for the automotive and commercial trucking industries. Mitchell 1's comprehensive line of auto repair shop solutions includes complete OEM and real-world repair information, diagnostic, estimating and shop management software and marketing services to help automotive service professionals simplify everyday tasks and increase efficiency, productivity and profitability.

WWW.MITCHELL1.COM

TOOLBOX // PRODUCTS

AUTOMATIC WHEEL BALANCER

Fully loaded with efficiency enhancing features, the new John Bean® B800P Wheel Balancing System makes life easier for shops looking for speed, performance and productivity. The B800P Wheel Balancing System is fully equipped and includes features that are considered add-ons with other balancers, such as automatic spoke detection and VPI — a patented Virtual Plane Imaging technique that ensures the most accurate balancing results.

WWW.JOHNBEAN.COM

PROGRAMMING TOOL

The CarDAQ-Plus 2® is the most widely used and recognized J2534-1 and J2534-2 device in the market. From OEM-released Reprogramming and Diagnostics capabilities, in conjunction with Drew Technologies' world renowned, expert Technical Support staff and J2534 Toolbox software application, you'll have what you need to keep vehicles in your service bay and increase customer satisfaction.

WWW.DREWTECH.COM

U-JOINT CATALOG

SKF has introduced a new Universal Joints catalog for passenger car, light, medium and heavy duty truck applications (part No. 457285). The SKF U-joint catalog provides detailed line drawings indicating U-joint locations for rear wheel drive passenger cars; 2-wheel drive cars, light and medium duty trucks; and 4-wheel drive and all-wheel drive cars, light and medium duty trucks.

WWW.VSM.SKF.COM

BRAKE PADS

Carquest Wearever® Platinum Professional Brake Pads, exclusively at Advance Professional and Carquest, offer the benefit of a comprehensive premium brake pad program, engineered for professionals. Designed for no comebacks, Carquest Wearever Platinum Professional offers superior formulations for longer pad life, improved stopping performance, cleaner wheels and silent braking. For more information on triple tested, quality Carquest Wearever brake products, contact your local delivery location.

SHOP.ADVANCEAUTOPARTS.COM

WATERLESS COOLANT

With a boiling point of 375°F, Evans Waterless Coolants will perform under extreme conditions, well past the failure point of water-based coolants. The high boiling point ensures that the coolant remains liquid at all times, enabling consistently effective cooling. Because it contains no water and does not promote electrical conductivity between dissimilar metals, electrolysis and metal degradation is eliminated.

WWW.EVANSCOOLANT.COM

OIL FILTERS

PurolatorBOSS™ oil filters support maximum engine protection for synthetic, high mileage and conventional blend motor oils. It is an ideal match for full synthetic oils, providing up to 15,000 miles of engine protection. BOSS employs SmartFUSION™ Technology, which features 100 percent full synthetic media supported by fully integrated, reinforced polymer mesh—providing 99 percent Dirt Removal Power™.

WWW.MANN-HUMMEL.COM

REGISTER FOR AAPEX 2016

AAPEX 2016 is all about keeping you and your business ahead of the curve. Don't miss the opportunity to see the latest aftermarket replacement parts, products and technologies from 2,200 exhibitors. Learn innovative ways to grow your business and what's new with telematics, online parts sales and social media marketing. It all takes place Nov. 1 through Nov. 3, at the Sands Expo, Las Vegas. For online attendee registration, visit the AAPEX website.

WWW.AAPEXSHOW.COM/ADVERT

ENGINE, TRANSMISSION MOUNTS

NAPA DriveTech ofers OE-equivalent engine and transmission mounts for the aftermarket. Only the highest quality materials aand components are used during the manufacturing process to ensure exact form, fit and function. NAPA DriveTech is manufactured exclusively for NAPA AUTO PARTS stores. Contact your local NAPA AUTO PARTS store for ordering information.

WWW.NAPAONLINE.COM

AD INDEX

AD INDEX

PRODUCT INDEX

MOBILE DIAGNOSTIC TOOL

Wells Vehicle Electronics unveiled an innovative automotive diagnostic solution that transforms Bluetooth-enabled smartphones and tablets into an OBDII scan tool. The GoTech™ Mobile OBDII Diagnostic Tool enables technicians to diagnose powertrain trouble codes, clear check engine lights and perform a variety of other diagnostic functions. The new tool is compatible with iPhone, iPad and Android devices.

WWW.WELLSVE.COM

BRAKE KITS

Centric Parts® has announced the availability of a range of front and rear StopTech® Big Brake Kits to fit a wide variety of Lexus and Toyota models. More than 20 new model and trim variations have been added to the StopTech catalog. StopTech Big Brake Kits (BBK) include stiffer calipers, larger rotors, higher friction pads, stainless steel lines and application-specific mounting brackets and hardware.

WWW.CENTRICPARTS.COM

SENSOR CLEANER

Penray Inc. has introduced its new cleaner for mass air flow (MAF) sensors, part No. 2520. Often aggressive solvents, like typical carburetor cleaners, can damage delicate plastic pieces. Penray 2520 is specially formulated to effectively clean the sensitive component without harming plastics, coatings or adhesives.

WWW.PENRAY.COM

FUEL PRESSURE REGULATORS

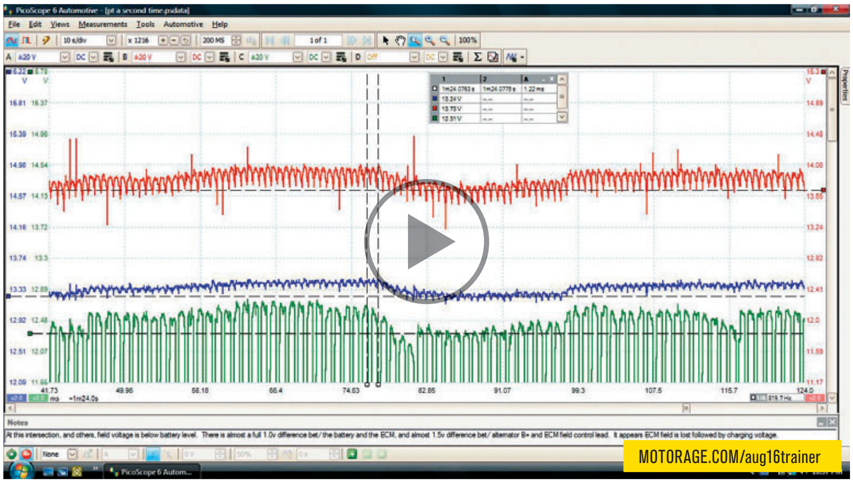
FUELAB 529XX Series Electronic Fuel Pressure Regulators work directly with FUELAB Prodigy fuel pumps to control pump speed, reducing heat build-up and vapor lock conditions related to street and strip operation. Just like standard EFI regulators, the 529 Series regulators relieve pressure (back to the fuel tank) once the set pressure is achieved. The system is easy to install with no calibration required.

WWW.FUELAB.COM

BATTERY AND CHARGING SYSTEM TIPS

THE FUNDAMENTALS HAVEN'T CHANGED, BUT THE PROCESSES HAVE

BY PETE MEIER // Director of Training



The battery residing under the hood (or back seat or trunk) still is essentially the same as it has been for decades. The vehicle to which it is attached, however, shares very little in common with its older predecessors. In the name of increasing fuel economy (mandated by Federal CAFE standard to reach 54.5 mpg by 2025), many of the traditionally mechanical systems on the car have been recreated to operate electronically.

But that presents a Catch 22 of sorts — adding electrical demand requires more from the battery and charging system which, in turn, robs more from the engine (something has to turn the alternator) and reduces fuel economy.

The solution has been a variety of charging system strategies that tailor charging system output to specific need. Some strategies are becoming so precise that installing a battery that is not approved can result in reductions in fuel economy and unexplainable Diagnostic Trouble Codes (DTCs). Other OEMs actually require you to use a scan tool to update the Engine Control Module (ECM) when you replace the battery, even if it is the exact replacement called for.

The good news is that testing these systems still starts with the fundamental techniques of checking open circuit voltage, battery loaded voltage and system charging voltage. The interpretation of these results depends on the vehicle specifics, but you already know I'm going to tell you to read up on those system specifics before you start any kind of testing.

In this edition of The Trainer, I'll show you how to test the system with a Digital Storage Oscilloscope (DSO) and how to interpret those test results. I'll also share a few tips on testing circuit integrity and checking for parasitic drain.

More and more, techs are reporting they are finding a variety of concerns related to a bad or incorrect battery. So don't let this simple component be the cause of your diagnostic frustration.

VIDEOS

Reprogramming: Come on in — the water is fine!

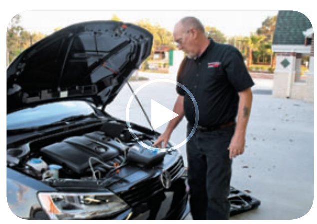
MOTORAGE.COM/jul16trainer

Defining the 'connected' car for your shop

MOTORAGE.COM/jun16trainer

Don't cause a cooling system problem!

MOTORAGE.COM/may16trainer



How to handle a hot customer

MOTORAGE.COM/apr16trainer

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