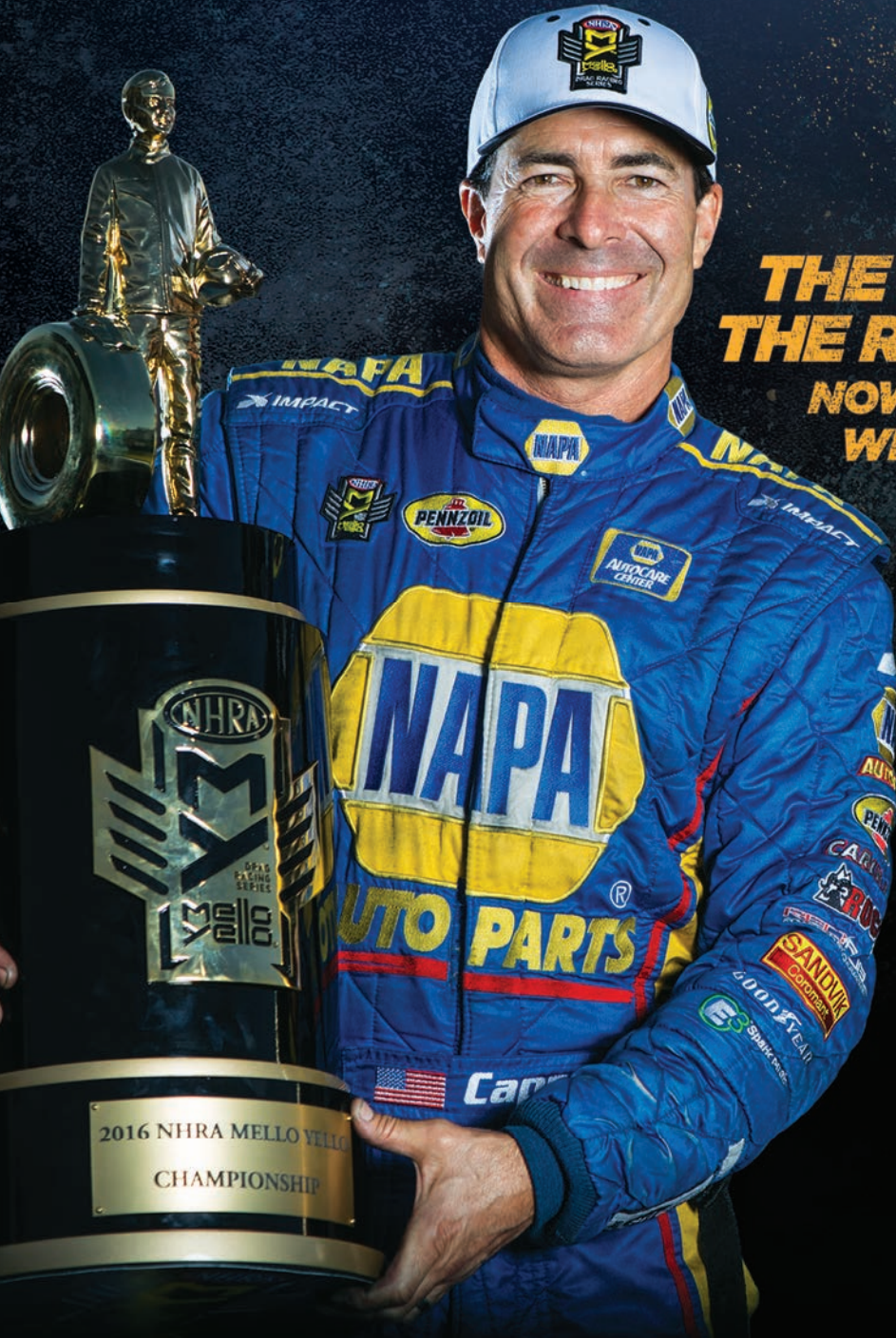


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Approach intermittent faults with logic,
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MY FAVORITE SCOPE TESTS

Your scope can be used to test nearly anything you can think of. Here are my favorite 5 uses for mine.

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KIA QUALITY CONNECTION

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In the webinar "Diagnosing Drivability with Global OBDII," Pete Meier and G. Jerry Truglia show all 10 modes of OBDII and explain what each brings to the table. Watch it now.

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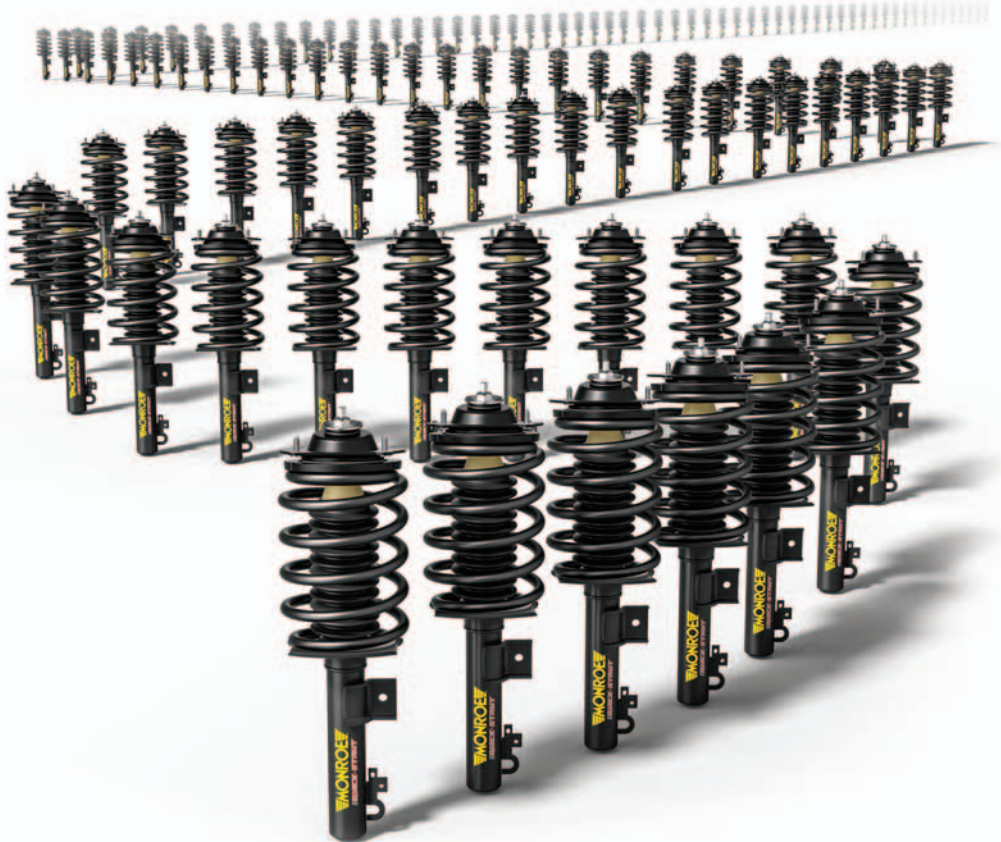
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PHOTO: TSCHANEN BRANDYBERRY

G. JERRY TRUGLIA teaches a full class during “Critical Thinking Diagnostics” at the Commitment to Training event at Joliet Junior College in Joliet, Ill.

INDUSTRY TRAINING

NACE AUTOMECHANIKA TRAINING EVENTS EDUCATE HUNDREDS

TSCHANEN BRANDYBERRY //
Special Projects Editor

➔ The NACE Automechanika Commitment to Training completed its third one-day training event of 2016 in mid-November, with a record turnout that brought the total number of automotive professionals trained this year to more than 370. The Commitment to Training program is the educational component of NACE Automechanika, the largest U.S. trade show dedicated to high-end technical and management-related training for automotive service

and collision repair shops.

Commitment to Training one-day events were conducted at Washtenaw Community College in Ann Arbor, Mich.; Fox Valley Technical College in Appleton, Wis.; and Joliet Junior College in Joliet, Ill. Each event featured industry-leading trainers presenting classes for mechanical and collision professionals on a variety of technical and management topics. Each event was presented at no cost thanks to manufacturer support.

Instructors who trained at the Com-

>> TRAINING CONTINUES ON PAGE 6

BREAKING NEWS

TRAINING AWARD

MONTANA TECH RECOGNIZED FOR TRAINING FOCUS

➔ With over 32 years of experience as a technician, Eric Taffs of Helena, Mont., is the 2016 recipient of the *Motor Age* Training/ASE Master Automobile + L1 Technician of the Year award. Taffs is currently employed at Placer Motors in Helena, where he has worked for 11 years.

Taffs' first foray into automotive repair began, like many, when he was young — he spent his summer breaks from school at the auto shop where his dad worked, which also had a salvage yard. Before long, the shop kept him occupied with projects. “The owner would bring me a couple of junk cars and turn me loose to make one run out of the parts from two,” Taffs recalls.

He later enrolled in his high school's automotive program but soon discovered that continual training would be a necessity to ensure a successful career in the automotive repair industry. Taffs

>> TECH CONTINUES ON PAGE 6

TRENDING

ASA LAUNCHES CAREER CENTER FOR SERVICE, COLLISION INDUSTRY

The ASA Career Center is a partnership with the Auto Care Association and aims to help employers and employees in the automotive service and collision repair fields.

MOTORAGE.COM/CAREER

FEDERATED ACCEPTING SHOP OF THE YEAR NOMINATIONS

Federated Auto Parts is accepting nominations for Federated Shop of the Year, an annual awards program that recognizes shop excellence, now through Jan. 26.

MOTORAGE.COM/SHOPNOM

SAXONBERG ELECTED NASTF CHAIR OF THE BOARD FOR 2017

Mark Saxonberg, who is manager of Alternative Fuel Vehicles and the Environment for Toyota Motor Sales, has been elected as the NASTF 2017 Chair of the Board.

MOTORAGE.COM/17CHAIR

FEDERAL-MOGUL MOTORPARTS ACQUIRES BECK ARNLEY

Federal-Mogul Motorparts has purchased Beck Arnley, a provider of OE quality parts and fluids for foreign nameplate vehicles in North America.

MOTORAGE.COM/FMBUY

NEW PRESIDENT OF WOMEN IN AUTO CARE NAMED

Tammy (Chaffee) Tecklenburg was elected president of Women in Auto Care, formerly the Car Care Council Women's Board, during AAPEX 2016 in Las Vegas.

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>> TRAINING CONTINUED FROM PAGE 4

mitment to Training events and who will participate at NACE Automechanika Chicago include John Thornton, G. Jerry Truglia and Pete Meier. Other trainers at the Commitment to Training events this year were Mike Anderson, Charles Ayers, Jason Bartanen, Chris Chesney, Jerry Goodson, Greg Marchand, Brad Mewes, Larry Montanez and Mel Schampers.

"We are thrilled that more than 370 professionals from around the country were able to make it to our one-day events to improve their skillsets," said Pete Meier, technical editor and director of training for *Motor Age* and the UBM Americas Automotive Group. "Continued education is vitally important to the success of today's automotive industry, and these professionals showed their dedication by giving up a Saturday to learn and study with the best."

The Commitment to Training events are one way NACE Automechanika continues its focus on bringing quality, in-demand training from top educators to the automotive collision and service repair industries. Many attendees of the one-day events also attended

Automechanika Chicago 2015 and plan to attend NACE Automechanika Chicago 2017. The upcoming training event and trade show will take place July 26-29, 2017, at McCormick Place West in Chicago.

"I went to Automechanika Chicago and then heard about the Commitment to Training events. I came (to the Washtenaw and Fox Valley events) because with all of the new technology on vehicles, you have to get all of the information you can," said Mike Felicioni, owner of Great Lakes Auto Body, Nunica, Mich. "And if it's free, even better."

"Seeing so many people take advantage of training and recognizing that they need to learn is encouraging for our industry. It ties in with our trainers at both the Commitment to Training events and NACE Automechanika, who recognize the importance of educating today's automotive professionals to ensure vehicle repairs are being made correctly and in a timely manner," said Jim Savas, VP and GM of the UBM Americas Automotive Group. "With the pace at which vehicle technology is advancing, these training opportunities are becoming

increasingly important."

The Commitment to Training combines live training with webinars, whitepapers, how-to videos, networking and more in an effort to educate today's automotive professionals. It is made possible by support from manufacturers such as Carquest Technical Institute, Delphi, Abaris Training, Hella, Mitchell 1, PPG, Polyvance, Pico Technology, Schaeffler Automotive Aftermarket, Mitchell International, *Motor Age* Training, Axalta, Garmat USA and GFS.

Many of these sponsors will also be participating in the trade show. Because of the time and financial commitment often required to attend training events, NACE Automechanika has secured sponsorships from top companies to offset training costs for mechanical professionals.

Registration is open for NACE Automechanika Chicago, and training topics covered at NACE Automechanika 2017 range from analysis of fuel trim corrections for drivability to social media for shops. You can view a list of training sessions scheduled through today; more will be added in coming months. **TZ**

>> TECH CONTINUED FROM PAGE 4

explains, "When my dad opened his own shop in the '80s, cars were beginning to show up with more complex technology, and it became clear that on-the-job training by itself wasn't enough to keep up. Faced with the frustration of not knowing enough, I chose to go to a manufacturer-specific school — GM Automotive Service Educational Program (ASEP) — and started working for their dealerships."

Taffs' dedication to training continued. In 2002 he was named the GM Medium/Heavy Truck ASE Technician of the Year and became GM World Class Certified in 2007. When GM discontinued Pontiac in 2009, Taffs began Subaru training and has recently achieved master technician status with Subaru. Taffs

has also served as an Automotive Youth Educational Systems (AYES) mentor.

While Taffs acknowledges the importance of certification, he stresses the need for continuous training. He explains, "Certification is one of the most important prerequisites to being viewed as a professional, but training for me is not about the certificate on the wall. Being a technician requires constant learning through formal training, experience and independent research and teaches one to be proficient in many disciplines, such as the sciences, communication, innovation and creativity. I remember when I took a scuba class, passed and then received a certificate, someone wise told me it didn't make me a diver — it was just a license to go out

and learn how to dive."

Upon receiving the *Motor Age* Training/ASE Master Automobile + L1 Technician of the Year award, Taffs reflected on his career and the future of the industry. He expresses, "It is an honor to be chosen by *Motor Age* and ASE for this award. Meeting with ASE officials, company leaders and fellow technicians from around the country was an amazing experience. As I look at the auto repair industry, I see ever-increasing competition, consumer expectations and price pressures putting more demand on technicians. Receiving this award, along with the trip and first-class treatment, moved my thoughts from the daily grind back to the big picture where I can take pride in my career." **TZ**

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CUSTOMER RETENTION STRATEGIES

Keeping your current customers helps build credibility, referrals and cost savings

CHRIS PRICE // Contributing Editor

Long gone are the days when automotive shop owners could simply expect customers to remain loyal for life. Consumers, fed up with paying too much for overly technical, poorly-explained car repairs, have grown distrustful of the industry. Shop owners are also experiencing the fallout from focusing less on customer service and failing to respond to a new generation of customers who don't shop for repair services like their parents did.

The unfortunate result is that automotive repair centers are now losing 20 to 50 percent of their customers each year, according to some industry estimates. Think about it this way: you're going to lose a certain percentage of active customers each year as people move away, buy new cars or pass away. But if you add to that count customers who don't feel they have a reason to return, then the line of customers exiting your shop is going to be a lot longer than

the line of people coming in.

It may seem reasonable to think that you can simply replace your departing customers with new ones, but the truth is that it's better to stop the flow of customers out the door. Keeping your current customer base is cheaper than acquiring new customers and helps build credibility and new referrals.

Here are some strategies to help you turn the tide and inspire more allegiance from your current customers.

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Employ a personal touch

These days, our interactions with customers are often conducted electronically. While that's convenient, it also doesn't provide much of an opportunity to engage customers or address concerns. Let's say a customer doesn't have a completely positive experience at my shop, but fails to mention anything before leaving. Typically, the customer will receive an automated email from my shop thanking them for visiting, but there's no guarantee that the email will prompt them to contact me about an issue. So, why not follow-up with a call to increase your chances of getting an honest response? Personal outreach is something we've gotten away from in the industry and yet, is still desperately needed. With that one call, I can get a more accurate gauge of how well the visit went and sort out any outstanding issues. This type of communication allows the customer to have a voice and also gives me the opportunity to explain anything that might not have been clear or correct any mistakes. Hopefully by the end of the call I've overcome any issues and proven that my shop is willing to go the extra mile to keep the customer's business.

I know that the idea of follow-up calls is daunting, but there are software tools that can help simplify the process. Kukui, for example, just added a follow-up module to its software platform that generates lists of customers who should be called for upcoming services. Full disclosure: I serve as a product architect for Kukui, but I can attest that using the product has helped my shop land new appointments. I am also a strong believer that these types of personal interactions can make the difference between losing and keeping a customer.

Track your numbers

Many shop owners believe they can

just guesstimate when it comes to customer counts. That's not a great way to figure out how well you're performing and how severe your retention problem may be. Even shops that are great at tracking and pay close attention to sales numbers and average repair orders can forget to monitor something like customer frequency. Examining the number of customers who have only visited your shop once, for example, can be a great way to gauge loyalty and measure the effectiveness of your marketing efforts. If you notice a surge in single visits after running a Groupon or aggressive coupon, it may indicate that your offer is priced to only attract "one and done" customers. However, it might also reveal that your shop isn't giving customers a reason to return. Either way, if you don't track these type of figures, you won't know what kind of action to take. To me, failing to count key numbers is akin to driving a car without a dashboard. Establishing a tracking program should be the first step in any customer retention effort.

Embrace technology

I know there are plenty of shop owners who will claim that they have done business for decades without bothering with social media or search engine advertising. But the fact is, they can't do business that way any longer. Younger consumers, who will eventually make up the bulk of your customer base, live their lives online. If you don't have a strong Internet presence, you don't have a chance of keeping them as customers. If you haven't done so already, make sure you have a search-optimized site that is mobile friendly and easy to navigate. Get active on social media and remember to both encourage and respond to reviews. And last, consider search engine advertising to increase your chances of landing customers

looking for your services. These measures will help you build loyalty among Millennials and others who depend on technology to guide their buying decisions.

Adopt a holistic approach

Unfortunately, there isn't one magic bullet when it comes to customer retention. Performing outreach through a variety of marketing channels is your best bet for cultivating long-term support. So, while utilizing technology is absolutely essential, you can't ignore more traditional marketing methods such as direct mail campaigns. Sending out postcards when a customer is due for service is a great way to stay front of mind. For those customers who you haven't seen in six to 12 months, finding a coupon in the mail might prompt a response, especially after they receive an email from you or call expressing how much they miss your business. Community sponsorships can also inspire loyalty. Whether you sponsor a local Little League team or provide a large donation to a special cause, remaining active in the community will help you stand out from the crowd and keep your customers from straying to the competition. Last year, my shop gave a car away to a family in need and received great positive exposure from the effort. Staying engaged on as many fronts as possible will increase your brand exposure and improve your ability to retain customers.

Retention is one of the biggest challenges facing shop owners today. Employing the strategies discussed above has helped me maintain stronger ties with my customers, and I hope they can do the same for you. *TLZ*

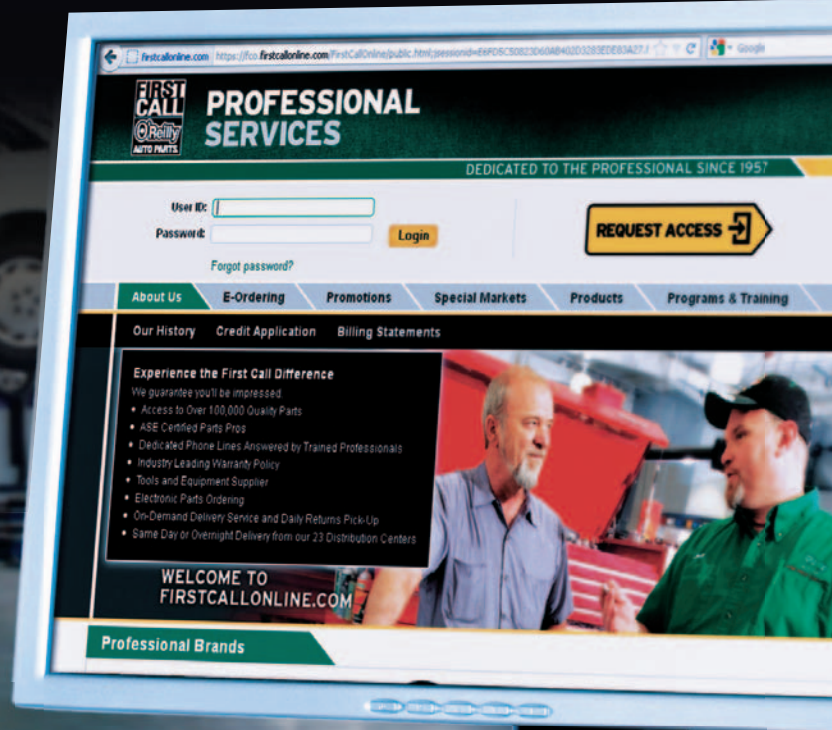


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How to sell the complete estimate in your shop

Sales hinge on the attitude of the salesman, not that of your customer

Every shop owner in North America has witnessed their front counter staff going into a sales slump from time to time. If you don't catch it quick, the result is a severe drop in sales and gross profit. I was watching ATI coach Eric Twiggs teach his clients how to diagnose where the problem could be with their front counter. Eric began telling the story of a shop owner named Ted who has owned his shop for 30 years and is the face of the business. He had always been the only service writer and customers asked for him by name. With certain people, he would prioritize the ticket before they raised any objections, clarifying what had to be done in the current visit and what could wait until the next one.

He believed his longtime customers would keep coming back as long as he was there to give them the lowest price. This belief kept Ted at the shop working in the business and made him reluctant to recruit a service manager.

After coming to the first ATI shop owner's class, Ted realized the importance of working on instead of in the business and decided to hire Rick as his service manager. Ted's first order of business was to bring Rick up to speed on his customers' buying habits.

One of his patrons, Alan, dropped off his Ford F-150 requesting front brakes and oil maintenance service.

Ted has known Alan for over 20 years, and Alan never invested in recommended services beyond what he came

in for. When the technician came back with an estimate that included lower ball joints, struts and a transmission service, Ted knew it was time to warn the new guy.

"I've known Alan for 20 years, so don't feel bad when he declines the additional work. He's got two kids in college and money's tight." Armed with this knowledge, Rick called Alan and presented the estimate findings.

The call only lasted seven minutes, so Ted was pretty sure of what happened. He went to console his new hire, but before he could say anything, Rick interrupted him with the following statement: "Everything has been approved, and the parts are on the way!"

The original work that Alan requested was around \$300. The final ticket came to \$3,100! Ted now understands the difference between his perception and the customer's reality.

The sooner you realize that your perception isn't always the customer's reality, the better you'll get at selling the complete estimate! Stay with me to learn three strategies that will help you embrace this mindset.

Acquire the beginner's mind

I began my career as a service advisor in a tire store with no background in automotive. As a beginner, I consistently produced the best average repair order results in comparison to the other four advisors at the location.

They had been working on cars their entire lives and had worked at the location for an average of five years. What

gave me the edge?

My lack of industry experience gave me the beginner's mind. My co-workers would always make one of the following statements: "The customers around here don't purchase additional maintenance;" "It's an election year and people aren't spending money;" or "Our area is different from the rest of the country."

My selling skills were average at best and not as strong as the other advisors. Since I didn't have any perceptions about the customer's reality, being new was my competitive advantage. In other words, I didn't know what I didn't know!

WHILE MONEY IS IMPORTANT, THE MOST COMMON CONSUMER CONCERN IS RECEIVING VALUE FOR THE MONEY.

Think back to when you were new to the automotive industry. I'll bet there was something you were able to accomplish simply because you didn't know it couldn't be done. Since you didn't know what you didn't know, you were open to trying different things.

Noted author Shunryu Suzuki is quoted as saying, "In the beginner's mind there are many possibilities, but in the expert's mind there are few." Your business will change for the better if you present each estimate with the belief that anything is possible.

I challenge you to approach your

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customer interactions with the beginner's mind so that you experience the possibilities.

Leave your wallet at home

I was having a conversation with the service manager of a former client, who suggested that we lower his prices because he was losing customers. I asked him how many he'd lost and he said he didn't know. I asked how many customers had complained, and he said he hadn't heard any complaints.

I thought this was odd until I spoke with his shop owner. She mentioned that the manager was going through a divorce and experiencing some financial problems. And then it hit me. He was the one who thought it was too expensive, not his customers! He was selling with his own wallet.

The key is to know the difference between sympathy and empathy. Sympathy is when you feel compassion or express understanding for a customer's situation based on your perspective.

Empathy involves getting out of your own head and viewing things through the eyes of the buyer. This raises the following question: What do your customers really want?

According to a 2011 American Express Survey, 70 percent of the respondents said they would be willing to spend

more money with companies that provide excellent customer service.

While money is important, the most common consumer concern is receiving value for the money. You will be positioned to deliver value if you leave your wallet at home and see things from the customer's perspective.

Change a bias to a benefit

Confirmation bias is when you use a singular event to confirm what you already believe, while ignoring evidence that tells a different story. Let's use our friend Alan with the F-150 to illustrate this point. You've installed the parts matrix at your shop, and Alan was the fourth customer you worked with yesterday.

If you suffer from confirmation bias, you will use the fact that he questioned your parts pricing as confirmation that the matrix doesn't work, even though the first three customers paid with no problems.

When shop leaders say: "My customers are complaining about the new pricing," I usually discover that it was only one or two people and not every customer. If you want to sell the complete estimate, use price objections as confirmation that you're on the right track. This will change the confirmation from a bias to a benefit!

If nobody ever questions what you

charge, it's because you aren't charging enough! This makes hearing objections a benefit, because they give you the opportunity to increase your profits and to improve your communication skills. The more objections you overcome, the better you get at overcoming objections.

Checklist to remove sales slumps

So there you have it. Ted's new service manager has helped him to acquire the beginner's mind, leave his wallet at home, and change his confirmation bias to a benefit.

As a result, he's having his best sales and gross profit year ever. His sales have improved by 12 percent, and his gross profit has increased by 52 percent over the previous year! If you embrace these strategies, you will sell the complete estimate and have more money to put in that wallet you left at home!

If you are looking for a tool to help your sales staff sell the complete estimate, first you have to manage their sales process to see if they have fallen into any bad habits, which is easy to do. Every great sales person has an equally great sales manager to help them out of slumps. If you want to diagnose your front counter folks, you can download the ATI Sales Management Checklist to uncover the problem by going to www.ationlinetraining.com/2017-01 for a limited time. **TLZ**

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Chris "Chubby" Frederick, CEO



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 Coach Eric Twiggs. cfrederick@autotraining.net



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Why the daily and monthly data is so important

Data snapshots help ensure the business is staying on the right track

Working with numbers for business measurement was never on the radar in the beginning of your career, nor has it ever been one of your passions. This is understandable — that kind of work is never exciting. When a passion for data entry accuracy is lacking, many errors may occur in that data entry because the only thing on one's mind is "I want this over with!" That is also very understandable!

This is the No. 1 reason why you should have a competent person responsible for any data entry that is used to measure your business. A numbers person may be a little quirky in your mind, but they love numbers and working with them to see what kind of outcome they get, which is very similar to your quirky passion of working on an engine through diagnostics to see what kind of performance you can get. Two kinds of quirky people working together can really achieve greatness.

Without accurate data, the only thing you can really watch is your bank account. If it is low, a shop owner can panic and start to do things that can dramatically affect their business in a negative way.

So why is data information so important in today's business?

1. Daily data entry into the Key Performance Indicators (KPIs) allows you and your team to visually see and focus in on what is really important in the shop — namely proper productivity "accountability," such as labor sales, inspections and hours billed for the day and per invoice compared to objectives. This lets you know if you are informing and educating clients professionally on proper safety and reliability of their vehicle, which can be determined by measuring the amount of deferred work from completed inspections. As you move closer to reaching the objectives — and that does take time — everyone can see that they are fully engaged as a solid team and working professionally on behalf of the client. That is a culture very hard to find today, and when it is in place, all of you should hold your head up high.



RENEW YOUR FOCUS IN ENSURING THE DATA ENTERED DAILY AND MONTHLY IS ACCURATE AND ALWAYS COMPLETED IN A TIMELY MANNER.



2. Your monthly report should sum up the entire month in ALL revenue and operating expense categories measured against budgets and objectives, allowing you to see how you are doing. It should also give you a quantifiable analysis and measurements that allow you to see into the future based on what you are accomplishing each month. This complete report points out the strong areas of the business that are really working well, along with the weak areas of the business to be addressed and in order of importance. Prioritizing management's actions can help improve efficiency in achieving the desired results. This kind of report allows you to be accountable not only to the business team with your defined and measured actions, but it also lets you know if you are doing your job properly in order for the business to move forward and prosper. It talks to you and pats you on the back mathematically, or will kick you mathematically as well as to say "pay attention."

Renew your focus in ensuring the data entered daily and monthly is accurate and always completed in a timely manner. You should have a daily routine for entering the KPIs. Instruct your book-

keeper to enter accurate monthly data, targeting the 10th of the month following or sooner if possible. This would provide back to you a very timely report and analysis of the business so you can continue to work on your business effectively and not get caught in the trap every single day of working in your business. The occasional day in the business is understandable, but your No. 1 priority and your job is to manage the team, which in turn is called managing the business. **TL**

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. Bob has more than 36 years of business management experience within the independent aftermarket industry, consulting independent retail shops on all facets of their business operations. Bob is one of 150 worldwide AMI-approved instructors. greenwood@aaec.ca

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A few good men

Family-operated shop thrives in pastoral New Jersey

ROBERT BRAVENDER // Contributing Editor

➔ While outsiders might consider New Jersey to be two megalopolises connected by a turnpike with Atlantic City on the coast, there are actually pastoral parts of the Garden State, and Flemington is one of them. Besides its historic courthouse (site of the Lindbergh kidnapping trial), this quaint little town is also home to Boni Tire & Auto Service.

Pronounced “Bonnie,” the shop was started in 1999 and is still run by its founder, Dan Boni, Sr., who earned his stripes as a manager at a tire store chain before deciding to go into business for himself. To build a foundation in the Flemington community, he launched an advertising campaign emphasizing that his was a locally owned and operated business.

“I hire local people, and my money wasn’t going back into some corporation somewhere,” Boni explains. “My prices don’t have to be as high as some other shops because I don’t have a corporate office that I have to pay. And if you have a problem with your car, you see me, the owner. If you don’t see me, you’ll see my two sons.”

Boni started off by renting a three-bay gas station. “I was there for about 9 years, and I got so busy I had to hire more people,” he recalls. “I didn’t have enough room so I did a build out at a strip mall, and now I’ve got seven bays, five employees, plus my two sons who run the counter as well as the store when I’m not around.”

While Boni sought an independent atmosphere, he did take one thing away from his time with the chain. “They were always training the store managers, training the employees,” he recounts. “They had a center down at the corporate office where they had whole shops set up where they’d teach up-and-coming stuff. That was instilled in me, so when I opened my own business I did the same thing.”

Today Boni pursues a variety of classes through the normal channels...and some unanticipated ones. “The funny thing is,” he says, “the GM and Ford (dealers) just down the road from us are starting to get into it, and they’re actually encouraging us to attend their big classes — it’s only \$30 — which is pretty cool. They’ll teach about fuel injection, how to read the computers, how different sensors work and interact with things — we just recently learned how the sensors around the camshaft can get clogged up and throw everything off. They showed us how to diagnose that because I guess it doesn’t really throw up a code. And other cars would have that same problem.”



BONI TIRE & AUTO SERVICE
Flemington, NJ // www.bonitireauto.com

Daniel Boni, Sr. & Lori Boni
Owners

3
No. of technicians

95
No. of customer vehicles per week

1
No. of shops

6,800
Total square footage of shops

\$1.29
million
Annual gross revenue

18
Years in business

7
No. of bays

8
No. of employees

\$365
Average repair order

PHOTOS: BONI TIRE & AUTO SERVICE

Besides the training, Boni has also invested in newer equipment. “We use the bolt-on technology to streamline servicing for customers, and we do a lot of the preventative maintenance and give the customer a list of what they’re going to need down the road. Say they have 60,000 miles on their car; we’ll tell them that their next servicing requires this, this and this. It works pretty well.”

What also might surprise you about rural New Jersey is that according to the state’s official website, the Garden State has more horses per square miles than any other state. Kentucky and Tennessee are free to question that stat, but for the auto repair industry, this translates into the pickups that haul horses around in trailers.



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"I'd say I do more of those and Suburbans than I do actual cars," Boni notes, to which end he bought an extra-long 4-wheel Hunter alignment rack. "I actually have one guy who likes to do diesel stuff, so we send him to do a lot of training in that. We just did a diesel the other day where we had to take the whole cab off the frame in order to work on it. He can knock that out in about a day and half, which isn't too bad."



They're also experimenting with an online diagnostics center. "I guess we're one of the first ones to do that," considers Boni. "The people who do our website came up with that. Basically, you put your symptoms down (in an email); if you've been to Advance Auto or Auto Zone for a trouble code, you can put that in. Then we'll (text back) what your problem might be and roughly what the cost is to fix it. It sounds ok, but we haven't had many people use it yet; although, some version of this could play a bigger role in the future."

Meanwhile they use Mitchell-On-Demand to track all their coupons. "If I don't get a good pull, which in my opinion is a solid one percent, than I won't do that advertising anymore," notes Boni. "My big one is Money Mailer; I do very well with them. I'm around 2.5 percent return on them, which I think is a fantastic number in the grand scheme of things. But people out here are not big coupon (users), so I also advertise at the high school with the boosters, and I put the banners up. At the elementary school near here I just bought a little over \$1,500 worth of school supplies for them. I donate that and they give me a little blurb on their school things for free."

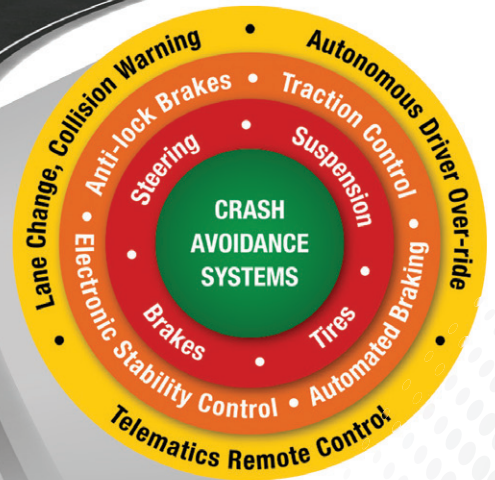
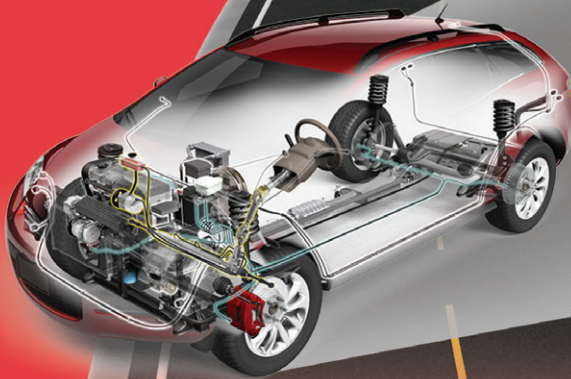
But is this type of marketing measurable? "Actually, it is," Boni maintains. "When customers come in, my sons and I ask how they heard of us. Word of mouth is huge in this area. Where I used to work, none of that translated to the way people are out here; it's a whole different animal. These people want to be taken care of, spoken to, they want to understand. I'm a people person, I like dealing with people, solving problems."

It should be noted that when translated from a particular term in Latin, 'boni' can mean 'good men.' Throw in a few good women, and you've got Boni Tire & Auto Service. 



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.
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CLEARLY SET STANDARDS WITH DETAILED DOCUMENTATION, COMMUNICATION

CHRIS CHESNEY // Contributing Editor

At automotive service facilities, service standards are the expectations for your team. Standards should be based on the expectations of your customers and reflect the customer's view of these expectations.

Draw from observations and gather direct input from your customers on their expectations of the repair experience and your team. Define the customer experience you seek to provide and create a blueprint for the processes that can deliver that experience. Then, measure results. Categorize your service standards as either a Hard or Soft Standard. Hard Standards can be counted, measured or timed. Soft Standards are more subjective or opinion-focused and can't be quantifiable measured. These standards can be gathered by speaking to customers via a variety of tools including reviews, call-backs or surveys.

For a step-by-step guide, here is one example used by McGraw-Hill:

1. Determine who you want as cus-

tomers and what they want from you. An example could be: "I want to be a low-cost service provider for my local community."

2. Convert customer expectations into behaviors and actions. You might begin with "I will communicate with my customer to keep them informed of our progress." Now, drill down in more detail until you identify all the actions to meet this expectation. E.g.: "I will notify my customer via text when we complete our inspection, have their service offer ready, have parts on order, when their vehicle is being serviced, when their vehicle is ready for pickup and when their vehicle has been delivered."

3. Create the standards for each action.

4. Develop measurements for each standard. This could entail creating reports from your shop management system or an audit sheet.

5. Establish target metrics for each standard.

6. Track the results and compare results to your standard targets.

7. Share the results with your team and constantly train on how to improve.

8. Regularly update the targets and

measurements for your shop.

The best way to create and implement these standards successfully is to include your team in the step-by-step creation and modification of standards in steps 2-5. Depending on the size of your business, recruit a leader from each department — technician, service advisor, manager, parts supplier, mentors — to take time to create these standards. Practice also drives the process forward: I suggest you tackle one or two standards first to test your processes. And always start with something non-intrusive and easily measured.

Finally, when considering what to do first, my suggestion is to start with small, easy-to-implement standards and then seek assistance when tackling larger areas of focus. A course from CTI called "Logical Trouble Shooting Process," recognized with an award from the Automotive Training Managers Council, guides you when creating standards that allows you to meet your customers' expectations regarding a very complex discipline. As always, send any questions or comments to Chris.Chesney@CARQUEST.com.

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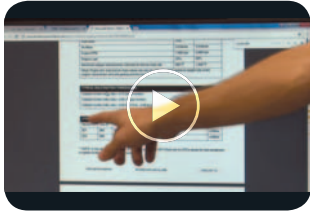
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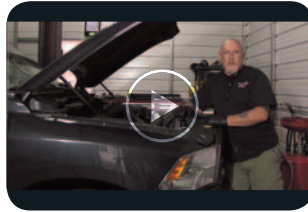


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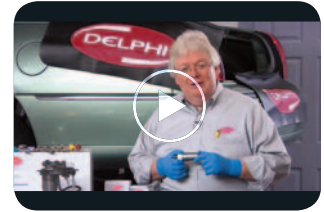
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SOCIAL INSIGHTS



CUSTOMER SERVICE FROM A TECHNICIAN'S PERSPECTIVE

As technicians, we must meet several expectations. Some are set by the customer and others are set by our employer. One obvious expectation that immediately comes to mind is to treat the customer's vehicle with the utmost respect. We don't do burnouts with it; we exercise care with it and we return it in the same, or better, shape than we received it. I'm not saying you need to do a full detail on every car you work on, but don't leave grease and oil stains on the body or interior either. The next expectation should be equally obvious.

Read more to find out what it is:
Motorage.com/techperspective

BATTERY AND CHARGING SYSTEM TESTING TIPS

The battery residing under the hood (or back seat or trunk) is still 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. Don't let this simple component cause diagnostic frustration.

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This lady I knew thought she and her husband were going to roll that old VW Beetle out of the barn, put a battery in it, run the field mice out of the glove compartment, fire it up and drive it to the courthouse wearing a big smile. And while we've all heard stories of people who, with minimal effort, recovered a ride that had been sitting for years, we all know that isn't usually the case, and I warned her that the moving parts on that barned bug would most likely be rusted together.

Read more at:
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MAINTAINING HYBRID FUEL ECONOMY

WHAT TO CONSIDER WHEN YOUR HYBRID CUSTOMER IS DISSATISFIED WITH THE NUMBERS

G. JERRY TRUGLIA //

Contributing Editor

Two reasons many vehicle owners state for purchasing a hybrid vehicle are better miles per gallon and helping make the environment cleaner. Working on hybrid vehicles for years, I have noticed that most of the hybrid vehicle owners do not properly maintain their vehicle and therefore do not achieve the advertised miles per gallon. It's such a problem that some state emission programs are starting to look into the EPA rating vs. the actual hybrid vehicle miles per gallon. Since every new vehicle is certified by the federal government for emissions and miles per gallon, there is an issue when hybrid vehicles do not achieve the posted numbers. Many of the hybrid vehicles I have worked on do not average anywhere near the suggested EPA ratings. One such example is a 2008 Toyota Prius (Fig. 1) that only averages 30.5 when it should be averaging about 46 mpg. That's a very large difference from what the vehicle owner is actually getting compared to the EPA rating. Think about how much more pollution the vehicle is emitting now compared to when it was certified.

Hybrids need maintenance, too

We know that all vehicles need routine maintenance, and hybrid vehicles are no exception, especially as they get older and the high voltage (HV) battery starts to deteriorate. Vehicle maintenance



PHOTOS: G. JERRY TRUGLIA

from an oil change to tire pressure to a tune up can all affect the performance of the vehicle. With hybrid vehicles there is also HV battery maintenance. It is important to check the status of the HV battery for proper vehicle operation. If we go back to the first hybrid that hit the streets, we would be looking at a Honda Insight that had a 3-cylinder motor. The Insight was dependent on the Integrated Motor Assist (IMA) electric motor that was sandwiched between the engine and the transmission to help do its part in propelling the vehicle. If the HV battery on the Insight was depleted, it became very difficult to drive up steep inclines or maintain a steady speed on a hilly road. Just like everything else on the vehicle, the HV battery sometimes needs maintenance. What happens over time to the HV battery is that it becomes unbalanced and the cells begin to lose their capacity. Take notice of the HV battery level when driving a hybrid vehicle

that has some miles on it or one that has been sitting around for a while. You will notice that the HV battery pack indicator seems to drain quickly. When this occurs, there will be a noticeable power loss and a drop in fuel economy. Many vehicle owners do not notice these issues since the power loss and the lower fuel mileage numbers are gradual, so they just keep on driving. If the vehicle owner checked the mpg as seen in Fig. 1, where it is 16 mpg less than what the vehicle should be averaging, the owner would most likely bring the vehicle in for a diagnosis.

Shared electrical problems

Most of the time the HV battery has problems with voltage drop (VD) at the bus bar connections to the stud. The bus bars (Fig. 2) get corroded and start to resemble the Statue of Liberty. In many cases, HV battery maintenance does the trick in getting the HV battery back up to

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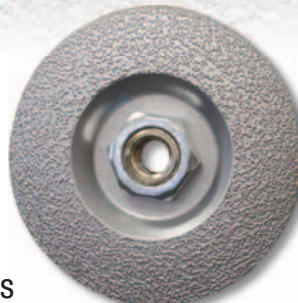
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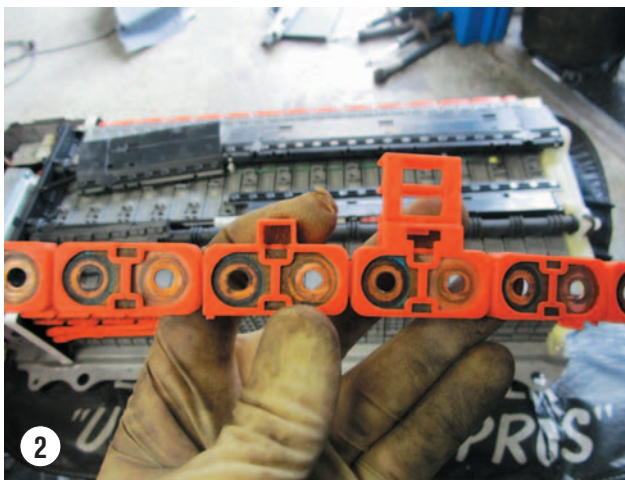
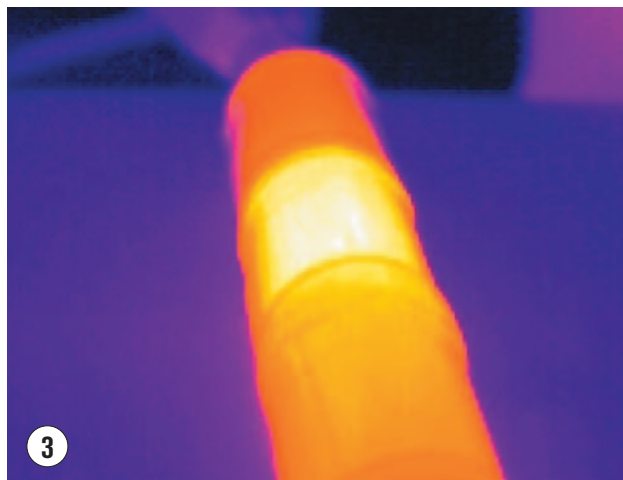
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its normal state — that is, if there is no battery cell damage. There are certain factors with HV batteries that involve age, discharge and charging cycles. In the case of the HV battery, the life span depends on temperature, vehicle use, discharge and charge cycles, among other factors. If the HV battery cell or module is dead, it cannot be brought back to life. We always examine the causes of the HV battery deterioration, which can be heat, time or air flow, to name a few.

Let's look at the heat factor and ways that all hybrid or electric vehicles have to cool their HV batteries. A technician working on one of these vehicles must make sure that adequate air is circulated through and around the HV battery pack. In many cases, I have seen premature HV battery problems or failure due to airflow obstructions. Most of the obstructions are manmade, caused by debris blocking the air flow vents, or a connection hose being detached from the HV battery blower motor assembly. All the OEs have installed cooling fans, while some use the A/C system, and others circulate engine coolant around the battery to make sure that the HV battery temperature stays in check. Heat is the No. 1 killer of the HV battery. Now let's move on to what we can do as service technicians.

First steps

The first items you should check when servicing the hybrid vehicle are the air vent and ducts to the HV battery to ensure they are not obstructed, clogged or disconnected. The next step would be to use the scan tool to activate the blower motor to make sure that all the fan speeds work. It is imperative that the vents are not obstructed and the ducts are clean so the cooling fan is able to do its job of cooling the HV battery pack. If the cooling system is working properly, it's now time to test the HV battery by using a tool like the Midtronics HYB hybrid battery tester or a scan tool that can read the HV battery PIDs correctly. I like the Midtronics HYB tester because it performs a test that provides results on the state of the HV battery very quickly, and it prints. I use the results along with factory scan data to inform and help sell the vehicle owner a battery reconditioning service.

Our next step is to remove the HV battery and connect it to a grid charger. Some grid chargers perform tests on the HV battery cells/pack as it discharges and charges the cells. The charging and discharging, if done early enough, will help balance the battery cells in the pack and in many cases with the right equipment identify a cell or stick that is no longer able to pull its own weight. Take a look at a Honda battery stick (Fig. 3) that has one cell overheating due to internal

resistance issues. Ford has programmed in a battery balance test (Fig. 4) in their factory scan tool (IDS) that helps keep the 250 D size cells in the HV battery pack balanced. There are grid chargers such as the one Mike Dabrowski came up with originally for his own Honda Insight to maintain and prolong the life of the HV battery. Mike has sold many of these chargers to hybrid vehicle owners, especially Honda Insight owners, since the battery packs have encountered problems. There are others, such as the one the Hybrid Shop had made by Nu-vant (Fig. 5), that are more involved in conditioning HV batteries. Owning and having experience with both of them has allowed me to recondition and rebuild many battery packs successfully. Midtronics is another company that has experience building charge/discharge units for the OEs and is now making their GRX-5100 EV/HEV battery service tool available to the aftermarket.

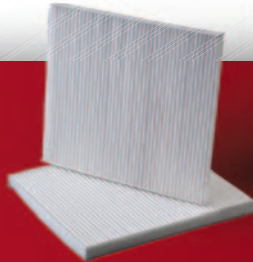
Many of the hybrid vehicles on the road are now older and out of warranty, needing the HV battery tested and reconditioned. There will be many more vehicles that will have an HV battery installed in them because of the government rule that is slated for 2025 when vehicles must average 54.5 mpg. Most likely that goal of 54.5 mpg will be achieved by electrification of the vehicle.

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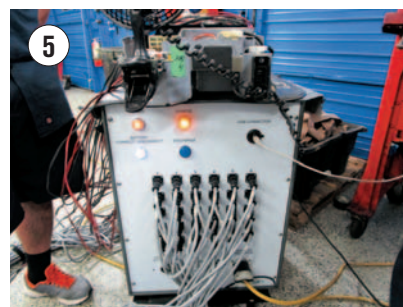
Many OEs and Tier 1 suppliers such as Delphi are back to work on the 48-volt system that will be showing up soon. With more hybrid and electric vehicles on the road, it will be commonplace to use equipment that checks, discharges, charges and exercises the HV battery.

Some examples from my shop

Our first problem vehicle is a 2008 Toyota Prius that came in with a complaint of poor mileage. The vehicle owner is experienced with hybrid vehicles, since he owned a 2005 Honda Civic hybrid and currently owns a 2014 Toyota Prius. As a previous and current owner, he was able to compare his 2014 Prius to the 2008 Prius, noticing a big difference in mpgs. To confirm the concern over his poor fuel mileage, our first course of action was to check the vehicle display to see the average mpg the vehicle was achieving. The vehicle owner thought that his 2008 Prius needed a tune up since it had more than 110K on it. We checked his service history and found that we performed a tune up at 90k after the engine had a misfire problem. Most likely since we tuned the engine up recently it was not going to be an ICE problem, but rather an HV battery problem. We checked scan data for engine misfires along with the GTC 505 “scope on a rope” tool that easily identifies engine

misfires caused by an ignition issue, but none were found. Our diagnosis on this 8-year-old Prius would concentrate on the HV side of the vehicle to see if we had an HV battery that had deteriorated.

The next logical step in our diagnosis was to connect our Midtronics HYB tester and test drive the vehicle to identify the HV battery state of health. The HYB reported that the “HV Battery Pack Requires Service – Pack Out Of Balance” (Fig. 6), making it easier to explain to the Prius owner that the HV battery needed to be serviced. Once the vehicle owner gave us the OK, we powered down the high-voltage system by turning off the ignition, followed by removing the service plug (high-voltage connector). After that, we were able to remove the HV battery and started removing the bus bars. The bus bars were totally corroded, causing a huge voltage drop. This confirmed our scan data, HYB test results and test drive where we noticed that the HV battery indicator was displaying a quick drop and rise in HV battery voltage. When the HV battery level either drops or rises quickly, it indicates that the HV battery has a capacity issue. We proceeded to remove the bus bars and clean them in a solution that prevents damage while getting them back to (Fig. 7) normal. We connected our Nuvant/Hybrid Shop HV battery reconditioning equipment to each of the 28

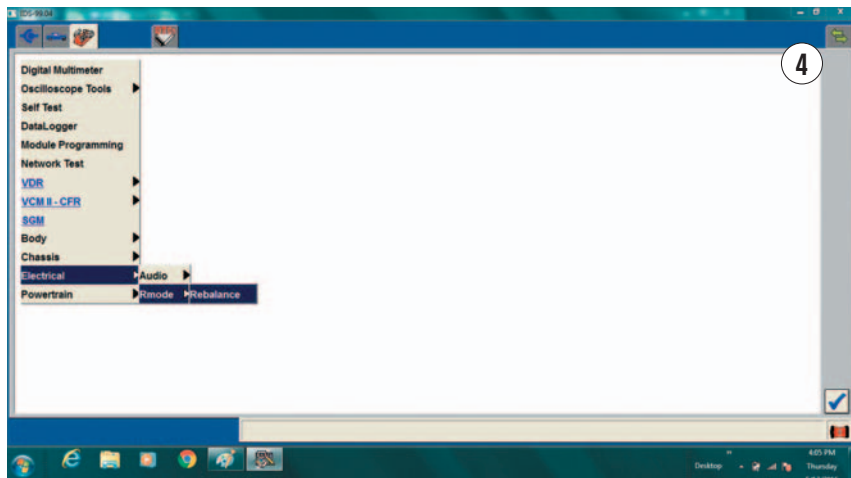


individual modules. This Prius pack was way out of balance and had one module, No. 22, that took extra time in coming up to a normal level.

I would like to note here that GEN II Prius models are getting old, and their HV battery modules are getting to the end of their life. I mentioned earlier that there is a life span on these modules. In this case, reconditioning was the way to go, but there are many times when good donor HV batteries are just not available, such as on a GEN I Prius, where we must purchase a new one from Toyota. When the reconditioning was completed, we installed the HV battery and test drove the vehicle with the HYB installed so we could compare the before and after readings. We found that the HV battery was now up to 92 percent compared to 78 percent when we started. The battery reconditioning service was performed successfully, and the Prius was back to operating normally.

A Honda example

Next let's look at Honda IMA problems that cause an issue with mpgs. The Honda hybrid system is unique in that the vehicle can still be driven even with a bad HV battery. The vehicle will have much less power and of course mpg will be greatly affected. The mistake that most Honda hybrid owners make involves the vehicle HV cooling ducts that are restricted with debris, making it difficult for the cooling fan to do its job. There is a procedure that can be performed on the HV battery that helps drain and recharge the battery pack



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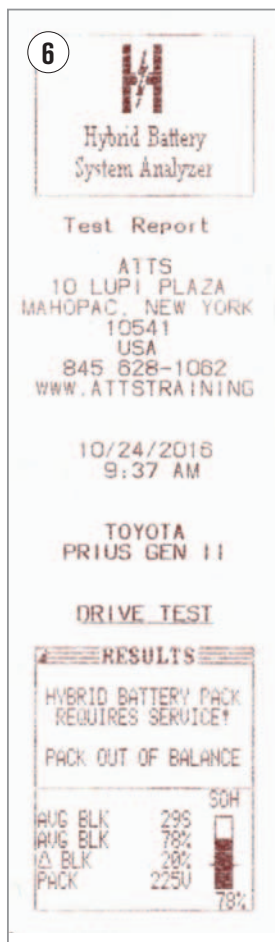
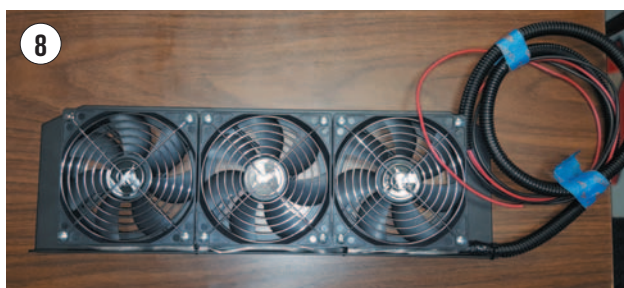
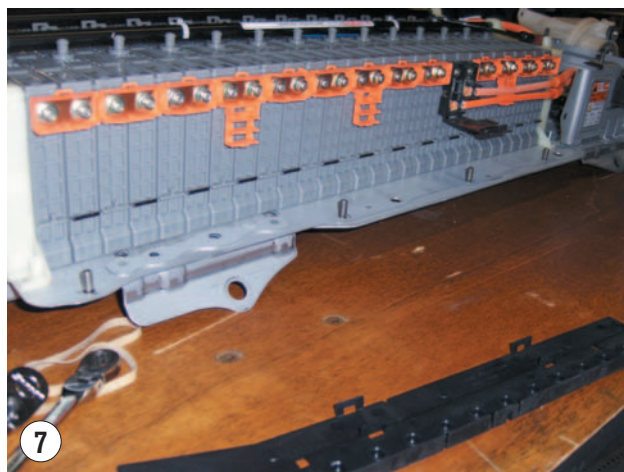
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and should be performed often once the vehicle is more than three years old. Be aware that Honda has warranted many of the Hybrid HV battery packs even if the mileage was over 80k, or in some states 150K. In some cases, we have contacted the dealer on behalf of the vehicle owner and explained the HV battery problem. We backed up our explanation with both the Honda factory scan data and the Midtronics HYB tester. In many cases, the Honda dealer was able to provide a new replacement free of charge to the owner. Since Honda hybrids have many HV battery problems due to improper airflow and heat buildup, it's a good idea to add an additional fan to keep the batteries cooler. Look at an additional fan (Fig. 8) that one of my students from North Carolina has made up to help alleviate HV battery overheating issues.

Let's move on to other issues that can prevent Honda hybrid vehicles from getting the proper mpgs. One is the AutoStop/IdleStop function that is used to save fuel and has now been adopted by many other manufacturers, known as Start/Stop. In stop-and-go traffic, there is a huge efficiency loss due to the engine running while the vehicle is immobile. All hybrids have a form of Idle AutoStop that will turn off the ICE when the vehicle is stopped in order to save fuel. Once you release your foot from the brake pedal, or touch the throttle, the ICE will automatically be started. With that being said, think about if the AutoStop is not operating as designed. What would be the result? You guessed it — less mpgs, due to the engine running more than it should. One of the ways a Honda hybrid system is able to achieve better mpgs is to use this feature, but before it can go into that AutoStop mode, there are some criteria that have to be met, such as the ICE has to be at a certain operating temperature, the MAP voltage has to be correct, the brake pedal has to be depressed and so on. So, if AutoStop is functioning properly and the HV battery is in good condition and there is still an mpg concern, there is yet another problem that is often overlooked.

The Honda Civic hybrid utilizes a valve pause system (VPS) that needs the proper weight oil to operate correctly. The VPS is used to control oil flow to the cylinder head that allows the rocker arms to disengage, thus providing ICE power from only one cylinder on 2003 to 2005; on 2006 and up vehicles, it shuts off all four cylinders. This engine requires 0w20 weight oil that is usually only found in a synthetic and in limited supply as a semi-synthetic blend. If the wrong oil is installed in the engine, it will prevent the VPS from properly operating, and the valves will not close as they are designed. The lack of proper operation will cause the ICE to stay running and not provide proper electric power from the battery. Using the wrong oil will also result in less Regen (power that the motor generator/integrated motor assist [MG/IMA] supply to the HV battery), causing premature HV battery failure due to the battery not being properly charged and discharged. I have repaired many Honda Civic hybrid vehicles that were only getting 30 mpgs with a simple oil change, since the engine had the wrong oil in it.



I hope this article has shed some light and understanding on mpgs in hybrid vehicles. Remember that the ICE and HV both need to function as designed or the mpgs will not be achieved. **TZ**



G. JERRY TRUGLIA, ASE World Class Triple Master Technician Auto, Truck & School Bus, L1, L3, F1, A9, X1 C1, is president of Technicians Service Training and a nationally recognized trainer/author. He founded TST to bring affordable training to fellow techs and owners. gtruglia@tstseminars.org

MY FAVORITE SCOPE TESTS

YOUR SCOPE CAN BE USED TO TEST NEARLY ANYTHING YOU CAN THINK OF. HERE ARE MY FAVORITE 5 USES FOR MINE.

PETE MEIER // Technical Editor

For years, I was amazed at how few technicians I worked with had ever used a scope, let alone owned one of their own. But I've been pleased to see that scope use is on the rise, as evidenced by the number of techs who raise their hands in the presentations I make around the country and the growth of online support groups. Here are a few of my favorite uses for the scope. I hope you find them helpful.

I am going to share the scope settings I use. I admit I am no "guru" in scope use and learn continuously from those who are. I'm sure many of you can offer advice on even more efficient ways of setting up and performing these tests, and I hope you will — in the comments section on MotorAge.com!

The relative compression test

Many years ago, I was tracking down

the cause of a slight misfire on a Chrysler minivan V6. After checking fuel and ignition, I found myself having to dive deeper into the mechanical health of the engine. All of you know how time consuming performing a conventional cranking compression test on a transverse V6 can be, and I also checked cylinder leak down on all six at the same time! I spent a few hours on the job that I never did get paid for.

The relative compression test is a way of assessing the overall health of the engine with a lot less trouble and in a matter of minutes, instead of hours. It is one test I perform on every engine that I find myself troubleshooting a drivability concern on.

Scope settings: *Channel 1 - High current clamp attached to either negative or positive battery cable. Scale set to read to at least 600 amps to capture initial inrush current expected.*

Channel 2 - Standard lead or secondary clamp attached to cylinder ig-

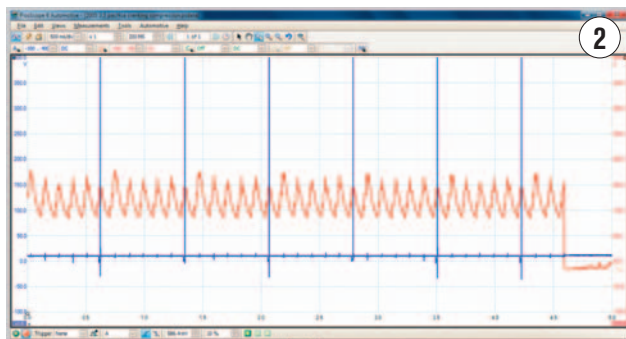
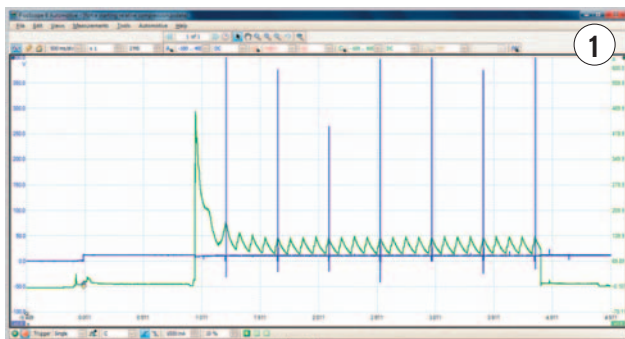
nitiation source (coil or secondary lead). Choose cylinder that is easiest to access. Adjust voltage scale to match connection and be careful to use attenuator if needed.

Time base - 500 milliseconds per division OR 5 seconds total screen time

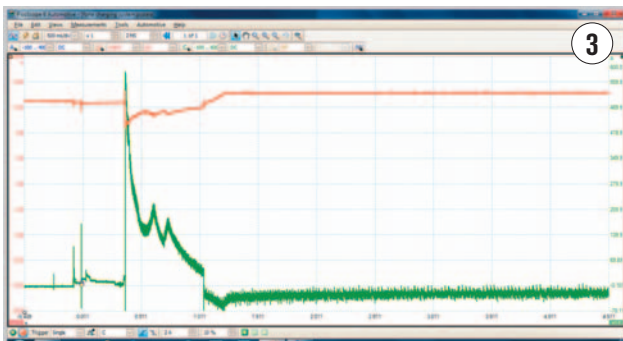
Trigger - Single capture with trigger set to rising slope and +1 amp.

These settings allow me to capture all the info I need on one screen and to do so without worrying about starting or stopping the scope manually. As soon as I turn the key "on," the scope will begin to capture data. Figure 1 shows an example of what you can expect to see.

The green trace is the current pattern captured. The focus is on the repetitive sawtooth pattern, where each peak represents the amount of current it took to push a cylinder through its compression stroke. Even on my old UEI scope, I could distinguish as little as a 10 percent drop in an individual cylin-



PHOTOS: PETE MEIER



der's compression using this method. In this capture, the cylinders are uniform in appearance. But remember, this is a "relative" view, relative to all the other cylinders. If there is a mechanical issue that is causing low compression across the board, you'll see a very similar picture with only one noticeable difference — the current levels of the peaks will be lower than you're used to seeing on a healthy engine. I can also see that ignition timing appears to be OK, since the ignition reference is intersecting the current pattern on, or just before, the peak. Spark occurs just before TDC, right?

Take a look at Figure 2 for an example of a "known bad" capture. Though hiding behind the ignition reference, the peak for that cylinder is not reaching the same level as the others. By following the firing order, I know which cylinder I need to take a closer look at. With that information in hand, I have no problem going back to the customer and asking for the additional time I'm going to spend isolating the exact cause.

Battery/charging system test

A common reason I hear from techs who own (or have access to) a scope

but don't use it is the time it takes to set up. If you fall into that category, then let me ask you this: Don't you start up your computer work station every morning so you can access your service information and work flow for the day? Starting up your scope should be on that same list of items. A side benefit is that you're performing a service for your customer that just might make you a little more money in the process.

Scope settings: *Channel 1 – Standard leads attached to battery positive and negative terminals. Scale set to read up to 2 volts per division or 0-20 volts total screen range.*

Channel 2 – High current clamp attached to either negative or positive battery cable. Scale set to read to at least 600 amps to capture initial in-rush current expected.

Time base – 500 milliseconds per division OR 5 seconds total screen time.

Trigger – Single capture with trigger set to rising slope and +1 amp.

Figure 3 shows an example of a typical system test result. But for clarity, let's break out the voltage and current patterns and review the key points individually.

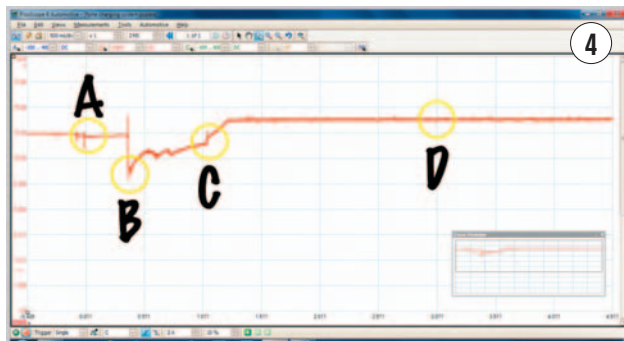
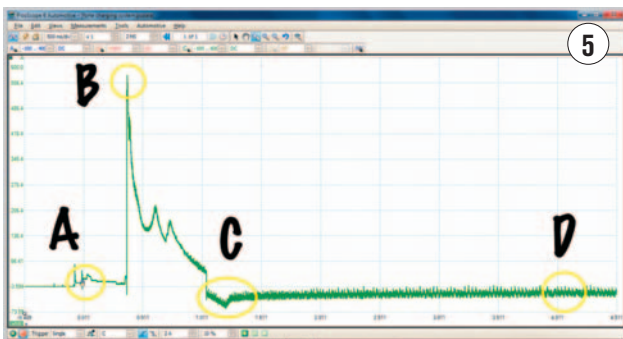
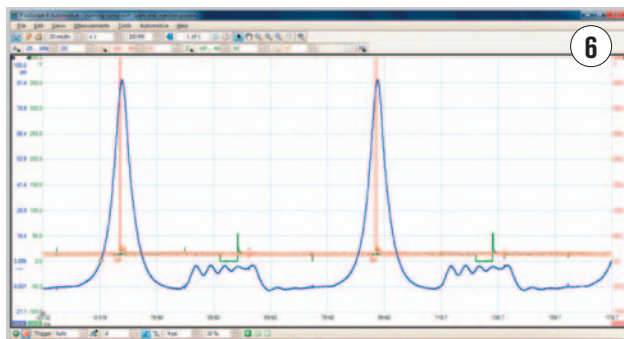


Figure 4 is the voltage alone. Just before "A" is the same Open Circuit Voltage you would read with your voltmeter, while "A" itself is the slight drop in voltage when I turned the key on. But I didn't stop there, did I? I continued to the "Start" position and engaged the starter motor. "B" is the inrush voltage drop caused when the starter motor is just beginning to turn. After all, I have to get the starter moving, and the starter is acting against all that mass in the engine. This loaded voltage reading is going to be lower than what you're used to seeing when performing a conventional loaded voltage test so rather than use the 9.5v-9.6v limit you learned in school, use 8.5 volts as your minimum here.

The time between "B" and "C" is the engine cranking. The little hills you can see are caused by the individual cylinders coming up on their compression stroke, just as we saw in the relative compression test. At "C", the engine has started and is running on its own, with the key returned to the "Run" position. The upslope is the charging system replenishing the battery before settling on a more stable charging voltage at "D." Figure 5 shows the current pattern.



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As we saw in the voltage pattern, “A” is where the key is turned on and the scope starts its trace. As the key passes to the “Start” position, current flows through the solenoid contacts and then into the starter motor. Again, the inertia of the starter motor and the engine have to be overcome before it will begin to move, and that brings us to “B” – inrush current. In this example, inrush current is reaching nearly 600 amps! But it’s only for a microsecond and is not an indication of any problems in the system.

By now, you recognize what the peaks represent on the way to “C,” or the time the engine starts running and the alternator starts putting back what the starting system took out. Notice the short but rapid increase in current that quickly drops off and becomes stable. Since the current clamp is around all of the negative (or positive) battery cables, the current graphed on the screen represents “net” current flow — that is, the final total of current demanded by the system and the current being supplied by the alternator. This net amount will run around 3 amps or so. Any significantly higher amount should be cause for further investigation and may indicate a sulfated battery that is placing a burden on the alternator.

Running in-cylinder pressure diagnostics

This is one test that I truly believe was ground breaking, changing the way we test engine mechanical systems forever. By adding a pressure transducer to your

scope, you can now “see” the pressure changes in a cylinder throughout the entire 720° engine cycle — and with no more effort that performing a cranking compression test with a mechanical gauge. In Figure 6, I’m showing you a normal cylinder with the ignition and injector events included for reference.

Scope settings: *Channel 1 – Pressure transducer is connected to channel 1. Follow the manufacturer specific set-up instructions for your scope. On this Pico, the transducer scale is selected from a drop-down menu and in this example is reading -25 to +100 psi.*

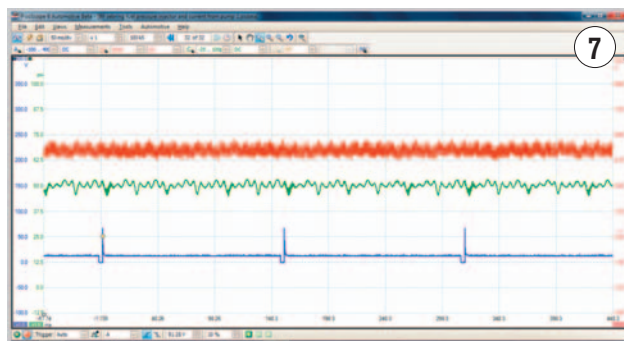
Channel 2 – Connected to ignition event based on ignition system used by vehicle.

Channel 3 – Connected to injector event, by backprobing ground side (control side) of injector and using a 10:1 attenuator to protect the scope from voltage overload. Scaling is -100 to +400 volts to allow for inductive kick of injector that occurs on turn-off.

Time base – 20 milliseconds per division OR 0.2 seconds total screen time.

Trigger – Set to “auto”, rising slope of channel 1 with capture to begin at 4 psi.

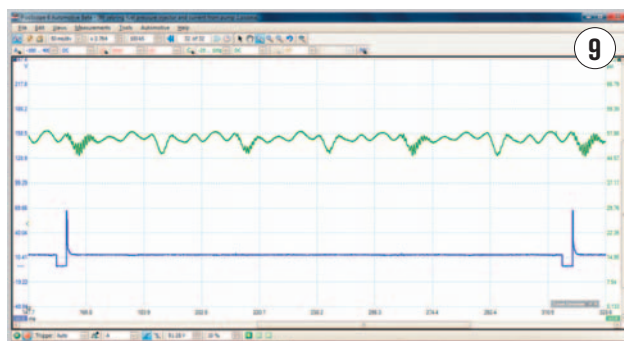
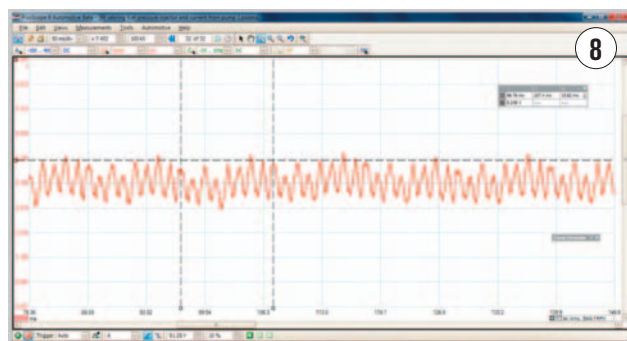
While this capture was taken using the Pico WPS500 transducer, there are others on the market, notably those offered by Snap-on and Automotive Test



Solutions (ATS). I have to offer props to ATS and its head, Bernie Thompson, because I sincerely believe he is the one most responsible for bringing this test method to the industry. There is so much information in this one capture that I can’t begin to do it justice in this short space. Luckily, Bernie has written a series of articles on this technique for us and you can access them all on our website. But to whet your appetite, consider that this method can find problems with poorly sealing valves, variable valve timing issues, timing belts that are out of time and a lot more — all without tearing anything apart for a visual check. Think that will save you time?

Fuel system testing

The pressure transducer can be used for a lot more than in-cylinder testing, too. One way I like to use it is to deploy it on my scope for monitoring fuel pressure in place of my mechanical gauge. It allows me a quick way to check for injector issues that otherwise would take a lot of time to test. But I’m getting ahead of myself. Let’s get to the settings I use to



capture the patterns you see in Figure 7.

Scope settings: *Channel 1 – Connected to injector event, by back-probing ground side (control side) of injector and using a 10:1 attenuator to protect the scope from voltage overload. Scaling is -100 to +400 volts to allow for inductive kick of injector that occurs on turn-off.*

Channel 2 – Low current clamp wrapped around a “Fuse Buddy” that has been placed in substitute for the fuel pump power feed fuse in the junction box. Scale set to 0-10 amps.

Channel 3 – Pressure transducer installed in fuel test port instead of mechanical fuel gauge. Scale set to -25 to +100 psi.

Time base – 50 milliseconds per division OR 0.5 seconds total screen time.

Trigger – Set to “auto”, rising slope of channel 1 with capture to begin at 50 volts.

Testing fuel pump current has been around for as long as I’ve been using a scope, but there are still lots of techs who have never heard of this technique before. The pattern shown is not clear enough for diagnostic use, so let’s take advantage of the scope’s ability to zoom in and take a look at the pattern shown in Figure 8. With very little effort we can see how much current the pump is drawing (a little more than 5 amps here) and what the speed of the pump is (roughly 5300 rpm). Consider that this approach works well on older style systems and that you may have to adjust it a bit when looking at pumps that are pulse-width modulated. Even so, the pump is a motor, just like a starter motor, and it’s current will be impacted by the amount of work it’s doing — or not doing. And using this method beats banging on the fuel tank with a hammer!

Consider a pump that has a low current draw and a high pump speed. That indicates a pump that isn’t working hard. Ever have a customer get towed

in for a “no start” concern where his car said it had a half a tank of gas but it was really empty? How about the opposite scenario — where pump speed is low and current demand is high? That indicates a pump trying to overcome a restriction — maybe a clogged filter?

On to Figure 9 for a closer look at the pressure transducer pattern. Notice the six lowest valleys between the injector events. We’re looking at a six-cylinder engine, and the injector pressure drops across all six injectors. How long would it take you to perform this kind of test conventionally?

In this example, they all appear even, so I don’t suspect a problem with a sticking injector. However, there are funny little squiggles on every other valley. What causes those, do you think? In this case, the three squiggle captures are all on the same bank and closest to the test port. This is normal “ringing” in the fuel line as each injector opens and closes. The rear are less so because the distance allows the rail to dampen the effect before it gets to the transducer.

And No. 5 is...

Actually, my fifth favorite test is any test that I haven’t tried before. The four examples I’ve provided are great examples of tests that once had never been performed before! But some enterprising technician asked “What if?” and tried it. Now, they are pretty standard for all of us!

So ask yourself the next time you face a diagnostic challenge how you could apply your scope to the situation. And if you come up with something, let me know. I’d love to hear about it! *TM*



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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ELECTRIC VEHICLE SERVICE — THE FUTURE IS HERE

ELECTRIC VEHICLES ARE MORE COMMON AND MOVING TOWARD MAINSTREAM. HOW WILL THIS AFFECT YOUR SERVICE BUSINESS?

JEFF MINTER // Contributing Editor

Since 1999, hybrid electric vehicle sales (HEVs) in the United States have seen a fairly significant increase. From the initial 17 Honda Insights sold in 1999, sales of HEVs grew to a peak of nearly 500,000 vehicles in 2013. Since then, in total there have been more than 4 million HEVs sold in the US.

Many don't realize that "modern" electric vehicles (EVs) were actually introduced to the US in 1995, before HEVs. EV model offerings peaked in 1999, before dropping off fairly quickly. EVs virtually disappeared from the US market by 2005 before reemerging in 2008. Since then, EV sales have continued to grow rapidly. From 2011 to 2015, the sales volume of EVs increased by over 500 percent while HEV sales increased by less than 45 percent. That increase, along with an aging population of the earlier EV models, is now placing shops in a position to seriously consider gearing up to service EVs.

The resurgence of EVs

When looking at national vehicle sales data by fuel type, both plug-in hybrid electric (PHEV) and EVs are combined into the "EV" category. The resurgence in EV sales began in late 2010 because of the introduction of the Nissan Leaf and the Chevy Volt, and in 2012, Tesla introduced the Model S. In 2016 there



NISSAN LEAF CHARGE PORT

PHOTO: NISSAN

were 29 EV/PHEV models available in the US, with 31 HEV models.

So why are we seeing this resurgence 10 years after EVs disappeared? It's likely a combination of improved technology, increased regulations and changes to incentives. The most obvious change in technology is in the batteries. The increased energy capacity available in modern batteries has allowed more flexible vehicle design, improved vehicle range and decreased charging time. Battery improvements, along with more efficient electric motors and motor controls results in the much higher EV performance we are seeing today.

The major regulation change that is pushing more PHEVs and EVs into the

market is the Corporate Average Fuel Economy (CAFE) requirements. The current plan is to steadily increase that requirement to 54.5 mpg by 2025. The CAFE standard testing is done using a different drive cycle than the one used to calculate the fuel economy numbers published on new vehicle window stickers. That difference results in the CAFE requirement number being around 25 percent greater than the number published on vehicle stickers. Even taking that into consideration, the advertised fuel economy will need to average around 40 mpg to meet the 2025 requirements.

To further complicate things, incentives for vehicle manufacturers and consumers are continually changing.

HEVs are a perfect example of this, as they were fairly heavily incentivized in the earlier years of production. Many of those incentives have since expired, and there are now more incentives available for EVs and PHEVs, which are likely here to stay and will continue to climb in numbers at a staggering pace, similar to the early years of the HEVs.

Technology carry over

If you are prepared to work on HEVs, then you're already at least part way there. If you aren't prepared for HEVs, you should start, as it will give you a head start on the PHEVs and EVs. PHEVs have all of the same basic components HEVs have (along with some additional items). The same holds true with EVs with the exception of removing the Internal Combustion Engine (ICE) and the supporting components. Any electric drive system will have some common components — high-voltage battery, inverter, converter, electric drive motor(s) and controller.

The high-voltage batteries in current PHEVs and EVs are Lithium-based. Some HEVs have leveraged Lithium-based batteries in more recent years; however, some still rely on Nickel Metal Hydride (NiMh) batteries. NiMh batteries don't have the energy density required for modern PHEVs and EVs to sustain the desired range, so it's highly unlikely we'll see that technology transfer over. Either type of battery requires thermal management (cooling and/or heating) to attain maximum life and capacity. This can be done using air and/or liquid heat transfer mechanisms, depending on the design. While Lithium-based batteries are much lighter and more compact than NiMH batteries, they can still be very large and heavy and typically require special equipment (fixtures, lift tables, etc.) to safely remove them from the vehicle without risking damage or injury.



BMW i3 EV

PHOTO: BMW

The inverter is the part of the system that allows a DC energy source (the high-voltage battery) to supply AC energy to the drive motors. It also allows the AC drive system to recharge the high-voltage DC battery. The operation and control of the inverter is probably one of the harder things for most technicians to grasp. You'll need to have a really good understanding of basic electrical concepts and diagnostic processes (ideally including the use of an oscilloscope for current ramping). In most instances, these units can be diagnosed like you would a typical controller on any vehicle; simply test the inputs and outputs. If the inputs test good and the outputs test bad, then the unit is at fault. Of course, if the inverter has failed, you need to be sure something else didn't cause the failure before replacing it. As always, root cause analysis is critical to avoid repeat failure.

The converter, in simple terms, is a unit to either increase (boost) or decrease (buck) DC voltage. One common function of a converter in EVs, PHEVs and HEVs is to replace the alternator. In that application, the converter allows energy from the high-voltage DC

system to be stepped down to charge the 12V battery and operate 12V lights, accessories, etc.

Lastly, there are the electric drive motors and the controller associated with the system. The basic concept of the electric motors is the same between EVs, PHEVs and HEVs; however, the design and applications vary widely. The good news is the testing of these motors is fairly similar regardless of the design; however, some designs make access to perform the testing difficult at the shop level.

Service opportunities

For PHEVs, it should be a win-win for proactive shops. These vehicles still have all of the ICE parts/systems and the associated required maintenance. There are differences in service intervals, etc., but in reality the same service opportunities exist for PHEVs as they do for HEVs. EVs will obviously not have the ICE-related service needs, but everything else from HEVs should pretty much carry over. You'll need to find other legitimate service opportunities beyond an oil change to bring the customer in, and some of these new op-

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portunities may be fairly simple, such as inspecting and cleaning the air supply system for an air-cooled HV battery. Others may be more involved, such as replacing the liquid coolant for various electric drive components.

While the warranties can be pretty long, and some even include preventive maintenance during the warranty period, there are still opportunities to capture the customers. Much like HEVs were leading-edge technology in the early 2000s, these vehicles are still somewhat at that stage. That means many of the owners purchasing these vehicles are “early adopters.” If the trends and demographics follow those of early HEV owners, EV owners will likely have a higher income level, a higher amount of education, be more tech savvy and less price-driven. It also means they’ll do a lot of research on their vehicles, including the needed maintenance/repairs, and they will likely be networked with other PHEV/EV owners who have similar interests.

To begin attracting these customers, you may need to somewhat tweak things you are already doing. Take a look at the services you already offer and ask yourself how you could change the marketing to focus on these customers. While the vehicles may be under warranty and might even have a maintenance package from the dealer, there are still items that won’t be covered because they are considered wear items or adjustments. For instance, if your shop performs alignments, you could offer customers an alignment to optimize fuel economy/range. Another area of opportunity could be brake services. Many of the maintenance schedules include a brake inspection with no mention of actually servicing the brakes. All vehicles with electric drive (HEVs, EVs and PHEVs) utilize regenerative braking, which reduces the use of the friction brakes. In some climates that can

lead to brake components seizing due to accelerated rust accumulation. Owners may want to consider an annual brake service (vs. just an inspection) to help ensure proper operation of the brakes. Remember to stress the importance of proper brake operation but not just from the safety side of things. A dragging brake will increase the force required to drive a vehicle, which will in turn decrease the efficiency/range. These are just a few examples of many services that could be catered to these vehicles/customers.

Lastly, look at how your shop is perceived and how you are communicating with your customers. A “green” image will be important to many of the EV and PHEV owners. Consider things like using environmentally friendly products in customer areas, promoting recycling efforts you likely already have in place, and cut down on paper use where possible. Many of these customers will likely prefer emails or text messages to paper estimates or phone calls. As an added bonus, most shops see an increase in repair approvals through the use of these types of communication tools.

Obviously EVs won’t replace “traditional” vehicles any time soon, but that doesn’t mean you should ignore them either. In fact, while hybrid vehicles were considered “emerging” not that long ago, consumers today would likely lump them into the “traditional” vehicle category. Staying up to date on these types of technologies will be critical to avoid having your available market share shrink in years to come. 



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BERNIE THOMPSON //

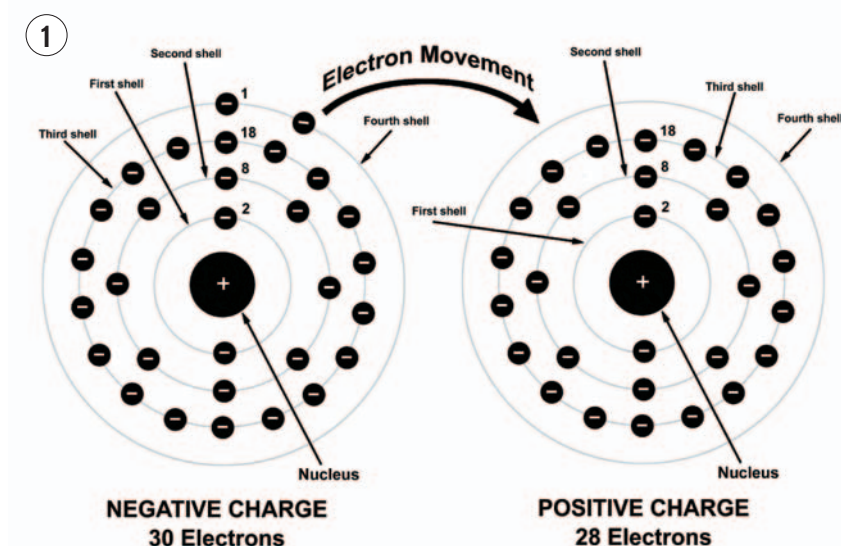
Contributing Editor

The modern vehicle contains over a mile of wire, up to 100 modules and thousands of electrical connectors. Looking at a wiring diagram of one of these vehicles can be a bit overwhelming. Without a doubt, the complexity of these vehicles has reached an all-time high. With onboard radar and laser detection systems, it may seem like you are working on some sort of aircraft or spaceship and not that of a road vehicle. So how does one navigate these complicated systems? When diagnosing this amount of wire, modules and connections, one can no longer guess at where the problem may lie.

Establishing a solid foundation

Whether you are working on a spaceship or a modern vehicle, it will be necessary to understand basic electrical principles. Perhaps one of the most important principles in diagnosing electrical systems is the voltage drop. This is where voltage is consumed by resistance.

Voltage is electric energy or electric pressure. This electric energy is the potential difference between two points with a charge present between them. This charge arises when an atom becomes imbalanced by losing an elec-



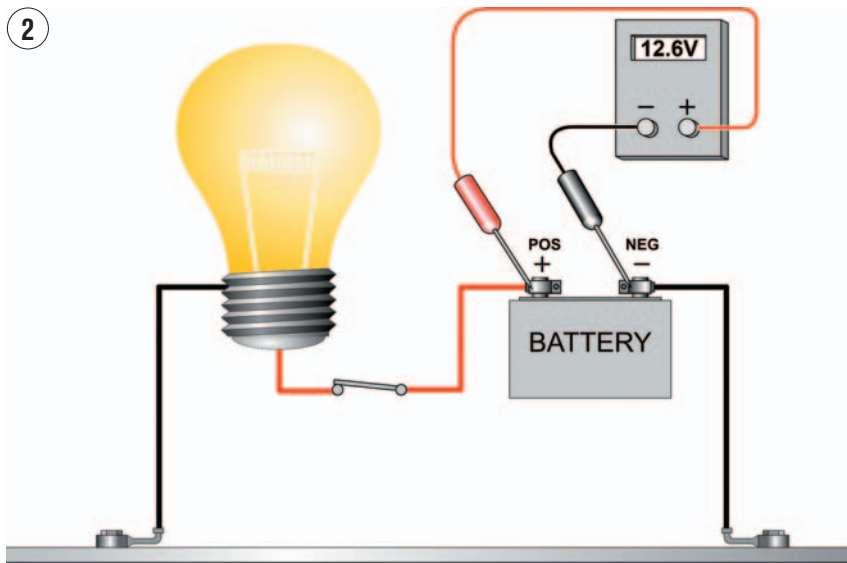
tron as seen in Figure 1. In most atoms, there are an equal number of protons (positive charge) as electrons (negative charge), and the opposite charges of these two kinds of particles balance out or are in equilibrium. It is possible to break electrons free from their orbits about the nucleus, causing an imbalance in charge. In order for the atom to lose an electron, the atom must have an outside force acting on it. This force must exert more energy on the electron than the bond between the nucleus of the atom and the electron. This force will be a large energy source that can be caused by light, magnetism, heat or chemical energy. As this energy is applied to a number of atoms, more atoms

become imbalanced, causing a greater difference of charge. When this occurs, a potential energy is created. This energy is referred to as electrostatic potential, which is the difference of charge in an electric field. This charge is typically measured in units called voltage. The greater the potential difference or voltage, the greater the work can be done by the electrical energy. In order to determine how great the potential difference is, or how much voltage is present, a measurement must be taken.

In order to make a voltage measurement, a reference must be provided. The voltage measurement is based on two probes: positive and negative. The potential difference between these

PHOTOS: BERNIE THOMPSON

2



probes is all that is measured. This potential difference is converted into units of voltage. In order for the total voltage in a system to be measured, a fixed reference point, such as the earth (ground), must be used so the total potential can be calculated. When measuring the voltage in a vehicle, the lowest point of potential will be the negative post of the battery. Therefore, the ground probe will be connected to the battery negative post (ground), while the positive probe will be connected to the circuit to be tested. The difference between the probes, or voltage units measured, will then be displayed on the measuring device as shown in Figure 2. The entire test is based on where the two probes are placed. This is very important because the only results displayed on the measuring instrument is the difference between the two test points.

Ohms, amps and volts

When testing a circuit, several methods of measurement can be used — ohms, amperage and voltage. Ohms is the measurement of the resistance that is within a circuit. The problem with using this type of measurement is that the circuit under test will need to be open. This means the ohms can only be measured in a circuit that is not under load; therefore, the resistance in ohms can measure low (good) but can be too high under a loaded condition. One such example is if an 18-gauge wire were used as the battery cable on an automotive starter. This wire would ohm with very little resistance, but under the load of the starter motor draw would create a large amount of resistance to the current flow. This is caused by a limited area of the conductor that can flow electrons. With a low electron flow rate, such as with an OHM meter, this limited area would not be seen. However, this limited conductor area when exposed to high current flow will allow resistance to occur to electron flow. In the case

of the starter motor, the resistance would be so high to a high electron flow rate that the electric energy (voltage) consumed by the wire would release enough heat to melt the wire, thus breaking the wire and the electrical circuit. This could also be illustrated with a highway in a large city. If one was to watch the flow of vehicles at two o'clock at night, there would be very little resistance to the vehicles moving on the highway. This is due to very few vehicles occupying the highway. But if one was to watch the same highway at the same location at seven o'clock Monday morning, you would find a totally different outcome. The vehicles would be backed up on the highway due to high resistance. The highway area and number of lanes did not

change between these two times. The change that occurred was the number of vehicles occupying the highway. Now think of the highway as the electrical conductor and the vehicles as the electrons. In order to see resistance, the load must be high. So the use of an OHM meter to measure vehicle electrical cir-



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cuits is not a good choice for most vehicle diagnostics.

Amperage measures the electrons flowing through the circuit. This electron flow is referred to as current. Current is always the same throughout the circuit, so no matter where the current is measured within the circuit, the results will always be the same. The current is a good indicator of the circuit's condition — low current indicates high resistance, high current indicates low resistance and the correct current indicates the circuit is functioning as designed. Therefore, amperage can show a problem is present within a circuit but cannot be used to locate where the problem is within that circuit.

Voltage measures potential difference of the circuit. This potential difference (voltage) can be used in a loaded circuit to locate where the problem is within that circuit. The electric energy (voltage) that pushes the electrons through the circuit will be consumed by any resistance within the circuit. By measuring where the voltage changes within the circuit, one can locate the resistance of that circuit. This measurement is referred to as voltage drop. In

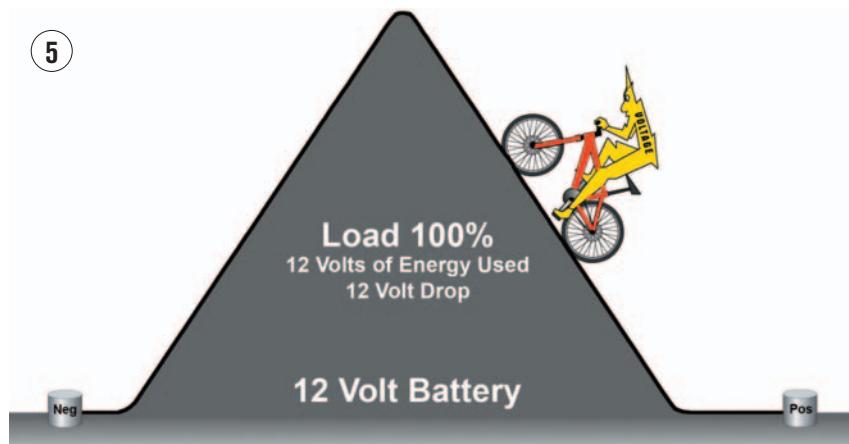
order to test a circuit for voltage drop, the circuit will need to be loaded. Current must be flowing through the circuit so that the electrical energy can be consumed or used by the resistance or load (the load would be the unit within the circuit that is there to use the electrical energy such as a head light, a blower motor or a solenoid).

Voltage drop is a reduction in voltage in an electrical circuit between the source and the load. Voltage drop is caused by resistance in the circuit that uses some of the electrical energy that would normally go to the load. This reduction in energy is also a reduction in the work that can be done

by the load, thus causing problems in the electrical circuit. This electrical energy that is used to cross the resistance in the circuit uses some of the potential difference, or voltage. This voltage change, or voltage drop, in the circuit will show the location of the resistance within the circuit.

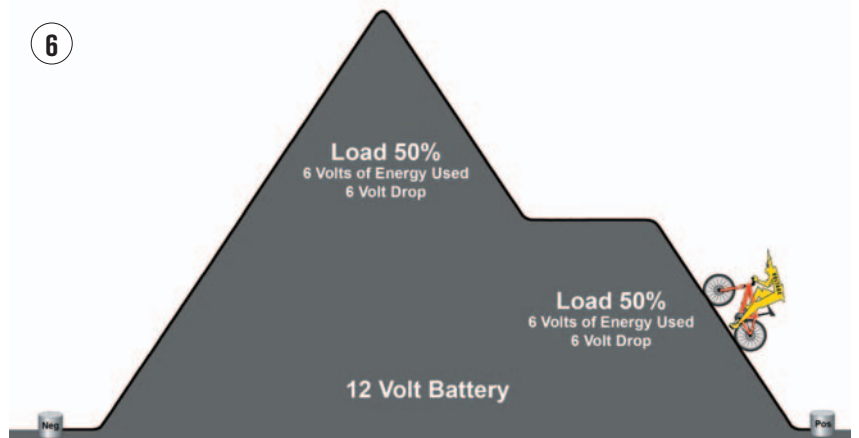
A slightly different twist

Now let's look at voltage with a slightly different twist to it, as shown in Figure 3. Think of voltage as the electrical pressure that pushes the electron through resistance. Now picture yourself being the rider on the bicycle (voltage) and the electron being the bicycle. The bicycle or



electron, will not move without an outside force acting on it; it will remain at rest. In order for the bicycle to move, you (voltage) will have to provide energy or force to the bicycle. While this force can be applied to the bicycle, it does not have to move the bicycle. Think of this as a bicycle that is against a starting gate, as shown in Figure 4. The rider can put pressure against the pedals, but the bicycle does not move. In order for the bicycle (electron) to move, several things must occur: the gate must fall, the circuit must be complete and the bicycle must return to the place it started from. Once the gate falls, the pressure will move the bicycle around the circuit. The rider, just like voltage, is the pressure to move the bicycle or electron; the more pressure applied, the more work can be done.

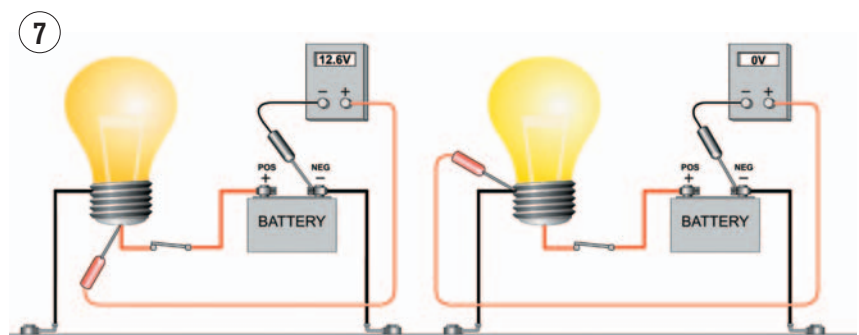
If you were climbing a hill on the bicycle as shown in Figure 5, you would need to apply pressure on the pedals in order to get up the hill. The more pressure you applied on the pedals, the more work you could do. The bicycle will not climb the hill by itself — it will need an outside force acting on it; it will need you (voltage) to apply this force. The force or effort that you apply from the bottom of the hill to the top of the hill is the potential difference. This potential difference is the amount of energy that was used or consumed in order to climb the hill. This potential difference is the lost energy that occurred to push through the resistance of the hill. This is similar to what happens to the voltage in a circuit — the voltage has to push the electrons through the resistance or load and in doing so loses energy. Once you have expended the energy to climb to the top of the hill, you will not have to expend very much energy to coast down the hill. There will be a slight loss of energy due to the friction between the road and tire, the bearings and the air resistance. This energy loss is similar to the resistance of the conductor in a circuit. There will



always be a small amount of voltage remaining in the negative side of the circuit to push the electrons through the resistance of the conductor. This is usually hundredths or tenths of a volt. Any resistance in the circuit will have voltage present in order to force the electron through the resistance. A small resistance will have a small voltage drop, whereas a large resistance will have a large voltage drop. At the point where there is no resistance within a circuit, there is no voltage present in the circuit. Voltage in a circuit is only present to push electrons through the resistance. If there is voltage present, there is resistance present. This is much like riding the bicycle — if there is a hill still remaining, you will have to have energy left in order to climb the hill. However, current is always equal throughout a circuit. Electricity is current or the movement of electrons, and voltage is what pushes these electrons through the circuit. Current within a

circuit is always constant, and voltage within the circuit is changing based on the resistance within the circuit.

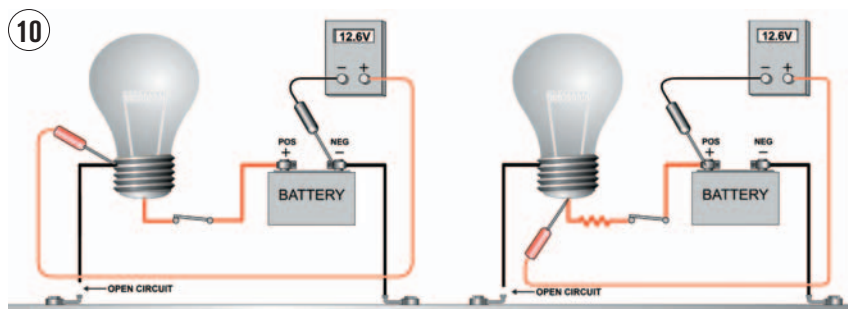
If there is more than one hill, it will take energy to climb each hill, as shown in Figure 6. After each resistance there will be lost energy that can be measured as voltage drop. The total of all the voltage drops within the circuit will equal the applied (source) voltage. The larger the hill, the larger the energy loss; the smaller the hill, the smaller the energy loss. If both hills are equal, the energy will divide equally between them. In a good circuit there will be a very small voltage drop on each leg of the circuit, positive and negative. This is due to the resistance of the conductor, which usually produces voltage drop of hundreds or tenths of a volt. Additionally, each switch, transistor, MOSFET or relay will produce voltage drop of hundreds or tenths of a volt within the circuit as well. The load will use all the energy in order to do the work. So on



the positive circuit leg, you should have very close to source voltage, and on the negative leg you should have very close to 0 volts, as shown in Figure 7.

Looking for change

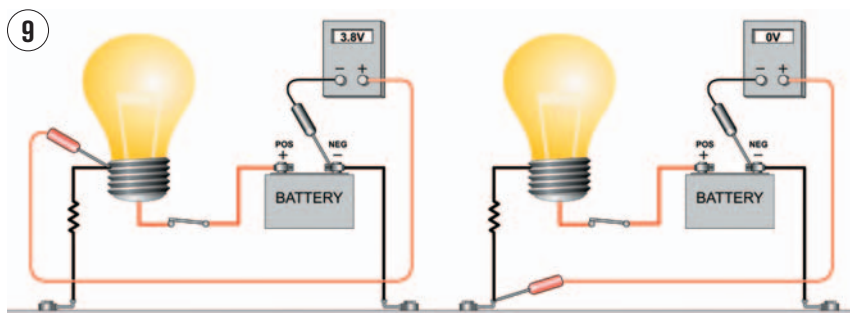
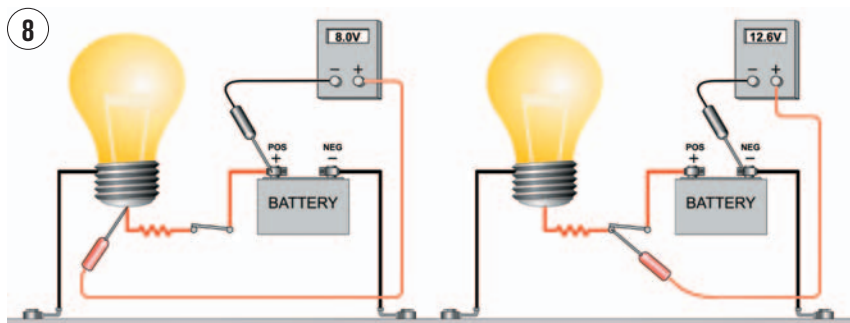
If there is a voltage change on the positive or negative leg of the circuit, this is an indication that there is unwanted resistance in the circuit. If you are testing the circuit at the load, on the positive leg the voltage drop is indicated by a reduction of voltage due to the resistance before the load consuming some of the energy, and on the negative leg, the voltage drop is indicated by an increase of voltage due to the resistance after the load needing energy to push the electrons through the resistance. By changing the test point on the circuit, the location of the problem can be found, as shown in Figures 8-9. The voltage difference is only measured between the probes. So once the resistance is not located between the probes, the voltage on the positive leg will show close to source voltage and on the negative circuit leg will show close to 0 volts. A circuit is comprised of both positive



and negative circuits, each of which makes up 50 percent of the total circuit. When testing the circuit, the first test points should be at the load; this will determine which leg of the circuit has the problem, positive or negative. If there is not a voltage drop present, the circuit is good and no further testing will be needed for the power and ground circuit. If there is a voltage drop present, the probes will then need to be moved in order to locate the problem, as shown in Figures 8-9. If you need to measure the positive leg drop, you can move the lead to the positive post of the battery. Now the measurement will only show the voltage between the probes, which is the positive leg. Always remember the circuit must have current

flowing through it in order to test it. If the circuit is open, there will always be source voltage present to the point of the open circuit, as shown in Figure 10. Since no current can flow in an open circuit, there cannot be a voltage drop present. So instead of a voltage drop, source voltage will be present to the point where the open circuit occurs. Be aware that an open circuit can hide a resistance contained within the circuit, as shown in Figure 10. If no current is flowing, then no voltage drop can occur showing the resistance.

Where there are two resistances within a series circuit, the voltage between these resistances can be used to convey data to a control unit. When these resistances are in this configuration, it is referred to as a voltage divider. This is a very common circuit that is used in the vehicle electronic systems that are based on voltage drop. With a basic understanding of these principals and a little practice, you will soon be able to navigate these complex systems. When diagnosing the modern vehicle just remember to follow the data. The data that you gather during your diagnoses will always guide you to the problem. **TM**



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A NEW YEAR'S RESOLUTION

AS EINSTEIN SAID, IF YOU CAN'T EXPLAIN IT SIMPLY, YOU DON'T KNOW THE SUBJECT WELL ENOUGH

PETE MEIER // Technical Editor

The holidays are over, and the New Year has begun. What resolutions did you make this year? After all, we make resolutions — little promises to ourselves — that will help us to become better than we were last year. If you're a professional technician, one of your resolutions should revolve around continuing your education, and 2017 brings numerous opportunities for you to do just that. Here's a list of some of the bigger training events coming your way in 2017.

MACS (Mobile Air Conditioning Society Worldwide)

Feb. 15-18, 2017

Anaheim, California

www.macsw.org (click on "2017 training event")

One of the first events of the year is the MACS training event and trade show, being held this year in Anaheim, Calif., at the Anaheim Marriott. This organization has a focus on the climate control segment of our industry and offers training for both the light duty and heavy duty markets. In addition, there will be presenters offering more generic fare — among them our own Tony Martin and Dave Hobbs. Accompanying that training is a trade show featuring more than 70 exhibitors, including *Motor Age*.

With plenty to see and do in the area (it's right next door to Disney), this event is a great break from the winter chill and is easily turned into a vacation/training and networking opportunity!

VISION Hi-Tech Training and Expo

March 2-5, 2017

Overland Park, Kansas

www.visionkc.com

Celebrating its 25th anniversary this year, ASA Midwest is once again hosting VISION at the Overland Park Convention Center in Overland Park, Kansas. As an attendee and presenter at past events, I can assure you that you will not be disappointed by the quality of the training available at this event. In addition, the event has become almost an annual pilgrimage for technicians and shop owners from around the



PHOTO: PETE MEIER

PETE MEIER taught "Practical Electrical and Scope Techniques" at all three Commitment to Training events, including here at Washtenaw Community College in Ann Arbor, Mich.

country who use the time to reconnect with old friends and network to meet new ones when classes are not in session. Attendees have the option of choosing daily passes for Thursday and/or Friday, a weekend pass for Saturday and Sunday, or the 4-day "Power Pass" that covers the cost of training for the entire event. A trade show is also co-hosted at the venue.

Insider tip: If you want to stay at the Sheraton next door to the convention center (home to all the after-class action), you need to get those reservations in early. Even now may be too late! It's that popular of an event.

Technicians Service Training (TST) "Big Event"

March 25, 2017

Tarrytown, New York

www.tstseminars.org (scroll down the home page to access the event link)

TST has been bringing quality training to the Northeast for many years now, thanks to dedicated volunteers on the TST Board of Directors. You'll recognize their president, G. Jerry Truglia, from the many webinars we've done together and the numerous articles he's penned for the magazine. Little known is TST's commitment to its area members, supplying top trainers on a "circuit ride" if you will, hitting venues in Massachusetts, Connecticut, New Jersey and finally home to New York, where the final session is also simulcast for the benefit of those who could not attend in person.

The Big Event is just that — their annual celebration of techs and training. This year, guest presenters will include Tom Rayk,

Wayne Colonna, Mark Warren and Scott Brown. The event has grown to the point that a new venue had to be selected, so don't go to Fishkill! In 2017, the event will be hosted at the Westchester Marriott in Tarrytown, New York. Cost to attend the event has been kept to a minimum due to the generosity of corporate partners. It's \$75 for a full day of training, and that even includes breakfast and lunch!

Automotive Training Expo (ATE)

*March 24-26, 2017
Seatec, Washington
atetrainingexpo.com*

ASA Northwest hosts the annual Automotive Training Expo at the Doubletree hotel in Seatec, Wash. — just a short ride from the airport. Event organizers have worked hard on growing the event with a focus on “quality, not quantity” and hosts a small trade show alongside the training program. While details for the event were not available at the time of this writing, I can certainly recommend this event based on the quality of the programs offered in the past.

NACE Automechanika

*July 26-29, 2017
Chicago, Illinois
www.automechanikachicago.com*

There is little doubt that of all the training events available to you, this is the largest. Last year, 2,000 technicians and shop owners came to McCormick Place for training and to see an international level trade exhibit. This year, it will be even bigger with the addition of ASA's International Autobody Congress and Exposition, better known simply as “NACE.” The training event for mechanical repair attendees (that doesn't mean you collision guys can't come!) will be held July 27-29 and will feature a who's who of instructors like John Thornton, Bernie Thompson, Jorge Menchu and

too many more to list. Nearly 140 sessions will be offered over the 2 ½ day period, and that doesn't include what the NACE folks have on tap!

What really makes this event unique is the structure we've adopted for attendees. There is no cost for the mechanical repair training offerings to you — none. All you have to do is get there and cover your trip and meals. This one is a no-brainer, guys and gals. You need to come to Chicago!

Chicago Area Networking (C.A.N.) Conference

*Sept. 22-24, 2017
Chicago, Illinois
www.asailcan.com*

ASA Illinois has some of the best instructors in the business living in the Chicagoland area, and you can see them at their annual C.A.N. Conference, to be held at the Westin Chicago Northwest in 2017. In addition to great technical and management classes, a small trade show is also held to allow attendees to interact with suppliers and aftermarket representatives. New last year, hands-on training was made available and is expected to return in this year's event.

Additionally, ASA Illinois co-directors have worked hard to offer continuous training and networking opportunities to their members. If you're a shop owner or technician, check out their main site at www.asailinois.org for more info on how membership can be of real benefit to your business and career.

AVI Conference/AAPLEX

*Oct. 31-Nov.2, 2016
Las Vegas, Nevada
www.aviondemand.com/avi-conference*


AAPLEX (and SEMA) are the largest industry trade shows in the U.S., and the folks at AVI co-host their annual AVI Conference at the Sands Con-

vention Center the Sunday through Tuesday of Industry Week. So far, no information on the 2017 event has been posted (Understandably — it's a long way off yet!), but if you have plans to attend the shows, make plans to attend this training while you're there.

Be sure to check out the Hoover Dam and Red Rock Canyon National Conservation Area during the day before you hit the Strip after class!

That's not all, folks!

While these may be among the better known training events, they are not the only ones available to you. More and more, your local ASA affiliates are hosting training of their own, and the aftermarket has boomed over the last few years with renewed commitments to training from companies like Federal-Mogul (Garage Gurus), Standard Motor Products, Gates, Carquest Technical Institute, NAPA, WORLDPAAC and many, many more. Your local parts house should have information on local offerings you can take advantage of, and if not, contact these companies directly to learn how you can have them come to you — or you can attend training at their dedicated facilities.

Ten years ago I used to complain as a technician that training opportunities were few and far between or too costly to attend for the “working man.” That is no longer true — and no longer an excuse — to get the continuous education you need to stay on top of your game. Be sure to let me know if I've missed something! 



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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THE INTERMITTENT WAITING GAME

APPROACH THESE PROBLEMS WITH LOGIC, DIAGNOSTIC CURIOSITY TO TACKLE INTERMITTENT FAULTS IN A TIMELY MANNER

JAMIE LAZARUS // Contributing Editor

This article could be aptly named “Human error compounds vehicle repairs, part 2” (see “Human error compounds vehicle repairs,” August 2014). In this case though, I was one of the people that erred while diagnosing an intermittent charging system warning indicator on a 2009 Chevy Cobalt LT. Yes, as hard as it is to believe, I make mistakes. I am indeed human after all!

What’s typical in a repair shop is not necessarily what a mobile technician sees. In fact, don’t you “stationary” techs and shop owners handle the typical situations? I’m usually not called to help until the shop’s exhausted most — if not all — of the ways to resolve their customer’s vehicle complaints. In some cases though, a shop will call me in because they are so busy with “gravity” jobs, and they also have a job that can potentially tie up a technician’s time in ways that aren’t as productive. This car’s problem happened “every so often,” and the shop was very busy already, so I got the call.

The nature of intermittents

The very nature of an intermittent fault implies that a considerable amount of time may be spent waiting for — or trying to recreate — the conditions in which the fault is present (and can be diagnosed). To an inexperienced or an impatient technician, they can bring a type of anxiety that may cause that person to jump to conclusions or to misdiagnose. I know this from personal experience. I don’t get scared anymore when the word “intermittent” is included in the problem description. I approach these situations as logically as possible.

I can’t recite an exact number, but I can say a majority of intermittent faults I’ve dealt with were related to a previous repair. If the customer is in your shop for the first time, do you ask questions about what may have been done previously? Do you strive to have repeat customers? Isn’t it great when you can look up the repair history on a vehicle when that customer returns



2009 CHEVY COBALT LT

for more work? Don’t you just love when you can verify which services and previous repairs had been done using your service history? Believe it or not, this is one of the most powerful tools a shop has when it comes to diagnosing problems.

This car had no history. That is, it had been sold at an auto auction a few months prior to being sold again by the used car dealer who called me in to look at the charging system problem it had. The Carfax the dealer provided the customer was spotless. The dealer’s technician notes about the pre-delivery inspection performed prior to the most recent sale were minimal. Basically, I was without one diagnostic tool already.

When the repair/maintenance history isn’t available, I try to put all my senses to work. In addition to all the other diagnostic tools I may need, I have to be very observant. I have

PHOTOS: JAMIE LAZARUS

to listen like I'm in a quiet room, smell like I'm near a bakery, see things (not just look at them), etc., etc. I must be The Car Whisperer (also my company name, for those of you not in the know)!

In addition to getting what little history was available, I asked all the questions I could think of about the problem before approaching the vehicle. The tech had verified that the alternator continued to charge when the "battery" indicator was illuminated. The battery had passed tests — both a conductance test and a load test. It was unknown whether the indicator would illuminate only after the engine warmed up or if it was lit when first starting as well. I found out it didn't matter if the car was moving or not, and it sometimes happened on turns, other times not. The tech did little more than this because he was eager to tackle the many jobs the shop had taken in. I was on my own from this point going forward.

Where would you begin?

You now have the information I had. Where would you begin your diagnosis? Do you approach all your diagnostic dilemmas with a logical, systematic strategy? I believe we must use a logical approach to properly perform diagnostics. My first step was to make sure I understood exactly how and why the car battery indicator would be illuminated.

I've gotten in trouble before by assuming the car I'm working on today is diagnosed identically as the same model car I worked on in the past. I could have started my diagnosis assuming the charging system on this car is controlled the same way as the one on the last 2.2 liter GM I worked on before — but I know better. The slightest engineering difference could lead to a complete misdiagnosis, which benefits no one. That type of short cut sometimes costs you in wasted time and money!

I read the "Description and Operation" of the charging system and found on this vehicle, like many, that the alternator is controlled by the Engine Control Module (ECM), and the Instrument Panel Cluster (IPC) controls the charging system malfunction ("battery") indicator. The two modules communicate with each other — and with other modules — through the vehicle's networks. The ECM commands how much the alternator should charge based on the demand calculated by the Body Control Module (BCM). The BCM receives information from the Battery Current Sensor located on the battery negative cable. The sensor measures how much amperage is flowing into or out of the vehicle's battery.

I like to look at the wiring diagram(s) too when doing my initial analysis. In this case my research was done using Mitchell 1 wiring diagrams. I prefer these because they're in color and are what I call "interactive" in that when you hover your mouse over a circuit displayed, that wire is made bold, which makes it easier to follow through the diagram. I made mental notes when I reviewed the diagram. Now armed with knowledge that applied to this vehicle, it was time for me to actually get near it!

Next I performed a visual inspection, which is where I sometimes find the cause of the customer's complaints. Visual inspection is often a skipped step in lieu of something more technical. Many times I've found something obvious when called to a shop after the technician had spent countless hours analyzing scan data, digital oscilloscope patterns and sometimes had pinpoint tested ECU connectors. Has this ever happened to you? We have all been guilty of over analyzing problems and vow to never overlook the obvious things again afterwards.

During my visual inspection, I looked at the underhood grounds



A/C PRESSURE SENSOR LOCATION

— the ones I'd made mental notes of while looking at the wiring diagrams. I noticed some had been painted; one looked as if it was attached to the painted surface of the inner fender, and I saw paint overspray on the headlamp bezel. "Hmmm, this car's been wrecked," I thought to myself. One more item was added to my collection of analytical data. Note that this is the stage of diagnostics I was in: data collection. I wasn't anywhere near reaching for a tool yet.

What's my next step? Should I get my DVOM and start checking for a voltage drop on those grounds? Should I load them while testing? Should I be taking a wrench to them to see if they were tight enough? STOP! No, these are NOT the most efficient steps to take at this point (and may actually impede an accurate diagnosis)! Resist the temptation to fiddle with something yet. I continued my visual inspections looking for oil leaking on the alternator or its belt, aftermarket electrical devices installed and for anything that just didn't look right. I didn't find anything else.

I then wanted to duplicate the customer's complaint. I turned the key to the RUN position and observed the IPC carefully, watching for bulb prove-out(s). I confirmed all the indicators, including the battery, worked as designed, so I started the engine. Of course, as it usually happens with an intermittent fault, the battery light went out and stayed out, as it was supposed to when everything is working correctly. Since the problem was not occurring at this time, I left the engine running while I started gathering the tools I might need.

Time to ask the patient a few questions

After shutting the car off and installing a scan tool, I restarted the engine and scanned the vehicle systems. I perform network tests in situations like these because there are so many modules involved. It saves time when doing a Diagnostic Trouble Code (DTC) check of all modules, especially when multiple ECUs report a similar failure. In this case, only the ECM reported any alternator-related codes and that was a History DTC. The Supplemental Inflatable Restraints (SIR) confirmed my suspicions based on my observations of the painted surfaces under the hood. I also found a code in the radio, but neither it nor the SIR DTC was important to my diagnosis of the battery light, or so I thought.

Okay, I have a History P0621 in the engine controller, so I looked up the information about the code while I waited for the indicator to illuminate. Once again, I want to be sure the diagnostics I use are applicable to this car. I read the DTC Descriptor section in Mitchell 1 to better understand why the DTC set and what I will need to do to diagnose it. Basically, the ECM sends a signal to the alternator to control its output, and on another circuit the ECM monitors a voltage. If the engine's running, there

should be high voltage on the circuit, and if not detected by the ECM, it will signal the network modules to turn the charging system fault indicator light on and it stores the P0621 DTC. Please tell me what is considered "high" voltage?

The troubleshooting chart is relatively simple for the code; there are only four steps. Unfortunately, where do you think the chart will lead if the fault isn't present while I test? While the charging system operates as designed, I wiggle electrical connectors, tap-test the ECM, revved the engine, let the engine idle, and I drive the vehicle while monitoring the voltage on the circuit. Never did the battery light illuminate. I checked the ECM calibrations to ensure they were the latest available (they were). So, what would you do next?

I suggested we let the problem become more apparent, happen more frequently and test it while the light was on. The shop felt otherwise. Since their tech mentioned he thought the ECM was at fault, they picked up a used module "in case" I found it faulty. Remember what I'd mentioned earlier in this article about jumping to conclusions? They asked me to replace the ECM, reprogram it for use in this car and to perform whatever functions had to be done when the ECM is replaced (there were four, in addition to Vehicle Theft Deterrent (VTD) relearn). When I was done, everything worked properly.

The next week, they called me back. Yes, the light was back on and now it's happening more frequently. When I looked at it this time, in addition to the complaint about the "battery" light being illuminated, there was a new situation: The air conditioner was not blowing cold.

A simple mistake?

Did you ever get the feeling there was just something you were missing? That there was something you should have



CHAFED WIRING INSULATION

picked up on? These were the feelings I was having when they called me! In addition to the alternator DTC, there was another ECM History DTC, P0641, for the A/C pressure sensor voltage reading low. When I researched that code, I saw there was a problem detected in a 5 volt reference circuit, which included the A/C pressure sensor. It seemed the car was getting "sicker" the longer this went on!

Since this new development wasn't present before the ECM replacement, coupled with the fact that it was a used ECM that was installed, once again the shop owner jumped to the conclusion that it must be a bad ECM and ordered another. I convinced the shop owner to let me diagnose where the faults reside prior to module replacement. Begrudgingly, he allowed me to do so. This is where I, admittedly, screwed up. No, the mistake was not in wanting to diagnose, but in how I did it.

When I focused on the original problem, the Alternator "L" terminal Voltage DTC, the P0621, and ignored

the A/C problem, I was perplexed with how much voltage was too much, or how much was enough voltage, when the test was to check if the voltage was “high.” I decided to look at the OE service information to see if that would help. Indeed, I was to measure the key on, engine off voltage on an orange wire, the “Generator Turn-On Signal” circuit, and see if it was between 4.5 and 5.5 VDC. Would you, dear reader, have interpreted in the original instruction 5 volts to be the deciding point between “high” voltage or not? I have learned to not settle for ambiguity when diagnosing, and I find the extra expense of the additional subscription is more than worth the cost!

So, I needed to measure voltage at the alternator and if not within specification, measure at the PCM. My mistake was in how I back-probed the PCM Micro-64 connector. I’d improperly placed my back probe in the ECM connector, made contact with the wrong circuit, and I read a different voltage at the ECM than what I read at the alternator. It made no sense to me that there was a different voltage, especially since there was nothing else on that circuit. It was past closing time by then and based on the results of my tests, the procedure indicated the illumination of the battery light was caused by the ECM. I asked the shop owner to have his tech replace it. Can you guess what happened when they test drove the car after installing the replacement module? Everything was fine! I cleared codes and sent the car down the road. Uh, that was mistake No. 2, right? I mean, shame on me for not including diagnostics of the air conditioning complaint at the same time!

Yes, the car returned again. This time there were five ECM DTCs stored, all having to do with the same 5 volt reference circuit! I graphed the 5 volt




ENGINE HARNESS PIGTAIL BREAK-OUTS

reference data PIDs and saw an intermittent “drop” to ground only when the air conditioner was on. Once I took my blinders off and started looking at the whole picture, I noticed things in common! Instead of focusing, I took a step back and looked at the whole picture; I looked at the problems with a different perspective. I remembered seeing grounds painted over, grounds installed on painted surfaces and the SIR DTC that indicated the vehicle had been in a front-end collision. I also heard from the driver after the last repair that the light stayed off until he accelerated out of a turn. All these clues made me take a closer look at what might have been affected either during or after a frontal collision.

I traced the alternator wiring to a juncture where about three other sub-harnesses split off the main engine harness. One of those was the A/C pressure sensor! Another was one of the sensors with a 5 volt reference

“low” code, etc. I looked at the whole harness where it was routed along the front of the engine until I saw where someone had placed a heater hose on top of the harness between the oil dipstick and the block. That hose didn’t belong there and was being stretched in that location. Once the hose was properly located, I saw the convoluted tubing that protects the engine harness had been worn through by a sharp edge of the block, just rear of the engine oil dipstick! By lifting the harness, I saw bare copper wire where the insulation had worn through on two of the wires in that harness, one being the 5 volt reference wire, the other being the orange alternator wire!

Yes, compounded human error played a part in how this car was not only resisting being fixed, but instead was developing more problems the harder I tried to repair it! The last clue is what led me to look closely at harness routing. When the driver said he made a turn while accelerating, I suspected the harness was rubbing against something and the insulation had worn through to the conductors. The body shop tech had misrouted the heater hose, which put pressure on the engine harness, which eventually rubbed through causing circuits to short to the block. Their human error, and mine, made this job a bit more difficult than it needed to be (but it’s fixed now).

Oh, and yes, I did address the grounds that were questionable, “just in case!” 



JAIME LAZARUS has regularly presented technical seminars since 1985. He recently taught instructors at the North American Council of Automotive Teachers

conference and the NASCAR Technical Institute.

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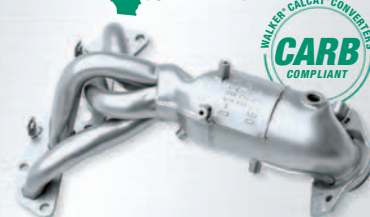


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THE ROLE OF THE ECM

HALF THE BATTLE IN DIAGNOSING DRIVABILITY COMPLAINTS IS KNOWING THE PART PLAYED BY THE ECM — AND HOW TO TEST IT

PETE MEIER // Technical Editor

It's a New Year and a new direction for "The Trainer!" I want to thank all of the men and women who've shared how much they appreciate and use the material I've posted here over the last several years. Many of you have asked for a more detailed series, though, saying that it would be of even more help to you. You asked — we listened!

This year, I'm going to focus on producing a series of videos specifically for the professional technician. And we're going to start with a series on diagnosing drivability concerns. This journey will take us through an understanding of the basic elements and dive into specific testing techniques you can apply right away.

In this first series, we start with exploring exactly what role the Engine Control Module (ECM) plays and the different ways it is used to control overall engine operation. I'll also show you how a Diagnostic Trouble Code (DTC) is born and how to use that knowledge



to perform diagnostic tests of your own.

I'll show you how to test the ECM (or Powertrain Control Module, if the transmission controls are contained in the same unit) power and ground circuits — one of the very first things you have to do before you can condemn one as "failed." Once you understand that, you

can apply the same test method to verifying power and ground circuits on any module on the car.

Yes, I have a lot planned for you in this first series of videos of 2017. It's just one more way we here at *Motor Age* strive to live up to our motto of "advancing the automotive service professional!" **MA**



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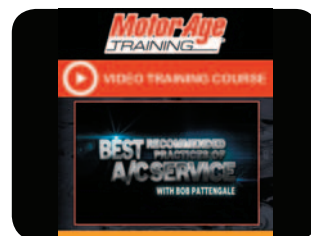
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