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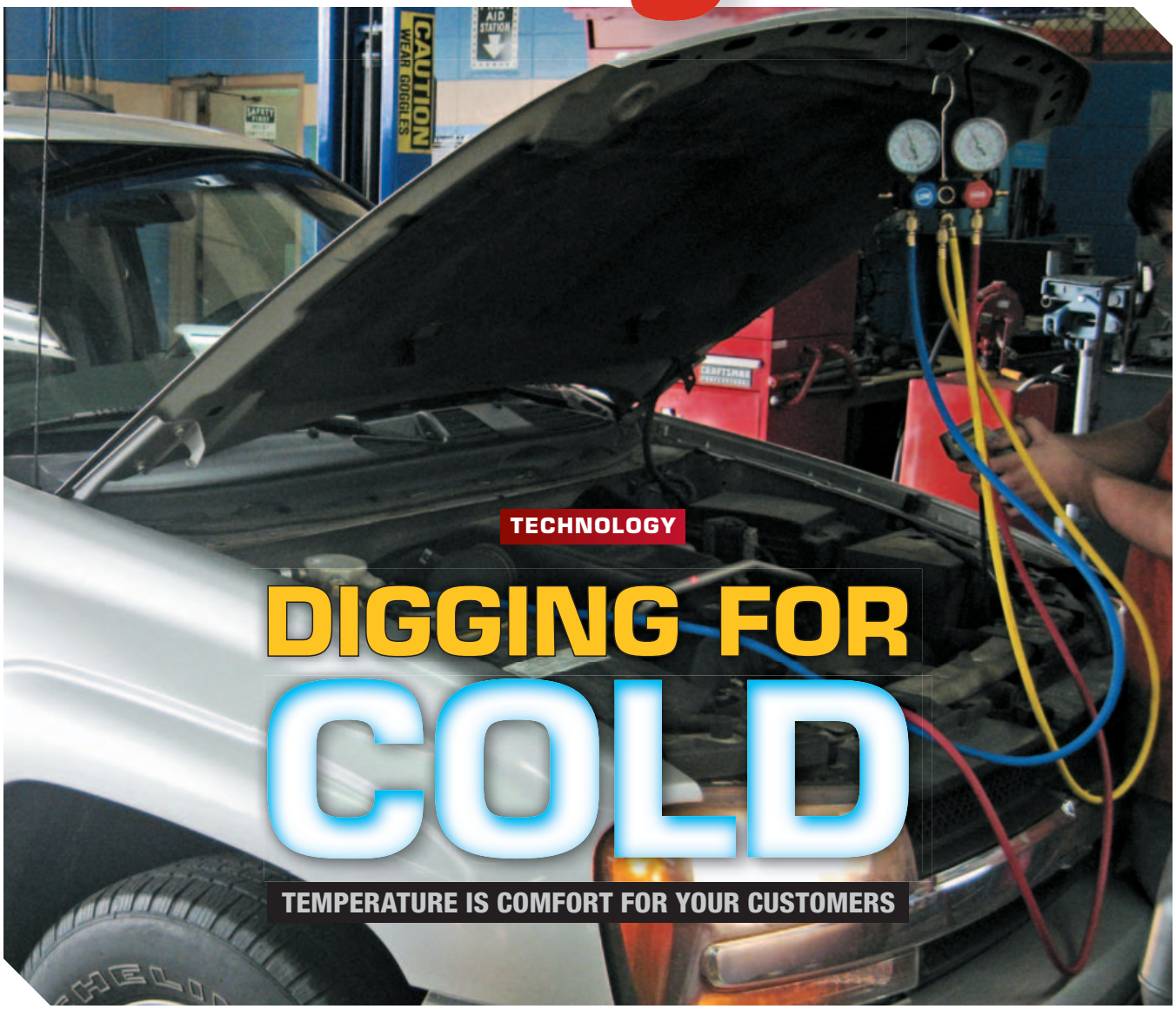
May 2016

Talk Shop Anytime

AUTOPRO WORKSHOP

Vol. 135, No. 5

Advancing the Automotive Service Professional Since 1899



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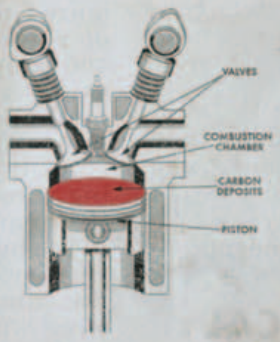

Fig. 2–Combustion Chamber

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ONLINE COVERAGE

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ASA PARTICIPATES IN CONNECTED CAR PANEL AT AASA VISION CONFERENCE

The panel discussed the future of vehicle-to-vehicle communications, the independent aftermarket supplier's role with advanced vehicles and how the diagnostics community can better prepare for these advances.

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NHTSA HOLDS FORUM ON DRIVERLESS VEHICLES

NHTSA requested comments on evaluation and testing of automated vehicle scenarios, detection and communication of operational boundaries, data recording capabilities, crash avoidance, identification of voluntary industry standards and several other topics.

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YANG OFFERS 2016 LEADERSHIP 2.0 SCHOLARSHIP TO YOUNG AUTO CARE PROFESSIONALS

YANG of the Auto Care Association is offering a scholarship of $6,250 to one young auto care professional to attend the University of the Aftermarket's 2016-2017 Leadership 2.0 program. The scholarship will cover the price of tuition, class materials and meals.

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Photo: Michael Willins

TECHNOLOGY

AASA Vision Conference shines light on tidal wave of technology hitting the aftermarket

BY **MICHAEL WILLINS** | GROUP CONTENT DIRECTOR

The digital revolution is upon us, and not just in the electronics we use at home. The automotive industry is being inundated with technology at every turn – telematics, in-vehicle connectivity, crash avoidance systems and autonomous vehicles, to name a few. And if aftermarket veterans up and down the supply chain aren't paying attention to these automotive changes, it's quite possible they could be left in technology's wake.

"Consumer devises have changed and are beginning to change the buying experience and owner experience with the vehicle owners," said Bill Long, AASA President and COO, during the association's annual Vision Conference. "It's not in our best interest to ignore these types of changes and how they will impact our industry."

The topic of technology was a focal point for this year's conference held last month in Chicago and centered around the theme of "Connecting the Aftermarket." Some 285 suppliers, leaders, distributors CONTINUES ON PAGE 6

BREAKING NEWS

AFTERMARKET SURVEY

AUTO TECHS SAY QUALITY IS MOST IMPORTANT PART ATTRIBUTE

BY **BRUCE ADAMS** | MANAGING EDITOR, AFTERMARKET BUSINESS WORLD

Auto technicians seek quality first when selecting parts to repair their customers' vehicles, according to the 2016 *Aftermarket Business World* Technician Attitude Study. Quality was selected as the No. 1 attribute that technicians said they consider first when selecting parts in five out of six product categories.

Brand, performance and availability were the next most important characteristics, according to the

[Aftermarket Survey]
CONTINUES / PAGE 6

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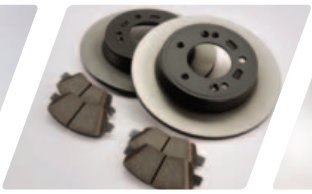

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[Aftermarket Survey]

CONTINUED FROM PAGE 4

survey. Finishing further down the list were price and warranty considerations.

Technicians overwhelmingly agreed that they tend to purchase parts from auto parts retailers. That was the top source selected by techs in five out of six product categories in the study. Jobbers and warehouse distributors were the next most often selected parts suppliers. They frequently were mentioned by techs as either their second or third choice as the go-to provider for purchasing parts. Other sources of parts selected by techs in the survey were dealerships, direct from the manufacturer and buying online.

When asked who their preferred supplier is, techs selected auto parts retailers first in four out of six product categories and second in the other two categories. Jobbers and warehouse distributors were most often selected either second or third.

Dealerships were the fourth most frequently preferred supplier. Techs who selected dealerships to purchase parts said they did so primarily for two reasons – OEM form, fit and function or because it was the only place the part was available. Other reasons receiving significant votes in that category were customer request and for the OEM brand name.

Methodology: *The Aftermarket Business World* 2016 Technician Attitude Study was fielded to readers of sister publication *Motor Age* via email. Study results are intended to show general industry trends, not statistical certainties.

[AASA Vision Conference]

CONTINUED FROM PAGE 4

and auto channel affiliates attended the three-day event.

Presenters were not shy about noting the impact of technology on the market, and the fact that some major winners and losers will emerge as a path featuring electric vehicles, autonomous cars, ride sharing habits and new in-vehicle technologies becomes more clear. Opportunities will exist for new products and services and collaboration will be a must.

"The building blocks for this transformation are already in place," Long told the audience. "We knew this day was coming. We just didn't know when." Suppliers, he said, will play a significant role in the transformation of the industry.

As an example of how suppliers could have a significant impact, Nat Beuse, Associate Administrator, Vehicle Safety Research for the National Highway Traffic Safety Administration (NHTSA), told attendees that existing crash avoidance technologies could reduce the annual number of collisions by nearly a third. That doesn't include soon-to-be released technologies still in development, which will have an even greater impact.

Also of note was the belief that consumers will drive a demand for aftermarket technologies as new vehicles enter the market with crash avoidance systems, telematics features or other connectivity options.

Denso's Senior Manager-Marketing & Strategic Planning David Williams says suppliers and consumers will benefit from analysis of Big Data that evolves from in-vehicle connectivity. The end result will be an increase in new or improved products for vehicle owners, he said.

Donny Seyfer, a shop owner from Colorado and current Automotive Service Association Chairman, took part in the panel discussion. Seyfer pointed out that it was critically important for shop owners and technicians to stay current on what's happening with new vehicles.

"This is going to be a firehouse if you wait five years," he said.

In his presentation, the OEM View of Connected Vehicle Service, Toyota's Mark Saxonberg echoed Seyfer's comments and highlighted the need for trained technicians in the aftermarket. Carmakers recognize that out-of-warranty vehicles will enter the aftermarket and they understand how critical it is for shops to properly repair advanced vehicles. Saxonberg believes a poor repair experience in the aftermarket can hurt an OEM's brand image and result in lost business when a customer begins shopping for a new vehicle.

"I can assure you, the automakers aren't hanging out in a smoke-filled room trying to figure out how we're going to (mess with) the aftermarket. That's not happening," he said. Automakers need the aftermarket and understand the value of a strong aftermarket as a way of supporting vehicles in their second life cycle – outside the bounds of dealer care cycle.

Registration opens for AAPEX 2016

Online attendee registration is now open for AAPEX 2016, scheduled Nov. 1 through Nov. 3, at the Sands Expo in Las Vegas, with AAPEXedu sessions starting on Monday, Oct. 31.

AAPEX registration includes access to 2,200 exhibitors displaying the latest products and services to diagnose, service and maintain the nearly 1.2 billion vehicles on the road throughout the world. This year, attendees also can visit an all-new Automotive Technology section on the show floor, and participate in short, 20-minute Let's Tech discussions on the latest technology related to vehicles, aftermarket solutions, the distribution channel and business.

Registration also includes access to all sessions in the AAPEXedu 2016 program, networking with buyers and entry into the SEMA Show.

Online attendee registration is $40 and fax or mail registration is $65 through Oct. 14. Online rates and onsite registration will then be $90 and $115 for fax or mail registrations.

Attendees also can reserve their hotel rooms now using onPeak, the official hotel partner of AAPEX.

Approximately 160,000 automotive aftermarket professionals from more than 140 countries are projected to be in Las Vegas during AAPEX.

AAPEX represents the $328.2 billion global aftermarket auto parts industry, and is co-owned by the Auto Care Association and the Automotive Aftermarket Suppliers Association, the light vehicle aftermarket division of the Motor & Equipment Manufacturers Association.

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MANAGEMENT

DEFINE YOUR LEADERSHIP STYLE

TAKE ON THE ROLE, DECIDE WHERE YOU ARE GOING AND PUT THAT FIRST TENTATIVE FOOT FORWARD FOR CHANGE

BY **BRIAN CANNING** | CONTRIBUTING EDITOR

ONE OF the greatest challenges facing the shop owners and service managers I talk to is in their taking on the role of leader. We can have the very best of intentions, the most thoughtful of business plans and the very best staff within our service area, but until we are willing to lead our people, little of substance is likely to be accomplished. The automotive industry, in its many facets, is decidedly challenging and decidedly unforgiving. Creating the perfect shop process will not make our people follow it and will not make sure our standards are met. Only leadership assures the quality of the effort. Only you, as a leader, can make it happen.

The United States Marine Corps defines leadership as "the sum of those qualities of intellect, human understanding and moral character that enables a person to inspire and control a group of people successfully." I really like this definition. Leadership is all about moving people successfully and in doing this, using intellect, character and human understanding to get our people to complete a task or mission. Leadership is all about success.

To compare what we do in our shops every day to what that Gunnery Sergeant is facing in combat might seem a stretch, but as he successfully leads his fellow Marines against a determined enemy bent on his destruction, I am wondering why we as an industry have such difficulty in getting our people to do the most basic things we want them to do. Why is he able to get his people to willingly face death and wounding every day, while we have difficulty getting our people to show up for work

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When it comes to travel, not everything we rely on today was intended for its current use. Sometimes, the best ideas come from unexpected places, proving that when you discover something that works, you can't help but see the possibilities.

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1. Charles Goodyear accidentally put a combination of rubber and sulfur on the stove and walked away. When he came back, he found a tough and durable material now known as the plastic we use today.

2

2. Temper foam, that popular padding that absorbs shock while providing comfort and protection, is now widely used in the helmets of race car drivers. It was originally invented in 1966 for use on seat cushions in rocket ships.

3. The earliest known compass dates back to 206 B.C. and was made from a naturally magnetic stone. Modern GPS technology indicates position but not direction, solidifying the compass' vital role on the road of life.

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4. The first known wheels were not invented for transportation. Instead, they served as potter's wheels. It wasn't until 300 years later that someone figured out how to use them for chariots.

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on time or be consistently productive? Acknowledging that there are issues of training, peer pressure and esprit de corps, leadership is what allows all of us to rise up in any situation and do something above and beyond what we would have any reason to expect. Leadership has the ability to make all of us better. Of course the unfortunate other side of that is that a lack of leadership has the ability to drive down efficiency, sales and literally drive us out of business. My advice is always to lead first, and ask questions later.

In becoming a leader it is essential that you take on the role in ways and practices that you can be comfortable with. Asking a Patton to be a Gandhi or a Gandhi to be a Patton will not work. There are leaders who are overbearing and directive, there are leaders who are incredibly hands off, and there are leaders who are somewhere in between. Before you have any chance of getting your staff to believe in you and what you are doing, you have to believe in it yourself. You need to be comfortable in that role or willing to grow into it. This is a tough journey, without a doubt, but you get to select the destination, choose the players, do battle on your terms and risk destruction on your way to that ultimate success. Isn't that worth the risk? To flounder along as you have been would not seem to be an option, and it is far too late to turn back. Most important here is that you take on the role, decide where you are going and put that first tentative step forward. There is no doubt that there is someone waiting to stomp on your foot, but it doesn't matter — it's time to go. It's way past time for you to lead.

It is an absolute truth that most of us would rather not lead. People are fickle; they do the craziest, most unpredictable things, and who needs that aggravation? My prototypical shop owner is a technician who somewhere along the way decided he no longer wanted a boss and having someone tell him what to do, so he did something incredibly difficult and courageous and opened his own shop. Starting out in this role, it was only he and his wife or partner, and life was good. He could handle the load, had nobody telling him what to do and leadership was the farthest thing from his mind. But as he did more and more good work and word got out, suddenly there was not enough of him to go around and he was forced to hire somebody. With trial and error he finally found someone who would do the things he asked. But more work led to more happy customers and before he knew it he had three techs, a lot boy, a receptionist and a part-time bookkeeper. And now he has to learn to lead — that, or possibly go out of business. Many seriously consider this option and would rather go out of business than have to tell someone to do something. That's frightening!

Like this shop owner, many of us are thrust into roles of leadership, and though we would much rather not, somehow we have to find a way to get our people doing the things we want and need them to do. Somehow we have to find a way to lead.

I am going to go to a second definition of leadership that will allow me to create what I hope would be a comfortable process for you to take those first steps toward becoming a leader. This second definition, provided by the U.S. Army, is the one I learned many years ago in Germany, where I was attending the Primary Non-Commissioned Officers Course (PNOC). The Army describes leadership as "the process of influencing others to accomplish the task or mission by providing purpose, direction and motivation." This is the definition I cut my leadership teeth on, and I still like it today because it lets me define the task and relies on me to provide what I see as the appropriate purpose, direction and motivation to assure that the task is completed. If I am not comfortable yelling, I'm not going to yell. If I choose to give an inspiring speech or threaten with punishment, I have that flexibility. Leaders are judged by their ability to get the job done. A good leader will use everything at his or her disposal to accomplish that. Remember, leadership is all about task accomplishment. If we fail in some kind of way to accomplish our assigned tasks, our approach to leadership has failed. It's as simple as that.

I would stress to anyone interested in taking on a leadership role or interested in improving the results they are seeing that the most difficult part in all of this is that first, determined step. From that moment forward, leadership becomes easier, more comfortable. In that same vein, I'll remind you that leadership is an action, not a thought, a goal or a philosophy. It doesn't begin until you take on that role.

Like justice, leadership is one of those things that needs to be seen, heard and felt and in every way evident. It involves commitment, accountability and a willingness to make unpopular decisions. It need not be lonely, but it is solitary in responsibility or accountability and decidedly impatient of success. Not for the faint hearted or shallow, leadership is a rock — reliable, steadfast, substantial, strong.

It's 9 o'clock; do you know what your leadership style is? Maybe it's time, or even past time, that you figured that out.

BRIAN CANNING
CONTRIBUTING EDITOR

Brian Canning is 30-year veteran of the automotive repair industry. He has been a leadership coach, Goodyear service manager, retail sales manager for a distributor, run a large fleet operation and headed a large multi-state sales territory for an independent manufacturer of automotive parts.

Email Brian at brimarc@hotmail.com

FINDING A PROFIT BOOST

LEARN NEW WAYS TO GET IMMEDIATE INCREASES TO SALES AND PROFITS

BY **CHRIS "CHUBBY" FREDERICK** | CONTRIBUTING EDITOR

ALL OF us have been in a position where sales or profits need an immediate boost, and we look for anything that we might be missing in our processes to get back on track. It doesn't matter whether you have been doing maintenance and repairs for 40 years or four years; it happens to all shop owners at one point in their lives. Some shop owners work on it and are motivated by being the best shop in their market by focusing on their processes daily. Some owners work in their business and only get to look at their business processes once a month. If you are looking for a quick fix that you might have done in the past, which you have stopped doing for a host of reasons, consider this article your wake-up call! Let's listen to a former shop owner from Arizona and current ATI coach, Kim Hickey, explain how she increases sales and profits immediately for her clients.

It goes without saying that you should be auditing your repair orders daily and then having meetings to discuss any problems, missing items, etc. Most shop owners perform their audits at the end of the day or first thing the next morning. The only problem with that is by the time you perform the audits, the vehicle is already gone.

The 100:10 rule

One of the things you can do throughout the day is pay attention to the 100:10 rule. Surveys done by both for-profit and not-for-profit automotive organizations are conducted annually to determine how much in repairs or maintenance is needed on the average vehicle. Some of the surveys have been carried out by pulling over random vehicles on the road and performing a complete inspection. It doesn't seem to matter who performs the studies and surveys, the results are relatively the same. The average vehicle needs about $100 worth of repairs or maintenance for every 10,000 miles the vehicle has on it. Studies and surveys have also shown that the average vehicle in the U.S. has 120,000 miles on it. What that means is that the average vehicle mileage for your customers is 120,000 and the vehicle should need about $1,200 worth of repairs or maintenance.

So now we have the rule of thumb you should be using to audit your repair orders throughout the day and on the fly. So what do we do with that information? For this example, let's pretend that your customer brought in a vehicle with 80,000 miles on it. After your service advisor completes the intake process and the walk-around with your customer, your service advisor will have gotten the mileage. Once your advisor gets the complete and thorough courtesy check back from your technician and types up the estimate, it should come in at roughly $100 worth of repairs/maintenance needed for every 10,000 miles on the vehicle. This is, of course, assuming the following:

- Your technician performed a complete and thorough courtesy check.
- The history was reviewed and any declined work is included in the estimate.
- The history was reviewed and any maintenance that was due but not yet performed is included in the estimate.
- Your advisor — being the gatekeeper — notices if the technician didn't note any items that should be due for the current mileage and adds the items to the estimate (after conferring with the tech as to why the items were not mentioned).

If the intake was performed, the history was reviewed, the tech performed a complete and thorough courtesy

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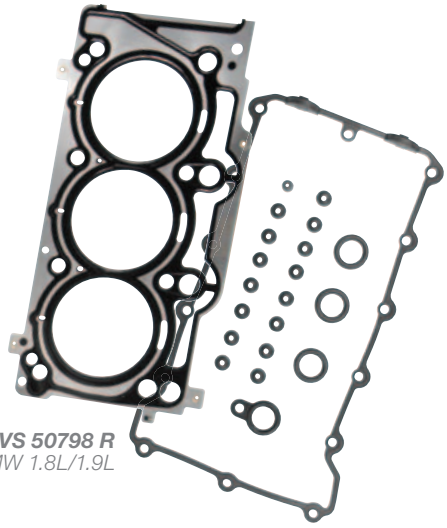

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inspection and your advisor was on top of any possible missing services or items, it is safe to initially assume that the estimate your advisor built on this vehicle will total $800. If the estimate didn't total approximately $800, the next step is to find out why. History should be reviewed. If you recently performed a big service or big repair, you can throw this estimate in the ready-to-call the customer pile (after, of course, your advisor practices out loud what they are going to say to the customer again and again until it is exactly what they want to say and exactly how they want to say it).

If the vehicle wasn't in very recently for a bigger repair or maintenance interval, it is time to dig deeper. Give your shop foreman (owner, lead tech or whoever is in a position to perform this part) a copy of the completed courtesy check along with a blank courtesy check form. Have the foreman pull the vehicle back in, rack it and then spot-check three items on the vehicle. If all three items that are spot-checked were on the courtesy check, then chances are it was a thorough courtesy check and just a fluke that it didn't come in at 100:10. If any of the three items that were found needing attention were not marked, give the blank courtesy check form to the tech who performed the inspection and ask him or her to do another courtesy check. You want to be sure and change up what items you choose to spot check. You don't want the techs to know what items you will be spot checking or else they will always make sure those items are checked.

At this point, many shop owners choose to announce to all the techs that it is time for a meeting to demonstrate how to properly perform a complete and thorough courtesy check. The reason behind this is similar to when a player comes late to practice — the whole team has to run. When someone at your shop is not performing a complete and thorough courtesy check every time on every car, they are letting down the team and the customer. The customer deserves better and so does that technician's co-workers. Hopefully your techs care about their team enough to not want to be responsible for causing them all to have to stay late for a courtesy check meeting.

Test your team

Another good test is to have all your techs perform a courtesy check on the same vehicle independently. Once they are done, choose the best and worst ones. Give your advisors the worst one and have them build an estimate. Then give your advisors the best one and have them build an estimate. The order of this is important. Remember when I mentioned earlier that your advisor is your gatekeeper? Your advisor should be able to look at history and current mileage and determine if any services and maintenance were not noted by the tech but should have been. This is your chance to see that in action. If they start with the best courtesy check first, they will already have seen things that should have been on the first one. If you have more than one service advisor, this is a good way to compare them as well. Have them all build an estimate off the worst inspection and then the best. See who filled in the blanks better and did a more thorough job of building an estimate. When actual estimates are built, it is easy to show the techs and advisors the difference in quality.

People seem to universally understand money. If you show your techs and advisors that courtesy check A resulted in a $300 estimate and courtesy check B resulted in a $600 estimate, they get it. Showing them that the difference between A and B is $300 carries a lot more impact than saying, "You didn't mention the belts and hoses were OE." The biggest difference I have ever seen between the best and worst courtesy check was over $3,000. The smallest difference was around $100. Any difference is too big a difference. If you had even a $25 difference in the quality of the courtesy check and it happened with 30 cars a week, that would result in a weekly revenue loss of $750 per week or $39,000 per year. If you are realizing the average net profit margin that ATI does, that is almost $10,000 missing directly from your pocket!

ATI Audit Checklist

If you don't know what your clientele's average mileage is, use your POS system to run a report and find out. This will give you a good barometer of how much your average estimate should be. If you are not tracking the difference between your estimate dollars and actual sales dollars, YOU SHOULD BE! Pull a lost sales report from your POS immediately. Remember what Chubby says: "If we can measure it, we can manage it." Chubby always reminds us that knowledge is only powerful if you can take action and change your results. If you would like a copy of our ATI Audit Checklist, you can download it at www.ationlinetraining.com/2016-05 for a limited time.

CHRIS "CHUBBY" FREDERICK
CONTRIBUTING EDITOR

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. Our associates love helping shop owners who are having the same struggle as many of them have had, and who are looking for the same answers — and in some cases looking for a lifeline. This month's article was written with the help of former shop owner and current coach Kim Hickey.

Email Chubby at cfrederick@autotraining.net

OPERATIONS
FINANCIAL FIGURES

INDEPENDENT REEXAMINATION

WHY ARE INDEPENDENTS LOSING THE FIGHT TO RETAIN CUSTOMERS' ONGOING BUSINESS?

BY **BOB GREENWOOD** | CONTRIBUTING EDITOR

STUDIES of the independent sector of the automotive aftermarket industry are confirming that independent shops are losing the struggle to retain consumers' ongoing business versus the growth in bay service business that new car dealerships are experiencing. The main reason this is happening is due to a lack of business focus by management of the independent shop. Too many business owners and managers are "too busy" trying to make money to slow down and prepare their business to meet the customer/client's real needs and wants in their market area.

Consider that weak shop owners focus on "cost" to save money, whereas the most successful shops focus on "value" to make money. Consider that new business standards are required for the new aftermarket business model that most shop owners/managers have not addressed within their business operation. It is time to "Re & Re" an independent shop.

Review each of these items within your own operation to ensure your business is heading in the right direc-

Photos: Getty Images


WHICH BRAKE PAD STOPS YOU UP TO 50 FEET SOONER?*
THE GUYS WHO KNOW, KNOW IT'S WAGNER® OEX
Jeff Buckley
ASE-Certified Technician
Midlothian, TX
Mike Rowe
Huge Fan of
Stopping Sooner
Rich Rigsby
Performance Specialist
Wylie, TX
WAGNER OEX
WAGNER® OEX

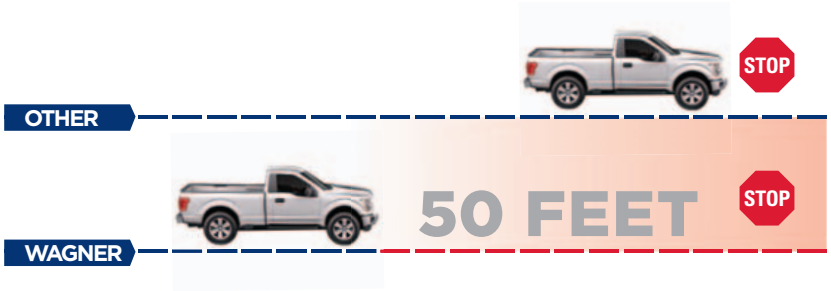
WAGNER® OEX

STOPPING UP TO 50 FEET SOONER?*

IT'S KIND OF A BIG DEAL.

In independent, 3rd-party 60 mph post-fade performance testing, Wagner® OEX outperformed other leading pads on popular vehicles.* Wagner OEX was designed for the three fastest growing segments in the U.S.: Pickups, SUVs and CUVs.

STOPS UP TO 50 FEET SOONER.*



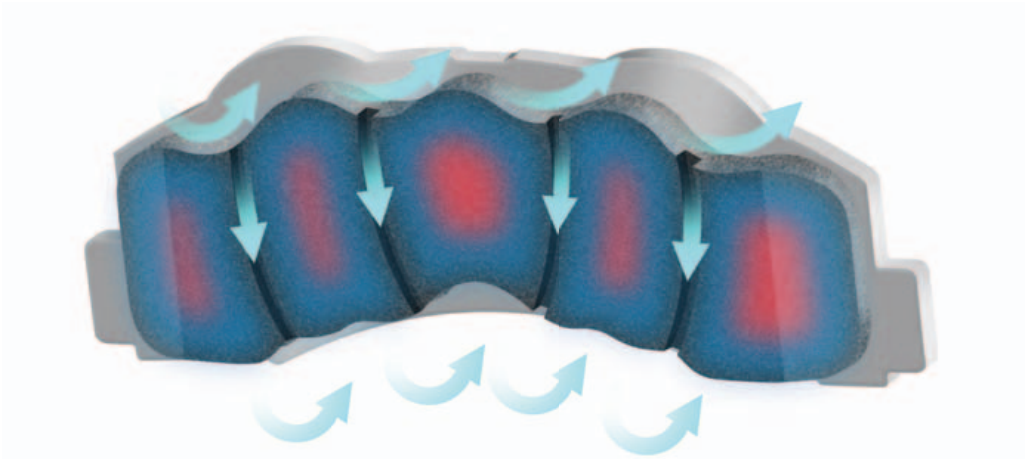
DESIGN REDUCES ROTOR WEAR

REDUCES DUSTING

PAD LIFE INCREASED UP TO 2X† LONGER

MADE IN USA OF U.S. AND IMPORTED ★ PARTS ★

Learn more about the Science Behind the Stop at **wagnerbrake.com**



We changed the shape and changed the game.

Our patent-pending shape and slot design creates turbulent airflow, which allows for cooler operation and superior stopping power.

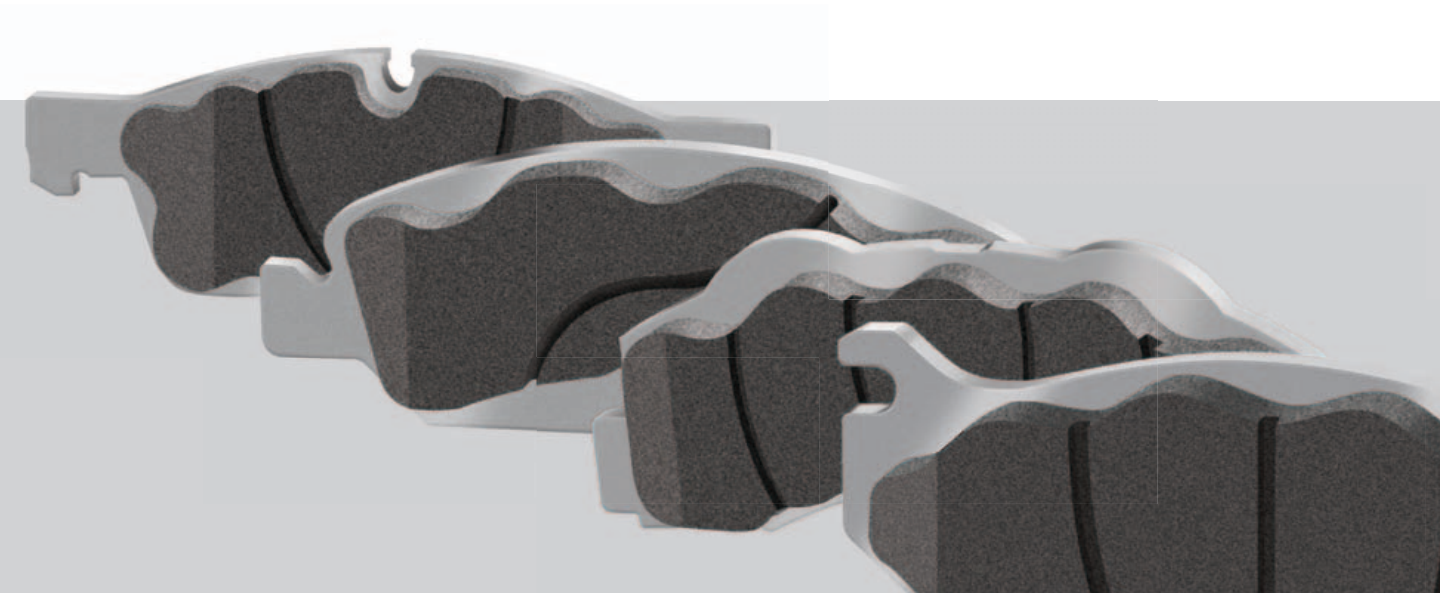
- Increased pad life up to 2x†
- Less dusting
- Reduced rotor wear
- Consistent performance in all braking conditions

---

114 **custom-shaped designs**
to fit most applications

Each Wagner OEX brake pad is designed with a unique shape which leverages the unique characteristics of each vehicle's brake system for ultimate braking power.

95% **coverage**
for U.S. Pickups, SUVs and CUVs



WHAT'S THE REAL DIRT ON WAGNER® OEX?

LET'S ASK THE GUYS WHO KNOW

Jonathan Dwyer
ASE-Certified Technician
Wayne, NJ

"Stopping up to 50 feet sooner than other leading pads"* is a pretty big deal, so Wagner put its new brake pads in the hands of more than 400 top techs from across the country. Here's what they had to say:

This will likely be our pad of choice.
Brad Rogers, Garland, TX

I like the fact that the hardware is in every package.
Kevin Friel, Poughkeepsie, NY

These pads made a noticeable difference. My customers love them.
Tommy Palmer, Brooklyn, NY

Wow, wow, wow – so different when stopping.
Scott Stidd, North Richland Hills, TX

99% found Wagner provided a higher level of quality

99% saw a noticeable difference in the new brake pads

95% likely to recommend to other professionals and customers

99% had an excellent, very good or good experience during a test drive

#partsmatter

Visit wagnerbrake.com for more information.

* Results based on 60 mph post fade performance testing, conducted by Link Engineering Company, comparing Wagner Brake pads to competitors' brake pads on the 2014 Ford F-150, 2011 Toyota RAV4 and 2013 Chevrolet Tahoe.
† Results based on internal testing comparing new Wagner OEX to other Wagner offerings.

FEDERAL-MOGUL MOTORPARTS

tion to retain all your customer/client business. If you ignore these items, there is a real possibility that you are already, or will soon, lose your clients to the dealerships within your area.

1. Renew the business format: The "same old, same old" does not work anymore. Shops cannot "bang them in and bang them out" to create large car count numbers. The math does not work anymore with that format. In fact, independent shops that concentrate mainly on volume to keep busy do not know that, on average, 60 percent of the work that they do does not create $1 of net profit for their business. It only creates sales and gross profit. They do not know how to measure this. They are working very hard to stand still and in many cases actually move backwards in their business.

Today, your business must be very focused on each individual client — one client at a time — and deliver value. Management's No.1 job is to build relationships; therefore, management must slow down at the front counter and take the proper time to meet, understand and council individual clients as to what the manufacturer recommends to ensure safe and reliable driving with their vehicle. Client vehicle technology and maintenance education is more critical today than ever before. The average consumer is not "stupid"; they are uninformed! Slow down and define the value you are prepared to deliver to each client.

2. Relearn the business: Continuous technical and business training and development is required today. Professionally operating an independent automotive maintenance and repair shop is the most complex retail business in this new era, requiring not only a great deal of capital, but also higher in-depth skills than ever before. Consider that technical development of the vehicle now requires highly skilled technicians who embrace vehicle knowledge with a tremendous amount of personal pride. These technicians are highly skilled professionals. The depth of knowledge they must completely understand, and stay on top of, is mind boggling, and it is management's responsibility to ensure these professionals have all the right training and tools to execute their skill.

Management must learn and measure the business in a totally different format today. Just measuring parts and labor sales and following the shop's bank account up and down doesn't work. Management must stay on top of the business numbers to ensure they are measuring net profit on each invoice before the invoice is closed off, one invoice at a time. Businesses that are only interested in sales and price of commodities don't get it yet.

3. Re-tool the business: Management must ensure the business is profitable enough to have the funds available for continuous investment in the right equipment required for today's vehicles.

As an example, consider basic equipment required to properly execute all vehicle fluid maintenance today such as a system flush, carbon clean, oil flush and transmission flush, to name a few. Equipment and tool requirements are higher today than ever before in the history of our industry. Without the right equipment, shop inefficiency affects the profitability of the shop. Even worse, the shop is not servicing its client base in its most professional manner, which will in turn, over time, affect the relationship of the customer with that shop, potentially driving them right back to the dealership.

4. Re-certify the business: Management must establish "standards of execution" throughout the shop. Define your standards in print. Each staff member from the front counter to the back office to the back shop must completely understand and believe in how to execute their function to exceed the customer's expectations. Certification today is not just a piece of paper or experience. Certification is an attitude! "We will not let the client down. We care! We will take the responsibility to make sure your vehicle maintenance and your experience within the walls of our shop exceeds your expectations."

5. Re-professionalize the business: Management must establish ongoing reviews with each staff member to ensure they are continuously aware of the importance of their personal day-to-day execution of their particular function within the shop and how it affects the clients' perception of the shop's professionalism. Management must also continuously review the systems within the shop. The systems are not only the software systems, but also include the processes in how the shop delivers its services to the consumer.

To "Re & Re" your shop today is simply not knowing what to do. You must become proactive. Consider this statement: "It's not what you know, it is what you do with what you know."

Too many shop owners today are very apathetic. Their actions seem to be advertising "I don't care about that stuff (above), and I have no desire to understand it." It is very unfortunate that these shop owners insist on hanging around in our industry, as they are definitely affecting the image of the independent sector, which in turn hurts the best independent shops within our country. Consider also that these weak shops work to the benefit of the new car dealers in that if consumers do not enjoy the experience at the weak shops, too many of them will assume all independents must be the same.

The challenge in front of the independent sector is not an easy one; however, it is possible to turn things around when all independent shops start to communicate with each other about the importance of raising the shop operation bar.

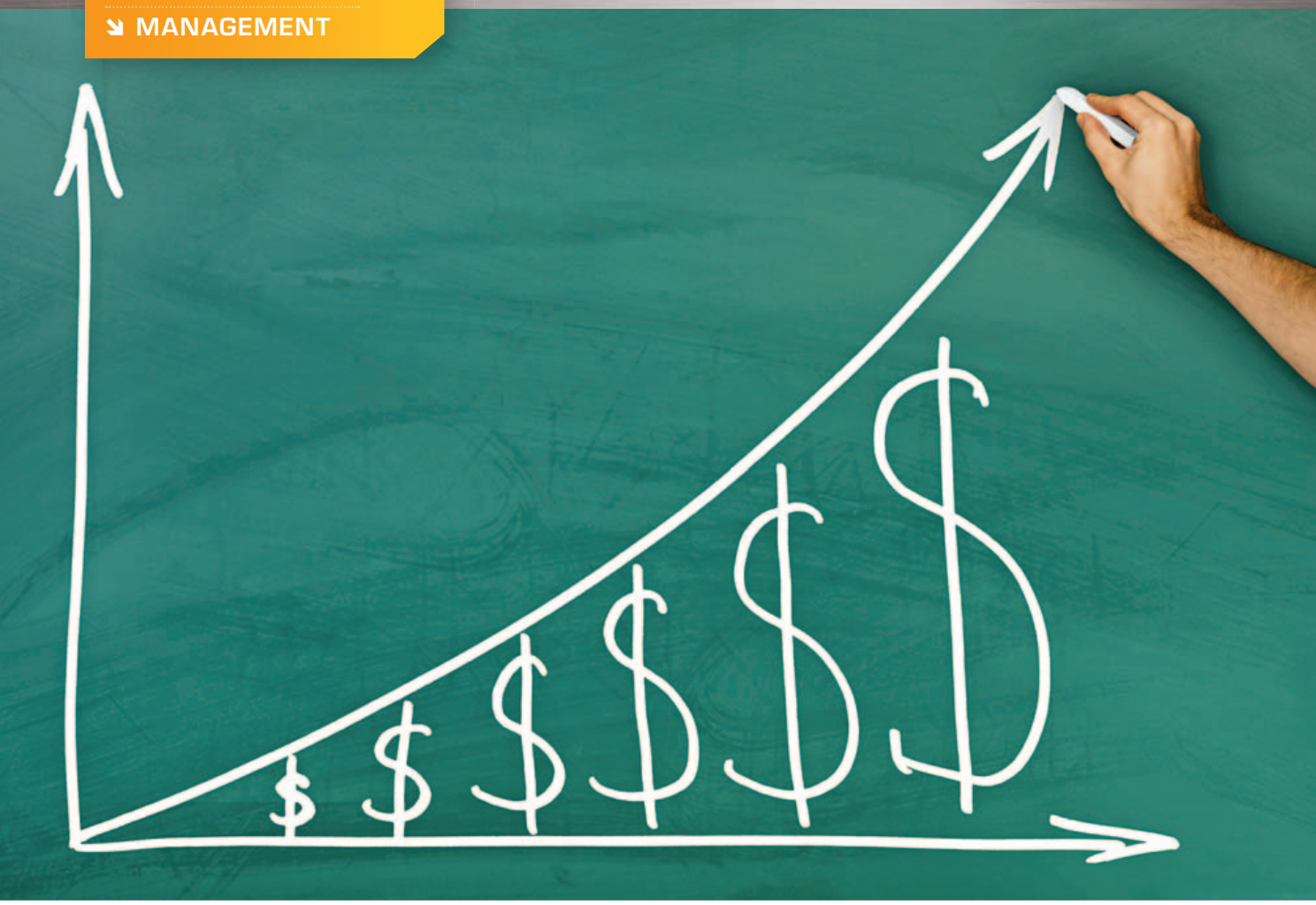
Consider discussing the above issues with your parts supplier who sells to these weak shops and all of your shop peers to see if your market area is interested in taking the market back.

BOB GREENWOOD
CONTRIBUTING EDITOR

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.

Email Bob at greenwood@aaec.ca

OPERATIONS
MANAGEMENT



FINANCIAL KEYS TO SUCCESS

BUILD YOUR OWN MULTI-MILLION DOLLAR SHOP

BY **W. SCOTT WHEELER** | CONTRIBUTING EDITOR

YOU'VE been working diligently to achieve that ever-so-elusive balance between gross sales and profits, and have managed to control your operating expenses to yield a nice net operating profit. You've worked for many years to develop and maintain a good customer base. You have a staff of highly trained and competent people. And yet, you're confused as to why the numbers don't always add up. Here, you will learn how to achieve your automotive service repair goals by consistently managing these specific financial tools.

It must be stated right now that at Automotive Consultants Group, Inc. (ACGI), we've developed, refined and are continually updating these tools, and have been for the last 16 years. Nonetheless, they are fairly basic in their design, such that once you understand their importance and what they tell you, you can then simply gather your needed numbers, develop your own format, and you're off and running. It should also be understood that any report should yield only one primary purpose: to tell you something that will aid you in managing your business.

Please note that this is an extreme-

Photos: Thinkstock

Branding

Training

Technology

Warranty

Digital Communications

Financing

Promotions

CRM

Service Assistant

Business Development

App

Digital Vehicle Inspection

Sell more services!

Outshining the competition means doing the job right the first time – every time. This requires consistency, accuracy, efficiency, and clarity when diagnosing a customer's vehicle.

That's why the best NAPA AutoCare Members use Digital Vehicle Inspection (DVI), developed by AutoVitals.

This tablet-based digital technology helps NAPA AutoCare members:

- Provide professional looking inspection report documents for clearer customer communication
- Increase Average RO Sales and prevent missed service opportunities
- Streamline Vehicle Identification with automatic VIN scan
- Create Vehicle Inspection history into a digital record for each customer

"This technology boosts my technicians' productivity and streamlines service advisor effectiveness. What's more is that it ensures every vehicle at the shop gets inspected thoroughly, respective work orders are reported clearly, and my customers are fully satisfied when they receive an easy to understand, professional repair."

–PK Kelley of Lawson & Son Auto Repair, Nashville, TN

Contact your local NAPA store or visit NAPAAutoCare.com/Benefits for more information.

NAPA AUTOCARE CENTER

ARO*	Cars per Day	Dollars Per RO
@ 1.4 ARO	18	= $213.81
@ 2.0 ARO	12.6	= $305.44
@ 2.6 ARO	9.7	= $397.07
@ 3.0 ARO	8.4	= $458.16

*ARO = Average Repair Order

Results would look like:
3 techs @ 8.41 hrs. each (105% productivity)
Tech production goal is $1,282/day

What a million-dollar shop looks like

One million in annual sales is:
$83,333 sales per month
$19,231 sales per week (52 weeks/year)
$3,846 sales per day (5-day week)
$41,667 @ 50 percent GP
21 average days per month
$1,984 GP per day

ly complex subject here, and so our hope is to provide you a basic understanding.

A basic understanding of where these numbers come from and what activities they are derived from, and most importantly, how to manipulate these numbers to make them go either up or down closer (or on target) with the industry-wide benchmarks, will be imperative. This last point — manipulating the numbers — is where we find most people have a challenge. Look at it this way: If you have a service consultant who carries a very poor close ratio (less than 50 percent), why on earth would you put in all the effort to increase car count? That's not where the real problem lies!

You should begin by knowing what numbers you'll need, and where to find them. You've probably already heard the acronym KPI.

What are KPIs?

As its name would imply, Key Performance Indicators, or KPIs, are specific and critical numbers used in your automotive repair business and across our industry. They tell the business owner how healthy their business is or is not performing. Many of these KPIs are actually generated during the sales process with your customer. The most important KPIs are generated during the estimating process. Other KPIs are managed differently, such as operating expenses and their control, having the correct compensation plans in place for all production personnel (technicians), and having the costs of your service writers (herein after referred to as Service Consultants) expressed differently. Those numbers are more often expressed as a percentage against sales.

Learn where to pull the KPIs from

When you begin to pull all your numbers together, it's imperative that you utilize the exact same date range for all data pulled for a defined period of time: day, week, month, quarter, or year. In other words, if you use your Profit & Loss Statement for the period of 2015, then your business summary report should also be for 2015.

PEOPLE WHO BOUGHT THIS

ALSO BOUGHT THIS

PENNZOIL PLATINUM HE™ OIL FILTER

HOW IT BENEFITS YOUR CUSTOMER

- oil that is 99% contaminant free*
- longer engine life

HOW IT BENEFITS YOU

- 2-3 synthetic oil changes per day with an upgrade to a Pennzoil Platinum HE™ Oil Filter, 260 days a year yields an additional $4,600 profit annually**
- Increase in margin on a synthetic oil change

HOW TO GET STARTED

For more information contact your local Shell sales representative.

MAKE IT A PENNZOIL CHANGE.™

FIND US ON PENNZOIL.com

*For particle sizes ≥ 30 microns
**Based on a $10.00 charge for the Pennzoil Platinum HE™ Oil Filter

(*Editor's note: the charts provided are simply examples and don't adhere to this rule*).

Data to pull from your shop management system (SMS)

Business Summary Report

Look to your SMS to provide a Business Summary Report that includes:

- Gross sales in the following: labor, parts, Sublet, shop supplies (all measured in dollars)
- Labor GPM percentage
- Parts GPM percentage
- Sublet GPM percentage
- Sales taxes are not calculated; they are simply a wash (in and out)
- Car Count/RO count
- Average Repair Order (ARO, dollars)
- Billable Hours per RO

Revenues by source:

Your SMS should be able to tell you where your customers are coming from. If you do any advertising at all, you have a cost associated with it. Your Service Consultants must ask every customer "how did you hear about us today?" Even if they are a loyal customer to you, they may be responding on this visit to an ad you're currently running. This must be tracked to yield the effectiveness of your various advertising campaigns. A customer sign-in sheet would easily capture this information. This will give you the data you will need to tell you your customer acquisition cost. The saying "cheaper to keep her" holds true here. It is easily much more expensive to find a new customer than to keep an existing one. (But that doesn't mean that some of your customers shouldn't be fired!)

This report may also tell you the effectiveness of your Customer Retention Management Program (CRM). However, most CRM programs used nowadays have their own dashboards for this information. Parental discretion is advised in reading them!

Sales by category:

This tells you what kind of work you perform the most, i.e. brake work, diagnostics, electrical, engine, transmission, etc.

Sales by service writer:

This tells you who is selling what, total dollars, and most importantly, at what GPM percent.

SECTION 1		
SHOP NAME	Shop Labor Rate	$93.87
Bob's Garage	How Many Production Techs?	12.0
ADDRESS	Business Hours Mon-Fri	M-F 8-6
CITY	How Long for Lunch?	1
STATE	Business Hours Saturday	9-5
ZIP CODE	How Long Sat. Lunch?	1.00
PRIMARY PHONE	Number of Working Bays	12
OTHER PHONE/CELL	**How are Techs Paid?**	**Check One**
FAX NUMBER	On Flat Rate	X
WEBSITE ADDRESS	Hourly	X
EMAIL ADDRESS	Salary	
	Other	

SECTION 2	
Time Period for Financial Review (Months)	Jan 1 Thru Jun 30, 2012
Which is How Many Months?	6
Number of Repair Orders This Time Period	4832
Total Labor Sales	$1,054,445
Total Labor Costs	$399,969
Total Parts Sales	$982,006
Total Parts Costs	$593,860
Total Sublet or Tire Sales	$7,058
Total Sublet Cost	$5,352
Total Shop Supplies/Hazmat/Other Sales	$36,748
Total Shop Supplies/Hazmat/Other Costs	$4,668

SECTION 3	
Total Operating Expenses	$853,118
Other Major Expenses	$0

From your bookkeeper

A current P&L

- Gross sales, the costs associated with producing those sales (COGS), total operating expenses, technician load/costs, service consultant costs, etc. In our experience, most CPA-generated P & L statements do NOT conform to this format. They normally lump all sales in as one number. The fact that your business has multiple profit centers, which carry their own individual GPM, mandates that they be split out and tracked separately.
- Advertising and marketing expenses
- Other major expenses, such as a shop remodel, or the purchase of new capital equipment, should be noted separately.

Cash flow statement balance sheet:

- Tax liabilities, equipment depreciation, long-term liabilities, etc.

Manual gathering

- Lost sales opportunities, also known as declined sales. Some SMS systems provides this, but many do not.
- Coupon sales or specials may or may not have to be tracked manually. (Discounts should be picked up by your Business Summary Report)

Find your value

Next, you need to figure out the value of one billable hour in your particular

shop. Use this formula:

Your Hourly Rate x (1 + P/L RATIO)
Note: P = parts, L =labor

= 92 x (1 + 40/60) (assuming a shop labor rate of $92/hr., with a parts/labor make up of $.40 parts, $.60 labor, for every dollar you sell)

= 92 x (1 + .66)

= 92 x 1.66

= 152.72/hr. (value of one billable hour)

So if you need $3,846 in sales per day to hit $1 million annually, $3,846 divided by $152.72, the value of one billable hour, equals 25.18 billable hours per day needed. If you accomplish this, you will hit your million dollars! It is simply math.

Now that you have an understanding of what numbers you'll need and where to find them, it's time to put you on the map. After all, how can you possibly get to where you're going if you don't know precisely where you are? At my consulting company, we've designed some proprietary software which amasses a tremendous amount of data, all based upon this simple little query. Gather these numbers up. (*See Chart 1.*)

Let's begin by studying the simple Chart 2 Annual Forecast. (Reader's note: the charts provided here are NOT all from the same shop or time frame. They are merely for illustrative purposes).

I'm very strict on using accuracy in working with numbers (unless of course you use rounding in certain instances, i.e. reading a P&L).

You can begin by pulling your P&L for 2015 (the full year). Write down the number next to Gross Sales. I would prefer that you add somewhere between 10 percent to 15 percent to this number. Standard business growth formulas are in this vicinity. This will be your annual sales target, which you should then break down to a daily target, and make certain your sales staff knows this number! From there, using your available data, fill in the remanding numbers. The last number — Billable Hours Per Day — you will need to calculate.

Understand what your shop is capable of — i.e. number of bays, techs, billable hour production, etc. A reality check here is needed. If you only have 5-bays, trying to hit $2M/yr. is not likely to happen (2nd location time?)

Marketing and advertising strategies should then align with your goals. Let me take a moment to explain the difference between this two commonly used words. "Marketing" is basically the various services you provide. If you open a custom wheel shop within your existing business, this would be considered a new market. "Advertising" would be the call-out to folks that you are now selling custom wheels. See the difference?

I provide all my clients with what's called a KPI Tracker. While initially daunting to look at, in reality it provides them a very useful tool to track critical numbers each day at close. My clients love it, use it, and swear by it. I am told it takes less than five-minutes to fill out each day. This document stays loaded up in the cloud. When they fill it in each day, I receive an immediate notification. What both the shop owner and I are looking for are anomalies that occurred that spe-

cific day. This could be a number that is either too good to be true, such as labor cost that day at 88 percent GPM, or really bad, like 18 percent GPM. In either case, it raises an immediate red flag and warrants further investigation.

What's really cool about this KPI Tracker (which again, you could design if you know a little about MS Excel), is that your annual goals you filled in a previous exercise push through into your daily targets, and also show you the variance to that target. Reach out to me, and I'll be happy to assist you in better understanding this tool.

Your KPI tracker

Your KPI Tracker should include the following, looked at daily, weekly, monthly, quarterly and annually:

- Car count
- MTD car count
- Daily gross sales
- Average repair order
- Sales to target
- Variance to target
- MTD variance to target
- Labor sales, costs and GPM
- Parts sales, costs and GPM
- Sublet sales, costs and GPM
  - o Variance to targeted benchmarks
  - o MTD variance to targeted benchmarks
- Tire sales, costs and GPM
- Shop supplies, sales costs and GPM
- Any other relevant data, such as number of oil changes, alignments, etc.
- Hazmat sales
- Total billable hours production
- Average billable hours production by RO

I preach a mantra that I'm certain you've heard before: "If you can measure it, you can manage it." Parental discretion advised here: only measure what you can and should, so that you can make adjustments in the various activities that these numbers are derived from.

Example: Tracking billable Hours/RO production

There is an industry benchmark for this, and quite frankly, as of this writing, it varies greatly. However, depending on the type of work your shop produces, suffice it to say you should be over 1.5 billable hrs./RO. Now, if you do nothing but quick lube type oil changes, that number will be MUCH lower. Examine this for yourself and find out what your number is.

The bottom line to all this:

- Know your numbers (meaning what activities they are derived from)
- Know what is acceptable (is a 50 percent close ratio for a service consultant acceptable?)
- Know what changes need to be made to bring your numbers more in line with where they should be.

TARGETS		
Annual Sales		$1,400,000
Working Days this Year		252
Daily Sales Goal		$5,556
Parts % of total sales	59%	$3,278
Sublet % of total sales	1%	$56
Labor % of total sales	38%	$2,111
Tires % of total sales	1%	$56
Other % of total sales	1%	$56
Labor Rate		$98
Average RO		$800
Cars per day		6
GP Parts		40%
GP Labor		60%
GP Sublet		25%
GP Tires		20%
Billable Hours		21.5

The financial composite — Where all this information ends up

A good financial composite will allow you to compile all this data. Visit MotorAge.com/FinancialComposite to see an example. Ours also supplies all of the benchmarks, and immediately tells you where you stand in comparison. The significant problem with either this financial composite, or your own properly formatted P&L, is that it is a snap-shot of what has already taken place!

Using coaches

In our presentations throughout the U.S. and Canada, we share a video about the value of time. Within this video is mention of Olympic athletes. In their world, the difference between first and second place is measured in milliseconds! And we both know they ALL had coaches to help them to achieve that level of success. There are many great repair shop coaches out there — seek them out, pick their brain, find out if you have a good fit and pull the trigger.

So, doesn't it stand to reason that you, with all your years of experience and knowledge, just might need someone to assist you? Okay, I said it. That was my plug for our company. Yet there is one critical element that separates us from the others: we care very deeply about helping you to have a better quality of life through this thing called automotive service and repair!

W. SCOTT WHEELER
CONTRIBUTOR

W. Scott Wheeler, president of Automotive Consultants Group, Inc. (ACGI) is a shop management expert in the transportation industry, with over 36 years' experience in the automotive, trucking, heavy-equipment, marine, motor sports and defense aerospace industries. He holds numerous ASE credentials, including two Master's Certifications.

Email scott at scott@automotiveconsultantsgroup.com


This is my BendPak
BENDPAK
There are many, but this one's mine.
"Here at Kindig-it Design we specialize in Bitchin' Rides and that takes killer equipment, thats why we use BendPak."
- Dave Kindig, Accomplished Designer
Specialized in Hot Rod Customs
Owner of Kindig-It Design and star of TV's "Bitchin' Rides"
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OPERATIONS

SHOP PROFILE

A snapshot of one of the industry's leading shops

SWEDISH AUTOMOTIVE / SEATTLE, WASH.

Expanded brand loyalty

What began as a Swedish brand repair shop has expanded to better service in the Seattle market

BY **ROBERT BRAVENDER** | CONTRIBUTING EDITOR

Fiords, Nobel prizes, Ikea furniture, Delta wing fighters and a history of making world-class cars — that's what Sweden suggests to the mind. Volvo and Saab: the former generally considered the world's safest car, the latter making the aforementioned jets.

They were automobiles that impacted the U.S. market such that shops like David Winters' Swedish Automotive could succeed.

"We have a big Scandinavian population here in Seattle, so Volvo goes way back," reveals Winters. "The first Volvo dealer that I'm aware of goes back to about 1959, and they're still in business. I mean my parents bought a 1968 140 Volvo when I was nine years old, and that's what I grew up driving.

"This business started as a hobby for me right out of college," Winters relates. "I took auto classes in high school; I had always putzed around with cars as a kid, particularly that old Volvo."

But he was on track to complete his education in a completely different field. "I was set to go for a Masters degree in geology from Washington State University, but got injured on a job. I came to Seattle to recover and realized I didn't want to go back to school, so I started picking up old Volvos to buy and sell."

This soon led to requests for repair work. Mentored by a couple of old hands in the industry, Winters rented a $100-a-month apartment with a non-heated garage behind it. That was in 1984. By 1990, he had branched into Saabs and was able to purchase his first facility, a three-bay shop.

"It was an old gas station from the 1920s set to be torn down," he recalls. "We remodeled it, popped a fourth bay out a year later. We were there for 20 years until 2010."

That year, Winters built his own shop, despite the unique challenges presented by the West Seattle real estate market. "It's almost impossible to find commercial property and build on it," he reports. "The minimum [structure] for one is usually a three-story building, and most are 4-6 stories. If you're competing with a developer who's going to put a six-story apartment on it and you're just building a one story shop, he's got deeper pockets because he's going to have something with six times the square footage."

But perhaps there was a solution in the problem itself. "I had been looking for close to 10 years for another piece of property, and one finally popped up four blocks from our original shop," Winters explains. "But

SWEDISH AUTOMOTIVE

David Winters
Owner

Seattle, Wash.
Location

1
Number of locations

33
Years in business

Volvo, Saab, Subaru, Mini Cooper
Brands serviced

AAA, ASA Washington, ASE, BBB, Bosch Service, EnivoStars, West Seattle Chamber of Commerce
Shop affiliations, certifications

swedishauto.com
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in the course of my search, I bought three other commercial properties: one apartment building, a pizza joint and a house. The apartment building doubled in value from '01 to '06, and the pizza joint and house were adjoining properties across the street from our old shop. I flipped all three of these and rolled them into one sale via a 1031 exchange, so there were no capital gains tax. Had we not invested in those other properties, there's no way in the world we could have done the project that we did. You just don't make enough money as a shop to be able to do that financially."

Sufficiently capitalized for construction, Winters then caught a break through timing; after the collapse of the real estate market in 2008, he reports that it "was a really good time to borrow money and have construction done, because there were a lot of really hungry contractors."

With an eye toward eco-friendliness, the new shop was built with utmost efficiency in mind: heavy insulation in the walls to maintain temperature; solar panels on the roof that produce 12 percent of their energy; waste oil burners to heat water pumped through the floors; even the landscaping is a wildlife habitat.

"Our landscaping uses native, drought-resistant plants, and we do not use herbicides or pesticides. We are recognized as a Certified Wildlife Habitat. Each bay is equipped with spill kits and our storm drains are marked to remind people not to put hazardous liquids down them. We use an oil/water separator to ensure only water goes into our city system and our waste oil is contained in a double-walled tank and used to heat the shop. And our ratio of garbage cans to recycling bins is 1 to 6!" Winters says.

But as the shop has grown, its market has shrunk; while Volvo is still going under Chinese ownership, 2011 was the last year of production for Saab. "We still service a fair number of Saabs; I still drive one myself," comments Winters. "It's probably 20 percent to 30 percent of our business."

But as early as 2007 they saw the writing on the wall and branched into Mini Coopers and Subarus. "The Pacific Northwest is the number one market for Subaru in the whole country," Winters reports. "Literally every third car that drives past our shop is a Subaru. They are a completely different animal: four-wheel drive, horizontally opposed four cylinders; they are not nearly as prone to intermittent electrical failures, so they're comparatively easy to fix."

While Swedish cars are no longer his sole concern, Winters maintains that for him specialization has always been the answer. "We have the factory tools for every car that we service, so we can get very accurate diagnostics fairly quickly. Guys who work on everything that shows up at their door? I honestly don't know how they do it.

"Everything is becoming so specialized," Winters continues. "A factory tool for Volvo is really expensive, and if you don't have it and you're working on a '99 or newer car, you are completely in the dark. All the diagnostic work, all the downloads are done through that tool. And Volvo is probably one of the worst as far as how much it costs to purchase that software; it used to be an annual subscription between $8,000 and $8,500 a year, but now we can purchase a three-day pass for about $130 any time we have to do a download. Initially I didn't like that, but now I think that's maybe a better way to go."

If Winters were to add other auto lines, would he keep the Swedish name? "Yes we will," he firmly states. "If I did expand it would be into something German, but I don't have any plans for that at this point. We stay pretty busy just with the four lines that we've got. And I really think specialization is very beneficial to the shop and the customer. We're not reinventing the wheel every time a car shows up at the door."

And his online customer reviews reaffirm the shop is good at what it does. "I have been going to Swedish for repairs since first owning my 2007 Volvo convertible. Dave is the superstar — one of the most kind and professional persons with whom I have ever had the fortune to deal, in any business. He communicates promptly and thoroughly, and if and when delays occur (due to ordering parts), his driver transports me to and from work at a moment's notice," said Ilene I. from Seattle, Wash. "I am thankful they are in West Seattle and consider myself fortunate to be a customer in such good hands."

Lana K., also from Seattle, wrote: "One of the better experiences I've had with a mechanic. He went over issues with my car and gave me upfront pricing and even walked through what was more important to address first versus issues that could wait or even things I could do on my own."

ROBERT BRAVENDER
CONTRIBUTING EDITOR

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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BOOST CUSTOMER LOYALTY AND KEEP THEM COMING BACK

Choose the right customer retention program for your shop

BY **TIM ROSS** | CONTRIBUTING EDITOR

Retaining customers is one of the biggest challenges facing shop owners today. It's estimated that automotive repair shops are losing more than half of their customers each year due to a variety of factors. Cars are better built and require fewer repairs, which is extending the number of days between visits. Shop owners are also seeing customers jump to dealerships, which in contrast to the aftermarket sector, are managing to retain 62 percent of their customers annually.

Part of the success dealership service centers are experiencing is due to warranties and pre-paid maintenance packages, which ensure customer loyalty. However, dealerships have also become more strategic about developing marketing programs targeted to reach existing customers across a variety of platforms. Independent service centers will need to adopt a similar approach if they expect to reverse the downward trend in retention. If you're only marketing with the goal of attracting new customers, you're leaving your existing customers vulnerable.

Acknowledging the need to advertise to your established base of customers is the first step to reducing attrition. The second — and much harder task — is to find an effective retention program that will provide you with a good return on your investment.

One of the key aspects of any retention program is user friendliness. In my experience with direct mail, if a marketing program is overly complicated or cumbersome, shop owners will stop using it. So find a retention solution that is intuitive and user-friendly. It should be automated and able to integrate with your point-of-sale system so you can pull data on which to base your campaigns.

There's no point in simply sending out generic offers to your existing customers at random intervals. Instead, rely on the information you already have to craft promotions that are well-timed and better targeted. For example, let's say you have a customer who is not due for an oil change, but your records show he declined a brake pad replacement a month before. Rather than sending out the typical oil change promotion, you can use his service history to send an offer for discounted brake pad replacements instead. A savvy retention program will factor in a variety of data, such as state inspections that might be required for vehicle registrations, or national trends on which types of offers are more likely to be redeemed.

Now, you can have really great targeted offers, but if you're only sending those offers out through one marketing channel, you're limiting your potential responses. Simply sending out follow-up emails to existing customers is not a retention program. With all the digital clutter these days, that strategy is bound to come up short. It takes many contacts on multiple platforms to make a sale. To diversify your outreach, consider incorporating direct mail into the mix. It's easy to delete an email but somehow harder to toss a printed offer for a free tire rotation or vehicle inspection. Plus, the postcard you send helps reinforce the email reminders a customer may have already received. Marketing via text message can also play a role as long as you restrict texts to the customers who have opted in and you tie them to appointment reminders and other messages that might already be of

CONTINUES ON PAGE 33

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Adaptability is key in the industry

MotorAge.com/Adaptability

SOCIAL INSIGHTS

• Training takes dedication and action from everyone in the shop

Motor Age contributor Chris Chesney, who serves as Senior Director of Customer Training for CARQUEST Technical Institute (CTI), tackles industry training head-on in this article.

"The issue our industry faces is the tremendous lack of commitment to even the 'good' programs," Chesney explains before outlining possible solutions. One is to establish performance standards and communicate those standards to your team.

MotorAge.com/dedication

• Automechanika Chicago announces free training events

Automechanika Chicago has launched a series of single-day training programs, Automechanika Chicago — LIVE Training Events, in cooperation with leading technical colleges.

The free training events begin this May at Washtenaw Community College in Ann Arbor, Mich., continue on at Fox Valley Technical College in Appleton, Wis., and wrap up in November at Joliet Junior College in Joliet, Ill.

All three events are part of the Commitment to Training initiative for both the service repair and collision repair segments, supported by industry sponsors. Learn more.

MotorAge.com/trainingannounced

• Your commitment to training

The Automechanika Chicago Commitment to Training initiative gives you the chance to connect with other automotive professionals who share your passion for training. By joining our community, you'll get access to the latest industry news, cutting-edge resources, expert tips and free training events. Visit this page for more information.

MotorAge.com/yourctt

• Building a championship team

This spring our Technical Editor and Director of Training, Pete Meier, was invited to visit the Team Kalitta Motorsports facility in Ypsilanti, Mich.

He took a look behind the scenes and spoke with Jim Oberhofer, VP of Kalitta Motorsports.

"Little did I know at the time, but the lessons and experiences Jim had to share would prove just as valuable to you in your professional careers as it does to those involved in professional racing at any level," writes Pete. Read their conversation in the full article.

MotorAge.com/buildteam

• Managing the need for service information with ProDemand

To be successful in repairing the multitude of vehicle systems today's professional technicians face, you need information — and more than just technical specs, fluid capacities and torque valves. You need to be able to quickly identify the systems and components involved and how they work and interact with one another.

This episode of "In The Workshop" takes a look at ProDemand, a resource that provides technicians with OEM repair, estimating, maintenance and practical experience-based information. Watch the video to find out how ProDemand can make your job easier.

MotorAge.com/manageneed

• Get a free telematics whitepaper

Telematics have the potential to reshape how the aftermarket engages and interacts with customers and potential customers, but only if the industry is able to gain access to this emerging arena.

Some of the benefits that telematics offer to shops include remote diagnostics and enhanced customer reach. Download the full telematics whitepaper to learn more.

MotorAge.com/freewhitepaper

TRAINING EVENTS

MAY 14
- Automechanika Chicago —LIVE Training Event; *Washtenaw Community College*

Ann Arbor, Michigan

AUGUST 9-13
- 2016 NACE/CARS Expo

Anaheim, California

SEPTEMBER 16-18
- 2016 CAN Conference;

Ithasca, Illinois

OCTOBER 8
- AERA Conference; *Speedway Motors Museum of American Speed*

Lincoln, Nebraska

OCTOBER 15
- Automechanika Chicago LIVE — Training Event; *Fox Valley Technical College*

Appleton, Wisconsin

NOVEMBER 19
- Automechanika Chicago LIVE — Training Event; *Joliet Junior College*

Joliet, Illinois

CONTINUED FROM PAGE 30

value to your customer base.

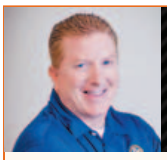
Once you identify a program, you need to measure its effectiveness. Simply tracking redemptions on coupons doesn't provide you with a full picture of how well your campaigns worked. It's wise to look for a program that includes analytics so you can see response rates by zip code, make and model and marketing channel. These types of metrics will enable you to calculate your return on investment in a much broader way and help you refine your future marketing efforts.

It's also important to utilize a retention program that includes call tracking, which will allow you to identify missed calls for follow-up opportunities. If those calls are recorded, you can also get a sense of how well your staff is managing leads and whether more training might be needed.

Last, but certainly not least, cost must always be a consideration. Remember that you often get what you pay for, so settling for a cheaper option focused solely on sending follow-up emails isn't going to buy you much. By the same token, paying a lot for a program with a lot of unnecessary bells and whistles that are hard to understand or implement, isn't going to be worthwhile either. Before embarking on any marketing initiative, I recommend taking the time to determine what you'd like to achieve through your new effort and how much you would be willing to invest to reach those goals. When it comes to retention, your objectives might vary from improving response rates to driving more repeat visits to increasing sales. Whatever you decide, make sure your program allows you to measure your results to ensure that your investment is paying off.

Your customers are being inundated with marketing messages from your competitors daily. Simply hoping that they'll return to your shop because you've provided good service in the past isn't enough. You need to cultivate your relationship with your customers by implementing a solid retention program that keeps your shop front of mind.

Simply put, retention should be a key strategy in your overall marketing mix. By using a combination of direct mail and email marketing aimed at retaining existing clients and acquiring new customers, you'll drive in new business to your shop while building loyalty.



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UNDERHOOD

THERMAL IMAGING AND ELECTRICAL TROUBLESHOOTING

THERMAL IMAGING JOINS THE VOLTMETER AND AMMETER AS A VIABLE ELECTRICAL DIAGNOSTIC TOOL

BY **ALBIN MOORE** | CONTRIBUTING EDITOR

As automotive technology has changed, so has the technology of diagnostic tools and processes. When I started in this business in 1966, a good volt/ohm meter and test light pretty much rounded out the arsenal for electrical test equipment. Several years later came the digital volt ohmmeter, then labscopes. Finding the temperature of something required a mechanical thermometer; years later, along came the non-contact infrared thermometers. Today we have the use of infrared thermal imaging.

In the March 2016 issue of *Motor Age*, I wrote an article on this same subject — "A picture is worth 1,000 words." This month I would like to carry on this thought with a little more in-depth study of how thermal imaging works and share a case study on an electrical system problem. Let's take a few minutes and explore how this works.

The right way to take a temperature

I think most of us are familiar with the handheld non-contact pyrometer, or thermometer. Those tools can save a lot of time and money when it comes to testing the temperature of automotive parts. Have you ever considered the knowledge needed to use the power of this tool? There is more to its use than just pointing and shooting. To make this sort of tool take accurate temperature readings, the technician must also have some knowledge of the system they are working on to understand the story the

Photos: Albin Moore

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temperature readings are telling.

When using the non-contact thermometer, the tool is looking at the infrared radiation that is radiated from the object. That sounds simple, but what is infrared radiation? The dictionary defines this as light waves in the 8 to 15 micron wavelength. These are light waves that are invisible to the human eye, but can be seen by sensors in a non-contact thermometer or an infrared camera.

All objects emit infrared radiation as a function of their temperature. This means all objects emit infrared radiation. Infrared energy is generated by the vibration and rotation of atoms and molecules. The higher the temperature of an object, the greater the motion and hence more infrared energy is emitted. This is the energy detected by infrared cameras. The cameras do not see temperatures. They detect thermal radiation.

Why do you need to know this? Different surface colors radiate the light waves differently and the sensors in the infrared device will not report the proper temperature. As an example, a shiny surface, such as bright aluminum, will radiate the heat differently than a flat black surface. Why does this matter? In some cases, it does not matter, especially if the technician is only using the temperature readings to compare the temperature of two different things that are made from the same material and have the same surface color and texture. Now if the technician is trying to get an accurate temperature reading, then the surfaces must be a dark color, preferably a flat black. An easy way to accomplish this is to keep an aerosol can of flat black paint in your tool box and just give the shiny surfaces a quick shot of the black paint.

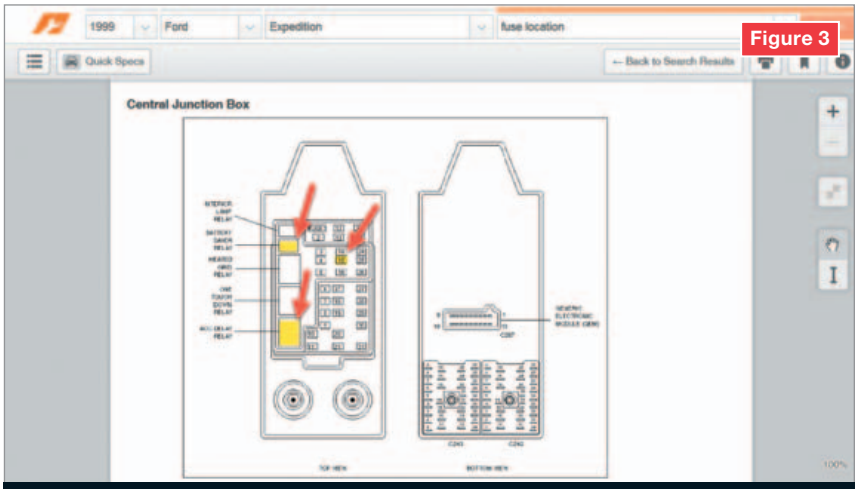

Figure 3

By comparing this graphic of the under dash fuse panel with the thermal image, it is easy to identify what each relay is and what each fuse is powering.

Since the handheld infrared tool we have been talking about only takes its temperature reading from one small spot, the information gathered is quite limited, much like using a volt meter to watch the voltage output from a generator, or to watch the voltage signature of a working fuel injector. The infrared camera uses this same technology, except it takes its temperature readings from several thousand little spots and plots this information on a screen so the human eye can see the results.

- A spot pyrometer just gives you a number; a thermal imaging camera generates an image.
- A spot pyrometer reads the temperature of one single spot; a thermal imaging camera gives you temperature readings for each pixel of the entire thermal image.
- Because of advanced optics, thermal imaging cameras can also resolve temperatures from a longer distance. This allows you to inspect large areas very quickly.

With this background of thermal imaging, we need to apply the tool to a diagnostic process. If we are working on an electrical system, one very important thing to keep in mind is that current flow produces heat. Any time current flows through a component or conductor, there is some amount of heat generated. Will a thermal image of a circuit or component tell us how much current is flowing in the circuit? No, it will not, but it will tell us if there is unwanted resistance in the circuit, or if the circuit is actually flowing current.

A real-world example

This afternoon, a new customer brought in his 1999 Ford Expedition. The vehicle is a high-mileage vehicle with 388,190 miles on the odometer. The vehicle is powered with the 5.4L engine, with its power running through an automatic transmission.

The vehicle owner says the vehicle had been sitting for three months and when he went to get the vehicle, it started right up and ran well. The vehicle was driven about 100 miles and parked overnight; the next morning, the engine would not crank. A trickle charger had been hooked to the battery and left overnight. The next morning the engine would not crank. At that point, a 70-amp charger was hooked up and the engine started with no problem.

After being parked for two days, the engine again would not crank. The owner says the headlights were

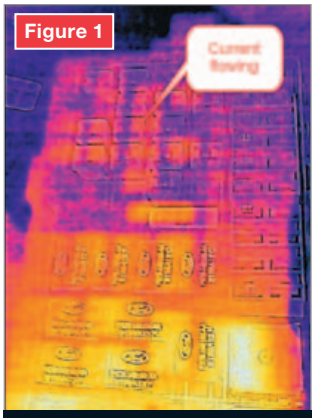

Figure 1

The underhood fuse box was my starting place in searching for the current draw problem. I didn't see anything that would stick out here, so the next step is the under dash fuse box.

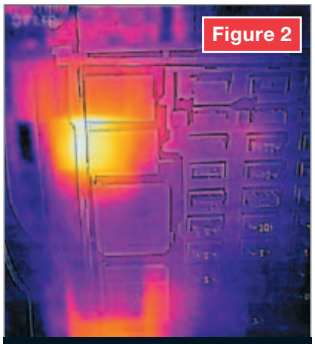
Figure 2

This thermal image of the under dash fuse and relay box shows two relays and one fuse that are warmer than their surroundings. This picture saves a lot of time not having to test each fuse for volt drop to verify there is current flowing through the fuse.

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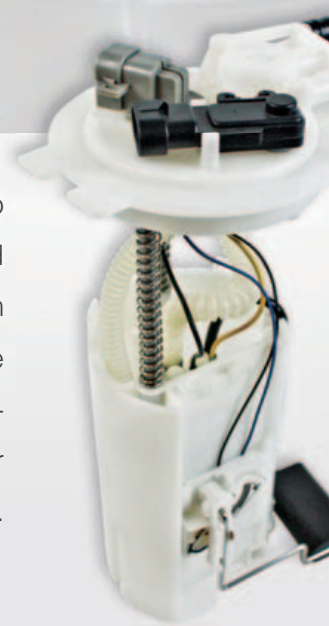

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nice and bright, so he thinks there is a problem with the starter solenoid that is mounted to the firewall. Three years ago, he had this same problem and a starter solenoid fixed it. When the vehicle was brought to my shop, the engine cranked and started just fine.

Before we embark on this diagnostic journey, we need to have a direction. Would you start looking for a defective part, such as a starter relay? Maybe pull and tug on the battery cables and associated wiring? How about suspecting a defective battery, or a poor connection at a battery terminal? Since the art of diagnostics is to get the problem to come to you, I want to start with something simple.

With any electrical problem like this, I want to use a systematic diagnostic approach. This will always start by qualifying the battery. It doesn't matter if the battery is old or new; always qualify the battery condition before any other testing is done. Since the battery is the power source for the starting system and if the battery is not up to its task, all other testing can be wasted time. In this case, the battery was new and clean and when load tested at 50 percent of its cold cranking amperage (CCA), the voltage did not drop below 9.9 volts.

With that hurdle crossed, the next thing to confirm is if there is any parasitic draw. All doors were locked and the ignition key taken out of the ignition switch. With my current probe hooked around the negative battery cable, I found a current draw of .537 amps (537 milliamps). At this point, I want to leave the vehicle alone to see if the current flow decreases as the different electronic modules go to sleep.

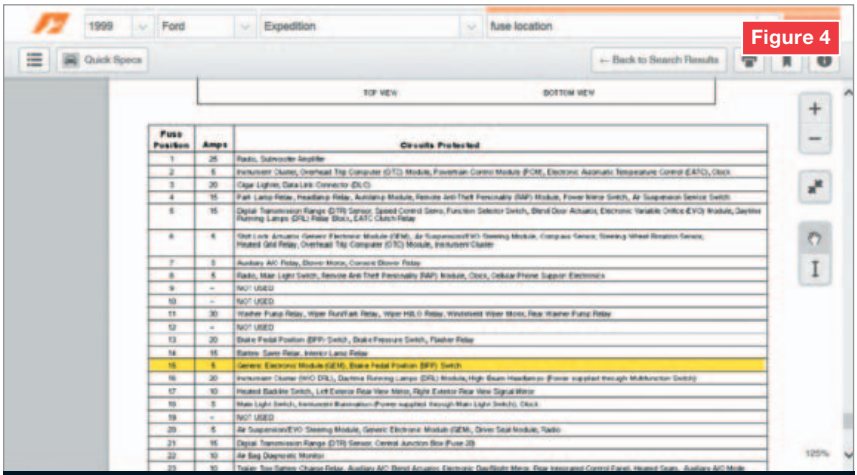

Figure 4

This fuse chart of the under dash fuse panel lists what each fuse protects and the amperage rating of each fuse. This chart takes the guess work out of trying to figure out what each fuse powers and is a life saver when someone has been in the fuse panel and has either pulled fuses out or put in fuses with the wrong amperage rating.

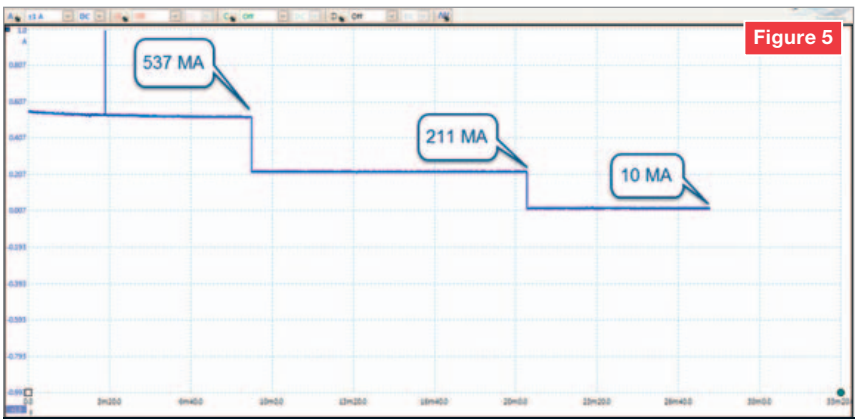

Figure 5

This is a scope capture of the current flow activity during the parasitic draw test. The beauty of using a waveform of the current flow is the technician can tell how much current is flowing and when things happened in the circuit. It is also a redundant way to verify correct readings of the inline amp meter.

TECH TIP

To find the allowable parasitic draw for a battery, divide the battery reserve capacity by four to determine the amount of parasitic draw in milliamps the battery will sustain. In other words, if the battery reserve capacity is 100 minutes, 100 ÷ 4 = 25. The battery will support a maximum 25 milliamp draw or .025 amps. This is an important piece of information to keep under your hat, since most vehicle manufacturers do not publish a maximum value for parasitic draw.

The vehicle was left alone for about an hour and when I went back, the inline amp meter was still showing a current draw of .537 amps. The next step in the diagnostic process is to find which circuit is drawing the current. Over the years, many different ways have been used to find this problem, of them: using a test light in series with a battery cable, pulling fuses and waiting, and using a voltmeter to check the amount of voltage drop across the fuses. Some of these methods are very accurate, some are not, but they all take time, which is a very valuable commodity for the diagnostic technician.

My first grab for a diagnostic tool to perform this task was my cell phone with the infrared camera attached. Since the underhood fuse box is the easiest to access I took a look there first. **Figure 1** shows the underhood fuse box. This box has a few small fuses, but most of the fuses are large fuses that feed other sub-circuits, which are fused in the central junction box that resides under the left side of the dash.

The next stop was inside the cab to take a look at the central junction box. **Figure 2** shows what I saw. There are two relays and one fuse that are warm from current flowing through them. I say they are warm, but they are not warm to the touch. The thermal image shows them as warm, since they are warmer than their surroundings. To determine what these components are, a quick look at MotoLogic service infor-

mation gave me the picture in **Figure 3**. The battery saver relay is activated, as is the accessory delay relay. By comparing the thermal photo to the fuse diagram, I can see fuse 15 is also flowing current. By using the fuse description chart in **Figure 4**, we know fuse 15 powers the GEM (general electronic module) that is sandwiched on the back of the fuse panel. This chart also shows the amperage rating of each fuse. This chart is very helpful after someone has either removed fuses from the fuse panel, or has installed fuses of the wrong amperage rating.

Now we know where the current is going; the next step is to pull the fuse 15 and monitor the current flow with the amp meter that is hooked in-line with the negative battery cable. I am sort of old-school when it comes to monitoring very low current flow on problems like this. I like to see both digital numbers and a graph of the activity on the circuit. Yes, I know this is a little overkill, but I also don't like doing the job the second time because something happened when I wasn't looking. To solve this problem, I use a low-amp probe and scope along with the amp meter in my Vantage Pro. The tools were hooked up, fuse 15 was removed from the under dash fuse panel, and within a few minutes the current flow dropped to .211 amps (211 milliamps).

This current flow is still too much — about 10 times more than the current flow allowed for this battery. By waiting a few more minutes, the current flow dropped to .010 amps (10 milliamps). I have also been capturing the data on my labscope as seen in **Figure 5**. On the scope capture, I noticed it took close to 20 minutes for all modules to go to sleep. Yes, this scope capture is redundant, but by using the scope, it is easy to step away from the broken vehicle and be productive on something else while modules are getting ready for their naptime. The scope leaves a visual recording of what happened in the circuit and is very accurate.

Now I have narrowed the problem down to the GEM module. By using a thermal image of the fuse boxes, it is very quick to find where the current is flowing. This does not discount the need for using an ammeter or voltmeter in the diagnostic process, it is just another great tool in the electrical technician's toolbox.

Thermal imaging is useful for more than electrical problem analysis. All automotive systems, whether electrical, mechanical or hydraulic, generate heat when they operate. Knowing how the system works and applying that knowledge to thermal imaging is a great way to make problem analysis quicker and more accurate.

ALBIN MOORE
CONTRIBUTING EDITOR

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

Email Albin at bwrench@yahoo.com

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Nixing NAG 1 problems

LEARN HOW TO TACKLE SOME ISSUES YOU MAY SEE WITH THE NEW AUTOMATIC GEARBOX GENERATION ONE.

BY **WAYNE COLONNA** | POWERTRAIN PRO PUBLISHER

IN THE Powertrain Pro section, we have written several articles about the NAG 1 five-speed automatic transmission used in Dodge, Chrysler and Jeep vehicles. It comes in both two-wheel drive and four-wheel drive configurations and may also be referred to as the WA580, W5A580, 5G-Tronic or 722.6 transmission. This article will continue with some additional issues that may show up in your shop.

A good friend and meticulous rebuilder, Dale Desveaux, owns and runs a shop in Napanee, Canada. He had a 2007 Chrysler 300 3.5L AWD vehicle with the NAG 1 unit come in to his shop. It exhibited a no upshift condition and was unable to get speeds over 15 mph due to a loss of power from the engine.

He attached a scan tool and pulled the following codes:

- P0501: Vehicle Speed Sensor 1 Performance — this code will set if multiple ABS wheel speed signals are invalid.
- U140A: Implausible Right Front Wheel Speed Signal Received — readings compared at 25 mph
- C101F: Right Front Wheel Speed Comparative Performance — different signal compared to others.
- U140B: Implausible Left Rear Wheel Speed Signal Received — readings compared at 25 mph
- C102A: Left Rear Wheel Speed Comparative Performance — different signal compared to others
- C121A: Steering Angle Sensor Not Initialized — refer to C1231 Drive Test Steering Angle Sensor

This particular transmission does not utilize a traditional output speed sensor for a vehicle speed signal. The ABS system converts wheel speed signals (specifically the rear wheel speed signals) into a vehicle speed that is then broadcast over the network. The TCM receives this signal and utilizes this information for shift scheduling and gear ratio calculations, among other things. In fact, you


Figure 1

WAYNE COLONNA
is President of the Automatic Transmission Service Group (ATSG) in Cutler Bay, Fla., and a frequent speaker/instructor for transmission training around the globe.

Photos: Wayne Colonna

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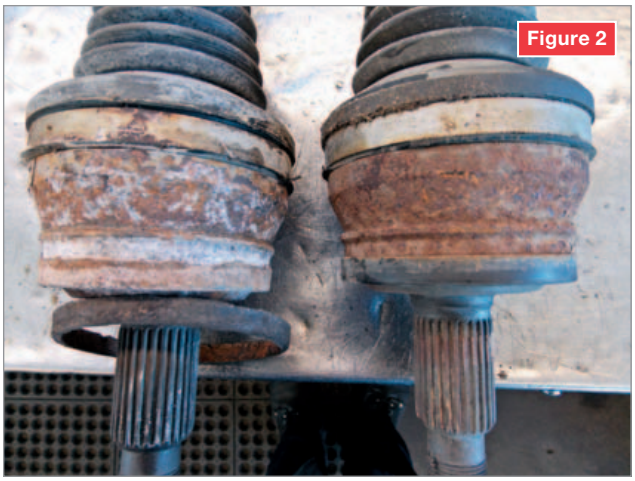
Figure 2


Figure 3

can read "ISS Factor" (January 2014), which explains the calculations are made to determine gear ratios.

Since vehicle speed is coming from the rear wheel speed sensors, there are a number of items to consider if gear ratios are wrong. One obvious cause of incorrect gear ratios is a slipping transmission, and for many reasons of its own. But the not-so-obvious reasons, which can easily be overlooked, would be the use of a transmission with incorrect planetary gear ratios, the installation of an incorrect rear differential, a TCM misapplication or an incorrect pinion factor that was performed.

But getting back to the 2007 Chrysler 300 3.5L AWD vehicle, the front- and rear-wheel speed signals are used together for ABS/Traction Control, Electronic Stability Control (ESC) if so equipped, AWD control, and for corner assessment (curve recognition).

What this basically means is that all four-wheel speed signals are used to determine if the vehicle is in a turn. The rpm signal will be lower for the inside wheel speed and higher for the outer wheels. Once this is seen, the TCM is commanded to hold the gear going into the turn to prevent shift busyness as the driver is going in and out of the throttle and braking on the turn. This also explains why different tire sizes on the vehicle will negatively affect shift scheduling. This typically results in late up-shift with sensitive kick-downs or no up-shifts at all as the computer thinks the driver is in a turn while he or she is actually driving straight.

An interesting aspect to this strategy is how the ABS system compares wheel speed signals to the steering angle sensor, verifying a turn is indeed taking place. One would think that a steering angle sensor code would appear if the wheel speed signals are indicating a turn while the steering angle sensor does not. This we have not seen on our technical help line. But what we have seen is when there is a total loss of wheel speed signals, a steering angle sensor code will set, as did with this Chrysler 300.

Looking at the code list, one rear wheel speed signal was lost, as well as one front wheel speed signal. This takes out any possibility of the ABS Module being able to determine if the vehicle is in a turn, which ultimately affects curve recognition strategies. This also caused a conflict with the data from the steering wheel angle sensor prompting the ABS Module to set code C121A.

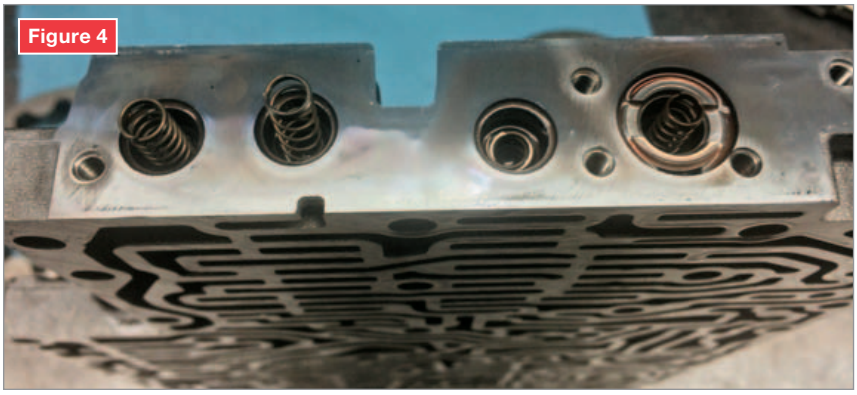
Figure 4

Chrysler information says DTC C121A "may" set with DTC C1231 because of the ABS Module detecting implausible steering angle sensor data. Although this code did not set, C121A pointed us to look at C1231. The information provided by Chrysler for this code breaks down and defines three performance problems that could cause this code to set — an erratic performance problem, a comparative performance problem or an angle over-travel performance problem (C1219, C123F C1240). Possible causes listed were a steering angle sensor installation problem, a faulty steering angle sensor or an ABS Module problem. With the steering wheel angle sensor being original to the vehicle, it eliminated an installation issue. It was also determined that Code C121A set only after it lost the two-wheel speed signals, which suggested an ABS issue rather than an angle sensor problem.

In short, it was quickly determined that steering angle code C121A was most likely the result of a loss of wheel speed signals. This made looking at the loss of wheel speed signals a priority in the diagnostic process. An interesting point to be made here is that the vehicle speed produced by the ABS Module, which is given to the TCM over the network, is calculated

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from the two rear-wheel speed signals, not from all four-wheel speed signals.

With that said, the loss of one rear-wheel speed signal was the primary cause of the no up-shift complaint. By getting the rear-wheel speed signal back, the transmission should begin to shift. The speed sensor wiring is encased, making it very difficult to check the signal with a scope near the sensor itself. It would require having to slice open the encasement, so it's best to check the signal at the TCM. However, Dale noticed that the encased left rear-wheel speed sensor wiring was long enough to cross over and reach the right rear wheel. For a quick diagnostic procedure, he pulled out the right rear-wheel speed sensor and poked the left rear-wheel speed sensor in its place. While on the lift, wheels off the ground, he ran the vehicle in gear using a scan tool view of the left rear wheel speed signal parameter.

The idea here is that if there was not a signal, the sensor or wiring will need to be inspected. If there is a signal, nothing is wrong with the sensor or wiring. This would point to a malfunction of the left rear exciter ring, preventing the sensor from producing a signal. And that is exactly what happened to Dale. He had an excellent reading so he pulled the axle to inspect the sensor ring and did not find one. With it being difficult to see what the sensor is reading to excite it, he changed the wheel bearing, as some vehicles have the pickup ring as an integral part of the bearing. Unfortunately, this did not resolve the problem. At this time he decided to pull the right rear axle and discovered that the sensor ring in this application is located on the end of the axle. Evidently, due to corrosion, the sensor ring had separated from the axle and became fixed to the housing (**Figures 1, 2 and 3**).

Once Dale replaced the axle with a sensor ring, it resolved the no up-shift complaint and the lack of power complaint. The lack of power felt like a faulty accelerator pedal position sensor or throttle body. This was an unexpected surprise as the definition for code P0501, U140B or C102A never once mentioned that it will affect engine power as some a form of failsafe. Nevertheless, codes P0501, U140B, C102A and C121A were eliminated


Figure 5

and the loss of power complaint was resolved. It was a gift readily accepted! All that was left was to fix the front-wheel speed signal, which would eliminate the remaining codes and restore curve recognition strategies.

Another entirely different problem that comes up is the setting of code P1731. The code definition is nothing more than "Incorrect Gear Engaged." It can be quite an elusive code to diagnose, as there are many possibilities that can set this code. This code may also cause the transmission to failsafe to neutral depending upon the type of failure the transmission has.

The theory behind P1731 is that the TCM compares the calculated gear with the gear the transmission has actually engaged. The actual gear is identified by verifying the signals of the two input speed sensors 1 (N2) and 2 (N3), as well as the transmission output speed


Figure 6

(from the ABS system). If the actual gear differs from the gear calculated by the TCM, the TCM value is adjusted to the engaged gear and a counter is increased by 2 points. If after a shift the engaged gear and the calculated gear still match, the counter is decreased by 1 point. A DTC is detected as soon as the counter exceeds a threshold.

The TCM offers a parameter of shift time for each of the shifts that take place. Looking at this parameter through a scan tool may provide a clue as to which gear is being problematic. In one sense, without having the ability to look at shift time parameters, identifying the cause of the problem is like trying to find a needle in a haystack. But sometimes the way in which the code sets can be a clue in itself.

John Parmenter, a well-respected tech who owns a shop in Centereach, Long Island, and is also a tech advisor for Precision International, ran into a 2006 Jeep Commander with this code. The vehicle shifted well through all the gears, except for a slight tie up on the four to five shift. Code P1731 would set after three drive cycles. With it taking three drive cycles to set the code along with actually feeling a slight bind up going into fifth gear, John suspected a valve body issue.

An interesting feature with the NAG 1 transmission is what's called "Shift Groups." There is a dedicated solenoid and a set of valves for each specific shift making up the contents of the group. There is the 1-2/4-5 shift group, a 2-3 shift group and a 3-4 shift group. With the 1-2 shift functioning well, the 1-2/4-5 shift group seemed to be an unlikely possibility. What John chose to do was to inspect the 3-4 shift group. What he discovered was a broken spring for the 3-4 Shift Pressure Valve as seen in **Figures 4, 5 and 6**. This prevented the proper release of the K1 clutch as the B1 clutch was being applied.

One other way that could point you in the right direction would be to clear the code and drive the vehicle, shifting it through each gear manually. Most of these vehicles have paddle shift or shift levers with tip-up, tip-down features that allow you to manually shift into each gear. The tip here is to hold each gear for longer than usual to see when a code sets, pointing you to the problem area.

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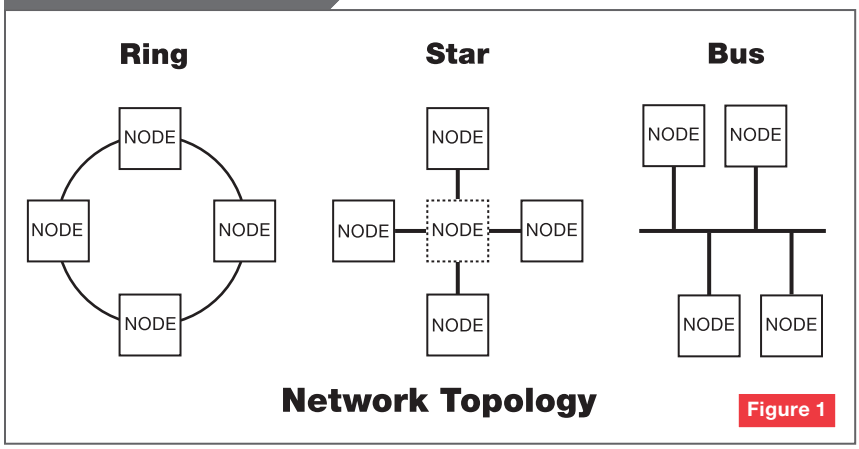

Figure 1

UNDERSTANDING CAN

AUTOMOTIVE TECHNOLOGY IS DEPENDENT UPON A NUMBER OF CONTROL MODULES AND THEIR ABILITY TO COMMUNICATE WITH ONE ANOTHER. WHAT DO YOU DO WHEN THE COMMUNICATION STOPS?

BY **BERNIE THOMPSON** | CONTRIBUTING EDITOR

It has been important to have different styles of communications for many years. Perhaps one of the earliest forms of this would be to communicate with flags. This allowed communications over long distances. However, this would require that the two individuals would need to be within sight of one another. Technology soon helped this problem with the telegraph. The telegraph enabled communication over vast distances. It accomplished this with messages that were comprised of on-off electrical pulses against time. This on-off coding was referred to as Morse code. These on-off pulses made up letters that would enable words and complete messages to be created. This communication style of on-off electrical pulses is still used in modern vehicles to send and receive messages.

One such communication language is the Controller Area Network (CAN). The CAN protocol was developed by Bosch in the early 1980s for automotive in-vehicle networks. The first vehicle in which the CAN language was used was the 1991 Mercedes S class. The CAN protocol has emerged over the last 25 years as the dominant automotive programming language. In 2008, regulations required that all vehicles sold in the U.S. must use the CAN protocol to communicate with emissions-related microprocessors. This CAN standard is ISO15765. It is important to be aware, though, that a vehicle platform can have several different protocols and several different network topologies in use on the same vehicle. Even CAN-based networks on the same vehicle can be different, as we shall see.

Understanding topology and protocol

It will be imperative to know which system topology (the way the individual modules are interconnected) and which protocol speeds are being used on a vehicle before you start to diagnose it. The network topology can be laid out in three distinct configurations: the ring, the star and the bus (**Figure 1**). Each of these topologies has advantages and disadvantages in their use. In the ring topology, for instance, if the communications wire becomes shorted or broken on dual ring networks, all the modules or nodes can still communicate. This is a closed architecture network, making it difficult to add nodes in the field. In the star topology, if the communication wire becomes shorted or broken, only one node will be lost. The problem with the star topology is the center node is the master and the other nodes are referred to as slaves. If the master node goes down, the entire network loses communication. The CAN network uses a bus topology and, if the communication wire becomes shorted or broken in the network, it will maintain communication as long as a dual wire bus is used.

The CAN bus topology uses a multi-master system where each node (also known as an ECU or module) is self-sufficient.

This means that each node has a crystal oscillator and can control the voltage levels on the bus. If one node fails, this bus network configuration will still function. CAN is a language and like Morse code, it uses on and off electrical pulses against time to convey data messages. These data messages are comprised of digital high and low voltage changes that are read as a binary code. This binary code is made up of 1s and 0s. The way in which the 1s and 0s are organized against time is what makes each network protocol different. Just as in different spoken languages, such as English and German, the same alphabet is used. What makes each of these languages unique is the way in which the letters and spaces are organized. In both of these spoken languages, the organization of the letters and spaces will have rules applied to them that will have to be followed.

Network protocol languages will also have certain rules that will govern them. These regulations are set by the Society of Automotive Engineers (SAE) and the International Standards Organization (ISO). The regulations mandated by these organizations

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ensure that a system standard will be followed so that all systems under the standard will operate and work together. When Bosch wrote the CAN language, no physical layer or transfer media were given. This open architecture was done on purpose to allow the CAN language to be more versatile, thus making it more powerful. By not confining the use of the CAN language to a set physical layer, the engineering teams can be more creative. This is why CAN is able to run at various speeds from 1-1,000 kilobytes per second (kbps) and be transmitted on different physical media such as 1 wire, 2 wire, twisted pair, shielded twisted pair, coax or fiber optic. The CAN network can also utilize different voltage levels to control the bus communications. To make sure that each of these CAN embodiments work correctly, SAE and ISO wrote standards for each of the various speeds and physical layers (**Figure 2**).

Just a Few of the More Popular Automotive Standards

- Passenger Car
  - J2284 - CAN High Speed Interface
  - J2411- Single-Wire Physical Layer
  - ISO 11898 - CAN High-Speed Transceiver
  - ISO 15765 - Diagnostics on CAN (J2480)
  - ISO 11992 - Truck and Bus Brake Standard
- Heavy Truck and Bus / Agriculture
  - J1939 - Truck and Bus Serial Communications Vehicle Network
  - ISO 11783 - Agriculture and Forestry

CAN Standards Figure 2

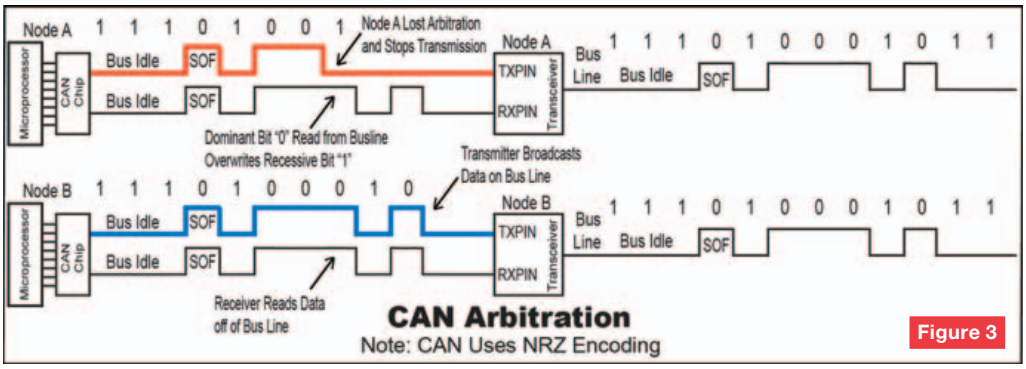
CAN protocol has been divided into three groups based on the transmission/receive rates. These rates are based on how many bytes can be transmitted in one second. CAN A is a low-speed CAN network that operates at 10 kbps. CAN A is used in a low-cost network scheme that will control body functions such as seat nodes, door nodes, mirror nodes, etc. These systems are not safety critical, so the transmission speed is not crucial. CAN B is a medium-speed CAN network that can operate from 33 kbps to 250 kbps. This would be used in body control functions or diagnostic functions that need to transmit larger amounts of data. CAN C is a high-speed CAN network that operates from 250 kbps to 1 megabyte per second (mbps). This would be used in safety-critical systems such as airbag, ABS, traction control, powertrain, etc. The network data transmission speed costs money. The faster the data transmission speed, the greater the cost.

Traffic control

Since the cost of these networks will raise the cost to manufacture the vehicle, the appropriate CAN bus will be utilized. What this means is there may be three different CAN networks operating at the same time in the same vehicle, but at different speeds. It is also possible that other network protocols and media types as well as the CAN protocol may be in operation on the same vehicle. CAN A, CAN B and CAN C run at different speeds; however, each of these can be implemented on the same vehicle. If all the CAN speeds were to run on the same wire with this much variation in speed, there would be data collisions. Think of this as a single-lane highway with VW Beetles driving at 10 mph and Formula 1 cars overtaking the VW Beetles at 250 mph. This would ensure that collisions would occur. To avoid this problem, each network is isolated to the protocol and speed at which the network is transmitting and receiving. Now that each network protocol and speed is contained on its own isolated network, the collisions from running at various speeds will be avoided; but because the networks have been isolated, there will be no way for these networks to share information.

One example of this would be the ABS node. The ABS node receives the vehicle speed from the wheel speed sensors and transmits this data on the high-speed bus. The powertrain control node could utilize this information because it operates on the same high-speed bus; however, the instrument panel will also need this data message in order to display the vehicle speed. The instrument panel is on the low-speed bus and cannot receive this information directly. In order for data messages to be shared among different networks on the same vehicle, a special node is used. This special node contains all of the transceivers for the different networks that are utilized on the vehicle. In this way, the node can receive a high-speed message on the high-speed transceiver and convert this data message out to the low-speed transceiver. This node is called a gateway, and it enables the transfer of data messages between the different networks on the vehicle.

A single vehicle can have several gateways to help transfer data messages between dif-

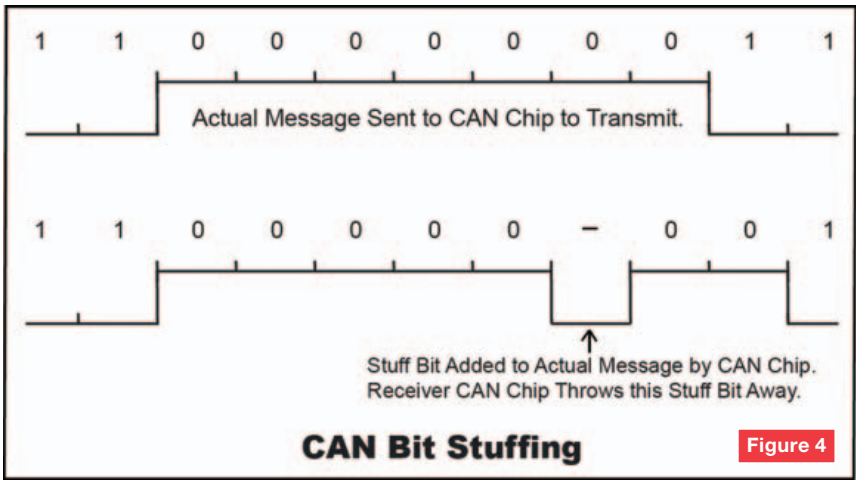


CAN Arbitration
Note: CAN Uses NRZ Encoding
Figure 3

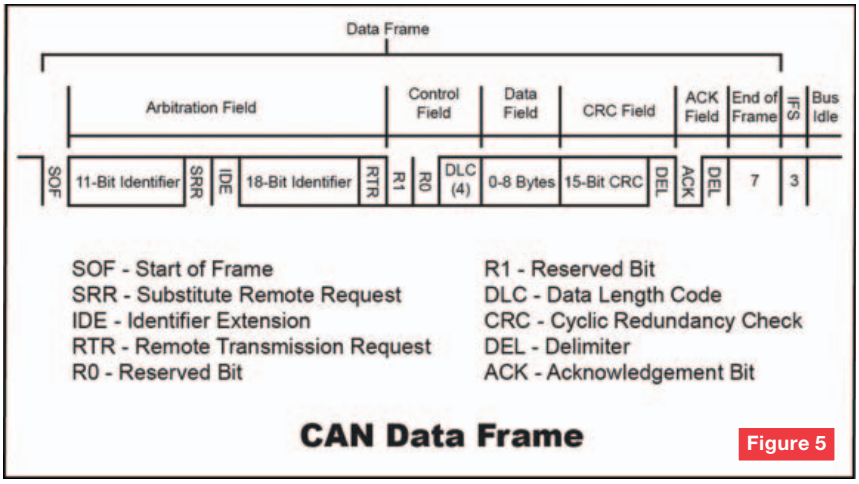
ferent networks. There are several different configurations a bus network can use to communicate. The first style is a token slot protocol. In this protocol, a token is passed between all the nodes on the bus from one node to the next. When a node receives a token, it can then send a data message out on the bus. Once the message has been sent, the token is passed to the next node so it can send its message out on the bus. In this token scheme, an urgent message will have to wait until a token is received by the node needing to send the urgent message. This creates a long latency period that is undesirable. Another bus scheme is random access, which is what the ethernet uses. This protocol also has long delay, which is also undesirable. Yet another bus scheme is CSMA/CD. This is the bus network scheme that CAN uses. CS stands for carrier sense (listen until the network is idle and it must wait if another node is transmitting). MA stands for multiple access (multiple nodes can access an idle bus at any time). CD stands for collision detection (method of resolving data collisions).

With up to 40 nodes operating on one CAN network, it will be imperative that an urgent data message is given priority over a normal data message by taking control of the bus. An example of this would be a single telephone with a line of 40 people waiting to talk on it. The person currently on the phone is calling to see if his laundry is ready for pickup. This person now puts the phone down and the next person in line is going to call home to let them know they are on their way. The last person in line needs to call 911 to report an accident with injures, thus this message is deemed urgent and must be sent next.

To make sure that urgent messages are sent in the correct order, they must be prioritized. In this example, the 911 call would come before any other call. If two 911 accident calls needed to be made at the same time, the next digit would indicate if there were injuries. An accident with injuries would be assigned a "0" and an accident without injuries would be assigned a "1." So, 9110 would take a higher priority than 9111. The accident with injuries in this example would take control of the phone line.



CAN Bit Stuffing Figure 4



CAN Data Frame Figure 5

This is similar to the way the CAN protocol prioritizes data messages so that each node on the bus can access the bus at any time; however, the node with a higher priority will take control of the bus to send its data message first. This style of communication is called bitwise arbitration (**Figure 3**). In the scheme of bitwise arbitration, if two or more nodes start to send data at exactly the same time, the node sending the higher priority message will take control of the bus. This is accomplished by the priority of the message containing more 0 than 1. Zero has a higher priority and is the dominant bit. One has a lower priority and is the recessive bit. If node A's message had the first two bits at 0 and the next bit at 1, and node B's message had the first three bits at 0, node B would have a higher priority assigned, and it would win the bitwise arbitration and take control of the bus. Thus, node B would send its data message first. Node A would have to wait and then try to send its message after node B was done. If the bus were idle then, node A could send its message. If another node needed to send a message and had a higher priority, it would win the bitwise arbitration, and then node A would have to wait again before trying to send its message. The first three bits of the data message will usually determine the outcome of the bitwise arbitration and therefore are assigned the main priority of the message. A wakeup call is assigned the highest priority, and it will start with three 0s. A scan tool is assigned the lowest priority and will start with three 1s.

During the transmission of the data message, the voltage level is changing between a high voltage state, indicating a 1, and a low voltage state, indicating a 0. The fewer voltage transitions that take place within the data message the better in order to limit radio-frequency interference (RFI). To minimize RFI, the CAN protocol uses

a method referred to as non-return to zero (NRZ). In this format, the voltage level does not have to change for each bit, but it can stay at a low voltage level — 0 — or a high voltage level — 1 — for up to five bits of length. If the data message is held at a given voltage level for more than five bits, the CAN chip will force a change in the voltage level opposite to the five bit level (**Figure 4**). This is called bit stuffing and is done so all the nodes on the bus can resynchronize to the rising or falling voltage edge. This bit stuffing also assures that the bus voltage level has not become stuck. This will help with the CAN diagnostics.

Message received

When a complete data message of 1s and 0s is completed, it is called a data frame (**Figure 5**). The data frame is composed of the start of frame, arbitration field, control field, data field, cyclic redundancy check field, acknowledgement field and end of frame. The CAN data frame can either be an 11-bit identifier or have a frame extension making it a 29-bit identifier. Most CAN vehicles now on the road use the 11-bit identifier. Newer CAN vehicles are taking advantage of the extended 29-bit identifier because more information than just the priority and identification can be conveyed in the arbitration field. The 29 bits can also contain information and source coding. Whenever a data frame is constructed and sent, it will be important for the data being transmitted and received to be correct. In order for this to be checked, the CAN protocol has incorporated an error detection and protection scheme. This is done with a process called cyclic redundancy check or CRC. The CRC is a 15-bit extension that is added on to the data frame. This extension makes the data frame divisible evenly by a mathematic equation called a polynomial. This relationship between the message and the CRC will produce a known value. If the value is anything other than the expected value, an error is marked against the message and the message is discarded. Therefore, any noise or disruption in the data frame will be caught and dealt with by the CAN error detection.

This CRC function is performed by the transmitter and receivers located in the CAN chip's hardware. The transmitting node uses its CAN chip to provide the outgoing bit stream with a CRC. At the end of the CRC, the transmitting node checks the CRC value before it stops transmitting. In other words, the transmitting node is checking itself. If the CRC numerical value is incorrect, the transmitter sends out an error frame by holding the bit stream down for more than five bits. Any receiving node on the bus can also send an error frame in this manor. This violates the bit stuffing error, so all of the nodes on the bus tag this data message as an error and discard it. The transmitting node then retransmits the data message. The CAN protocol determines which node is responsible for an error by penalizing the node that reports the first error. This node increases its receive error counter by a greater amount than the other nodes. This process is basically "shooting the messenger." The error indicators are watched by each node. In the case of intermittent errors, the CAN protocol will deal with these and will only add a slight latency. In these cases, the CAN error recovery is very good.

In the case of persistent problems where the errors counter exceeds a programmed percentage threshold, the CAN protocol will require the transmitter with the most error counts to get off the bus (bus-off state). Once the node has kicked itself off the bus, the only way the node can get back on the bus is if the bus has enough idle time, which is not likely, or if a hardware reset is done. It is important to realize that if a competing node does not stop transmitting once it loses bitwise arbitration, or starts transmitting when another node has control of the bus, or if noise interrupts during the message, the data message will be corrupt. The CRC will show a message error and this error will be assigned to the transmitting node. The problem here is the transmitting node is not the problem, but it will be assigned the fault. This can set a diagnostic trouble code (DTC) that would not indicate the true problem in the CAN network. Be aware that the scan tool becomes another node on the bus. If the scan tool has a problem, it can corrupt data messages and be the cause of false DTCs. Once the data message is sent, an acknowledgement — or ACK — from another node on the bus is sent. If no ACK is received in the data frame, the transmitting node assumes no other node on the bus received the message. This could indicate to the node that the bus is open.

Another method CAN uses to confirm the message was received is to have a response generated from the receiving node. On a high-speed class C CAN network, if a message is sent to a specific node, a response from that node is expected. If the receiver of the message does not respond, a DTC is set for the receiving node. A node that is experiencing an acknowledgement failure will not get kicked off of the bus. As soon as the node can communicate on the bus again it will recover from the acknowledgement error. In low- and medium-speed CAN A or CAN B networks, a response is not expected. If a message is sent to a specific node, no receiving response is generated. In this scheme, no news is good news. What can occur is that if a node on these style networks fails quickly, no messages will be sent out, thus, no errors for the failing node will be counted. Since there is no response expected, it is possible for a node to be completely inoperative and to have no codes to indicate that a problem exists. One such node that could fail in this manner would be a driver information module, or DIM. It will be important to study the CAN standards and have a good understanding of which network system you are working on. As more problems arise in vehicles with complex networks, the repair of these systems will become commonplace. So, have your knowledge and service bays ready.

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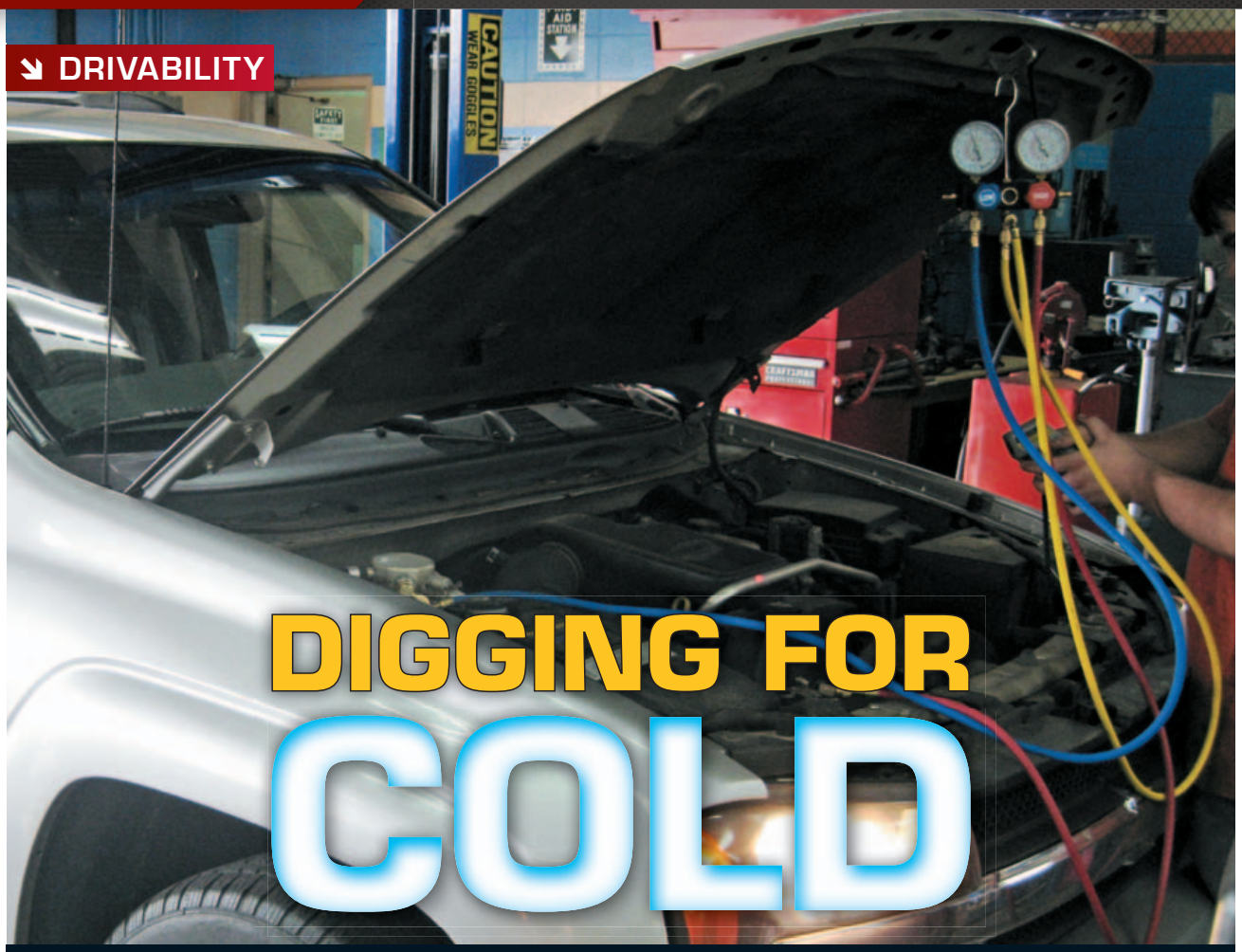

DIGGING FOR COLD

After the cold gas has been identified, and if there is any cold gas present, the gauges need to be installed and the pressures checked. There are no hard and fast static pressure numbers published anywhere, and ambient temps have a massive impact on the pressures anyway.

TEMPERATURE IS COMFORT FOR YOUR CUSTOMERS

BY **RICHARD MCCUISTIAN** | CONTRIBUTING EDITOR

Every vehicle is typically engineered for some measure of passenger comfort. The seats are contoured for the human body, and the instruments and controls range from merely functional to dashboard eye candy, replete with 21st century gadgets and widgets that range from really handy to silly and superfluous. Oh, and we like our entertainment systems, too. But even the most comfortable vehicle with the richest concerto can morph into an odiously uncomfortable ride if the weather outside is steamy and the driver can't control the cabin's climate. And then there is the problem of a heatless vehicle in the winter. In the subtropics where I live, we don't have a lot of dreadfully cold weather, but on days when it's cold enough to freeze, driving a car without heat can be pretty miserable. On those days, we find ourselves digging for heat. But even if the heat works, if the A/C is out of commission, the windshield won't de-fog properly because the A/C is as much a dehumidifier as it is a refrigerator.

One thing is certain: a vehicle owner who comes to your door in hot weather with hot air blowing will certainly be a lot happier if they leave having found cold at your shop.

In this article, we'll do a quick run down on where to begin and what to look for when a sweaty and uncomfortable driver comes digging for cold. And if you can surgically get a person's A/C back online when they've been suffering in the heat for a few days or weeks, it's a guarantee that you'll come away a hero.

In the driver's seat

To begin, make sure you know how to turn the A/C on. That statement might sound silly, but once back in the early 2000s, we were digging for cold on an '85 Buick Riviera and so I told a 44-year-old student to turn on the A/C.

Photos: Richard McCuistian

After sitting in the seat staring at the dash and rubbing his chin for a couple of minutes, he returned red-faced and embarrassed to where I was waiting and watching the compressor, reporting that he couldn't figure out how to turn the A/C on. Rolling my eyes and groaning at his incompetence, I sat down in the car and spent some time rubbing my chin and staring at that crazy CRT screen in the middle of the dash, just like he did before I could figure out the combination. I got it turned on, but it was most humbling.

And I'll never forget the five-year-old Geo Tracker that came in late one spring with the complaint that the A/C had worked fine the previous fall, only to find that there was no A/C button on the control head to engage the A/C — just a blind plastic plug and a stiff harness connector behind it that had never been plugged into anything. Not being familiar with the Tracker, I didn't at first notice that the A/C button wasn't there. I could jump the wires at the missing button's connector and get good A/C, but there had never been a button there, so how did the A/C work the previous fall? How did it ever work? I'll never know, and the customer didn't either.

The point is that it's important to understand the dashboard operation of the A/C before plowing ahead with another diagnosis.

Moving past turning on the A/C, the blower should be capable of moving air, as elementary as that sounds. When a customer says, "My A/C doesn't work," that statement carries about as much information as, "My engine runs rough." And since I've seen quite a few A/C concerns that were blower related but weren't recognized as such by the customer, I look for appropriate airflow at all speeds, and if I don't have it, I go after cabin air filters first, if the vehicle has them. Most folks (and many technicians) forget about the cabin filters and by the time they're checked, they're pretty loaded. If the filters aren't a part of the picture, leaves and trash in the evaporator case may be to blame if the car is regularly parked under trees. If the fan vibrates the dash when it spins, remove it and look for something in the squirrel cage. I once pulled a fan on a very clean Camry and found what looked like the bleach-tattered remains of an old dishrag in the cage, and the customer had not a clue how that stuff got in there.

If the airflow and cooling are normal early in the drive but then they taper off to nothing as the miles and minutes go by, look for an evaporator that is freezing up. I saw that concern on three different vehicles last summer. The first one was a Mazda pickup I mentioned in a previous *Motor Age* Garage article. A welded-together A/C clutch relay was keeping the clutch engaged, freezing the evaporator solid and killing the battery overnight to boot; the driver had noticed a loss of cooling and airflow after a few minutes of driving. The compressor was always engaged, thus causing the freeze-up as well as the parasitic drain.

Second was a Dodge pickup we checked a few days later that had the same A/C concern — lost airflow after driving. With a thermometer in the register on low blow/recirc (MAX) and both doors closed and the windows up, we saw the register temperature drop south of 30 degrees due to a stuck closed low-pressure cycling switch. Max/recirc, windows up and low blow is where the lowest temperatures can be measured.

A third icemaker we ran into in as many weeks was the 2010 Ford Fusion on which we initially replaced the evaporator thermistor only to find that the A/C control head was failing to respond to the thermistor's signal. After I explained what was going on, the owner opted to manually cycle the A/C to prevent the freeze rather than spending the money for a new control head. In her case, knowledge was power, I suppose. Anything that prevents the clutch from cycling off will freeze up the inner heat exchanger.

On this Geo Tracker, the button was mysteriously absent (bottom right of panel), and this connector (right) had never been plugged into anything. But it's good to know how the controls are SUPPOSED to work.

Every shop needs a good refrigerant identifier – the one we use is a unit from Neutronics®. Readings like this call for a dedicated machine and tank painted gray with a yellow top to remove and store the blended gas.

Gotta love the manufacturers who put both ports in a place where they're easy to find — some of them are egregiously difficult to locate. The low-side port is usually on the suction line and the high-side port tends to be on the discharge line between the compressor and condenser.

Speaking of evaporator thermistor issues, we tackled a Hyundai Santa Fe that had been repeatedly taken to a dealer because the A/C wouldn't cool, and lots of money had been spent to no avail, but a simple button-dance on the control head revealed a code that pointed to a faulty thermistor. The problem was that the dash had to be removed and it was quite a large project, but when we were done, we had found cold, and the owners decided to keep that vehicle and have it repainted instead of trading it in.

Under the hood

If the register is blowing warm or even hot and there is no control head diagnostic button combination, I like

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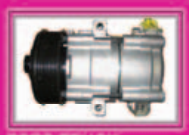
10S20F
14-21127NEW

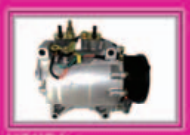


FORD TRUCK
97-07 F150
FS10
14-3028NEW

DODGE RAM
06-10 2500-5500
HS-18
14-0220NEW

NISSAN
02-06 ALTIMA
DKS17D
14-0142NEW

TOYOTA
99-08 VARIOUS
10S17C
14-0074NEW



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HS110R
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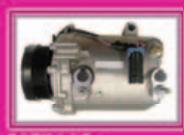

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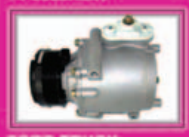
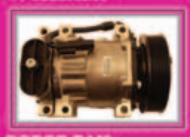
MSC130CVSG
14-20412NEW

GM TRUCK
96-02 PICKUPS
HT6
14-20151NEW



FORD TRUCK
02-06 ECONOLINE
SCROLL
14-0090NEW



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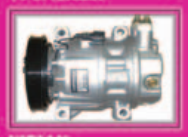

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CWV618
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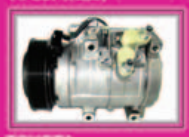
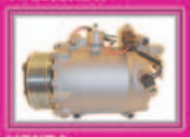


TOYOTA
04-06 SIENNA
10S20C
14-0135NEW



HONDA
07-11 CR-V
TRSE09
14-1003NEW

CHEVROLET
06-11 IMPALA
CVC
14-21471NEW

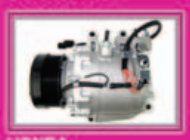
GM TRUCK
96-02 EXPRESS VAN
HT6
14-20447NEW

FORD TRUCK
94-11 RANGER
FS10
14-3022NEW

DODGE RAM
94-05 5.9 L DIESEL
SD7H15
14-SD4682NEW

NISSAN
09-14 MURANO
DKS17D
14-0782NEW

TOYOTA
03-08 COROLLA
10S15L
14-4004NEW $150



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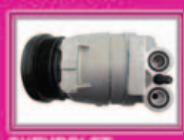
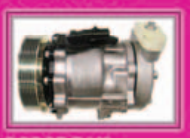
06-11 CIVIC
TRSE07
14-0250NEW



CHEVROLET
04-08 AVEO
V5
14-0301NEW

GM TRUCK
99-02 SILVERADO
HU6
14-20448NEW

FORD TRUCK
07-14 EXPEDITION
FS-20
14-3552NEW



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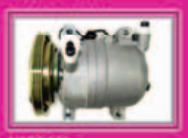
02-03 DAKOTA
SD7H15
14-SD4653NEW



NISSAN
99-04 FRONTIER
DKV14C
14-4008P

TOYOTA
94-01 CAMRY
10PA17C
14-3010NEW

HONDA
05-08 ODYSSEY
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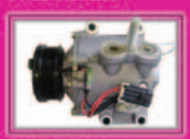
14-0241NEW

GMC
07-12 ACADIA
10S20C
14-21625NEW



GM TRUCK
02-07 TRAILBLAZER
TRSA12
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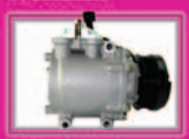
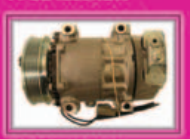


FORD TRUCK
03-06 EXPEDITION
SCROLL
14-0290NEW



DODGE RAM
98-02 DAKOTA 2.5L
SD7H15
14-2897NEW

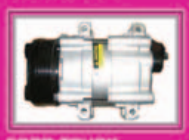
NISSAN
99-04 XTERRA
DKV14C
14-3108NEW

TOYOTA
02-06 CAMRY
10S17C
14-4030NEW

HONDA
91-00 CIVIC
TRS090
14-3555NEW

CHEVROLET
04-06 MALIBU
CVC
14-21136NEW

GM TRUCK
91-96 CHEYENNE
R4
14-20189NEW



FORD TRUCK
04-07 FREESTAR
FS10
14-3568NEW

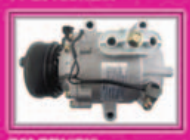
DODGE RAM
03-08 1500-3500
10S17E
14-0132NEW

NISSAN
01-04 PATHFINDER
CWV618
14-4009NEW

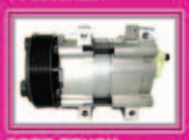
TOYOTA
95-14 TACOMA
SP-15
14-0253NEW

HONDA
03-07 ACCORD
10S17C
14-0155NEW

BUICK
93-05 PARK AVENUE
V5
14-20453NEW



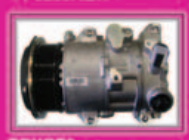
GM TRUCK
2005 EQUINOX
SCROLL
14-21153NEW



FORD TRUCK
99-03 SUPER DUTY
FS10
14-0066NEW

DODGE RAM
04-06 DURANGO
10S20E
14-0204NEW

NISSAN
99-02 QUEST
FS10
14-0019NEW



TOYOTA
07-11 CAMRY
6SEU16C
14-0384NEW

HONDA
99-04 ODYSSEY
10S20C
14-0071NEW

GENERAL MOTORS
66-93 VARIOUS
A6
14-22276NEW

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to pop the hood and check for compressor operation if it has a magnetic clutch, and if the compressor is spinning, I want to feel a cold suction line and a hot liquid line. If the compressor isn't spinning, it's time to sniff the juice with a Neutronics identifier and then connect the gauges or the machine to check for pressures.

When you first connect the gauges, you can make note of the static pressures, but there's only so much those pressures can tell you. Ambient temps have a tremendous impact on system pressure, and on a hot day, a half-charged system might show 80 psi on both gauges. If, however, the static pressures look that decent, the low-pressure cycling switch should engage the compressor, unless there's an electrical or mechanical problem — i.e. the compressor's clutch has worn to the point that the air gap is too wide. More about the electrical stuff in a minute.

If the compressor is spinning and the suction line is cold all the way to the compressor on a hot day, the refrigerant charge isn't likely to be a problem, but the blend door may be. And some platforms have a blend door and a heater control valve that bypasses the heater core when heat isn't called for, so pay attention to the valve if it has one of those.

When you're dealing with screwball pressures and non-coolers with a fully charged system, don't condemn anything until you've checked everything. The orifice is a dandy filter and the stuff you find there tells a story sometimes. And if the desiccant sock bursts, you may have these little rascals clogging things.

If the suction line is cold right out of the evaporator but grows warmer along its length as it travels through the engine room, suspect low charge, particularly if the compressor is short cycling. But realize that not all systems will cycle the compressor exactly the same way.

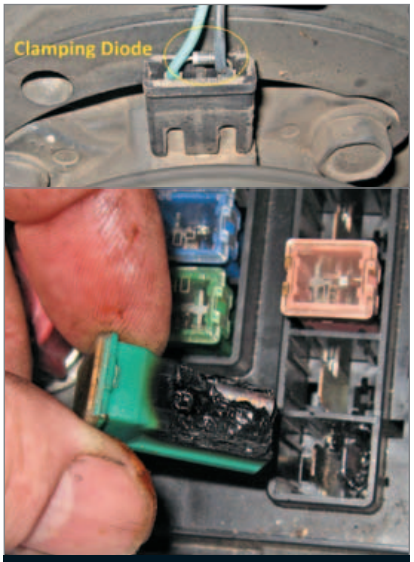
If the A/C charge is good and there is power making it to the clutch coil, gently bump the clutch with something (be careful!) to see if it kicks in with help. If it does, then doesn't kick in again after cycling off the next time, the clutch air gap should be checked and adjusted, — a procedure that differs from unit to unit. Some clutches have shims; others require special tools to press the clutch hub a bit closer to the pulley.

Pressure and juices

When the compressor kicks in, the pressures should dive in different directions, but how far they dive will be directly tied to ambient temperatures. On a cool day, you may see the low side on a fully charged system drop into the mid-20s with high-side pressures bouncing between 150 and 200, accompanied by short-cycling clutch times. On a hot day, you might see low-side pressure between 40 and 50 and high-side pressure up around 300. Make sure you have good airflow through the condenser and a healthy fan that works every time it receives power.

Low pressure on both sides with a normal refrigerant charge typically means the expansion valve needs replacing on systems that have those, but a clogged evaporator can have the same effect.

Too much oil in the system can be a problem, too; oil-saturated heat exchangers are inefficient at best, and flushing may be necessary if too much of the slippery stuff has been added. And if you aren't sure whether the charge is right or not, the best way I know to determine if the right amount of refrigerant is present is to sniff it first with the analyzer, then recover it completely (which may require heating the engine compartment by running the engine with the hood closed if your shop is cold), and then recharge the system with the proper poundage. Recognize that refrigerant gets trapped in system oil and that when loose refrigerant is recovered, oil-trapped gas will bubble into the system and will need to be recovered as well, or else you may overcharge. Watch for that!



Cooling fans tend to pull quite a bit of current even if they aren't faulty, and any resistance along the way can snowball into a meltdown — the A/C won't cool consistently without a consistently operating cooling fan.

If the underhood info sticker is gone or ruined beyond reading, look the vehicle up to find out how much refrigerant is required. Most modern systems on cars take only a pound or so. Vans and SUVS take a bit more. But if you've been recovering and recharging the same one every few months, pay attention to how much oil is extracted during the recovery process and re-add the same amount; we've replaced compressors that were destroyed from lack of oil when the same shop recovered and recharged the same A/C several times rather than fixing the leak.

Speaking of oil, when replacing components, always check the shop manual for the proper amount of oil that needs to be added for each one. The compressor may or may not come charged with oil, so never assume anything. Read the papers that come in the compressor's box to find out if oil is in there, and act accordingly. Oh, and by the way, it's a good practice to

stand the compressor on its nose for a few minutes before installing it. That allows the oil to move toward the front and lube the shaft seal, and we all know we should replace all O-rings and seals between lines and components.

If the threads gall during the wrenching process, you'll need to replace both components, and when you're performing pressure-and-juice service, don't ever fail to check and then replace the orifice tube with one that's the right color, because that's how they're coded. Trash on the orifice can be quite revealing, too, so be prepared to do a bit of service bay forensics to see if you can determine what happened. Rear A/C units typically have expansion valves even if the front unit is an orifice-accumulator system, and when you're dealing with a tubed one, make sure the TXV's sensor tube is firmly in contact with the suction line and wrapped with press tape.

Mechanical problems like these (balancer deterioration, bad compressor pulley bearing) can cause everything from a squealing belt with the A/C on to an engine that seems to be locked up. The A/C pulley is pretty big and with a good belt in place and tight, a locked up pulley bearing can keep the engine from turning at all.

Electrical stuff

The A/C won't work without electrical components, and while the PCM is typically the decision maker where clutch and condenser fan are concerned, some systems have an additional box that might be called an A/C amplifier. GM likes to call their box a "programmer" and on Automatic Climate Control systems, GM has called it a programmer ever since the late '60s. Earlier Asian makes love to use the A/C control boxes, even if they don't have Automatic Temp Control. The amplifier or programmer can be an issue, but pay attention to other modules that may be in the loop, because anomalies arise. Some might remember that I wrote about a 1998 Buick awhile back that had a faulty body control module (BCM). That BCM would talk to the scan tool, but it was preventing the A/C from engaging, and for some reason it wouldn't even let the PCM turn on the condenser fan — not ever, even with a blistering hot engine. Check the wire harness map for how the pressure cutout switches are wired, because you need to know.

If you suspect a burned out compressor clutch, simply remove the clutch relay, find the terminal that leads to the clutch coil, and use a low impedance test light (one that will draw some current) to see if you have a good path to ground through the clutch. If the wire is good to the compressor and the coil ground is solid, but you don't see a light at the compressor clutch terminal, the coil is open, and it's surprising how many times that scenario happens. If you DO see a light, feed some power into that terminal and see if you hear the telltale click of the clutch.

You can replace the clutch and coil if the coil is burned out or the clutch is coming apart (and that happens), but that usually costs about 70 percent of what it costs to replace the compressor, so I always swap the whole thing when a coil dies, along with the accumulator or drier and orifice or expansion valve. Go find some cold.

RICHARD MCCUISTIAN
CONTRIBUTING EDITOR

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TECHNOLOGY
UNDERCAR

PREPARING FOR ANOTHER A/C SEASON

One highlight of the MACS event is the trade show exhibits, which were well attended this year.

R1234YF COMES OF AGE, SERVICING REQUIREMENTS BECOME MORE STRINGENT – IS YOUR SHOP READY?

BY **PETE MEIER** | DIRECTOR OF TRAINING

While attending the annual Mobile Air Conditioning Society's training event and trade show earlier this year, I came to a sudden realization. For the past few years, I've been reporting on the impending demise of R134a and those refrigerants that were going to be the likely replacements. And my, how time flies! Without retelling the entire story, let me give you the short version so that you may better understand where we are today and what the impact on you and your shop will be.

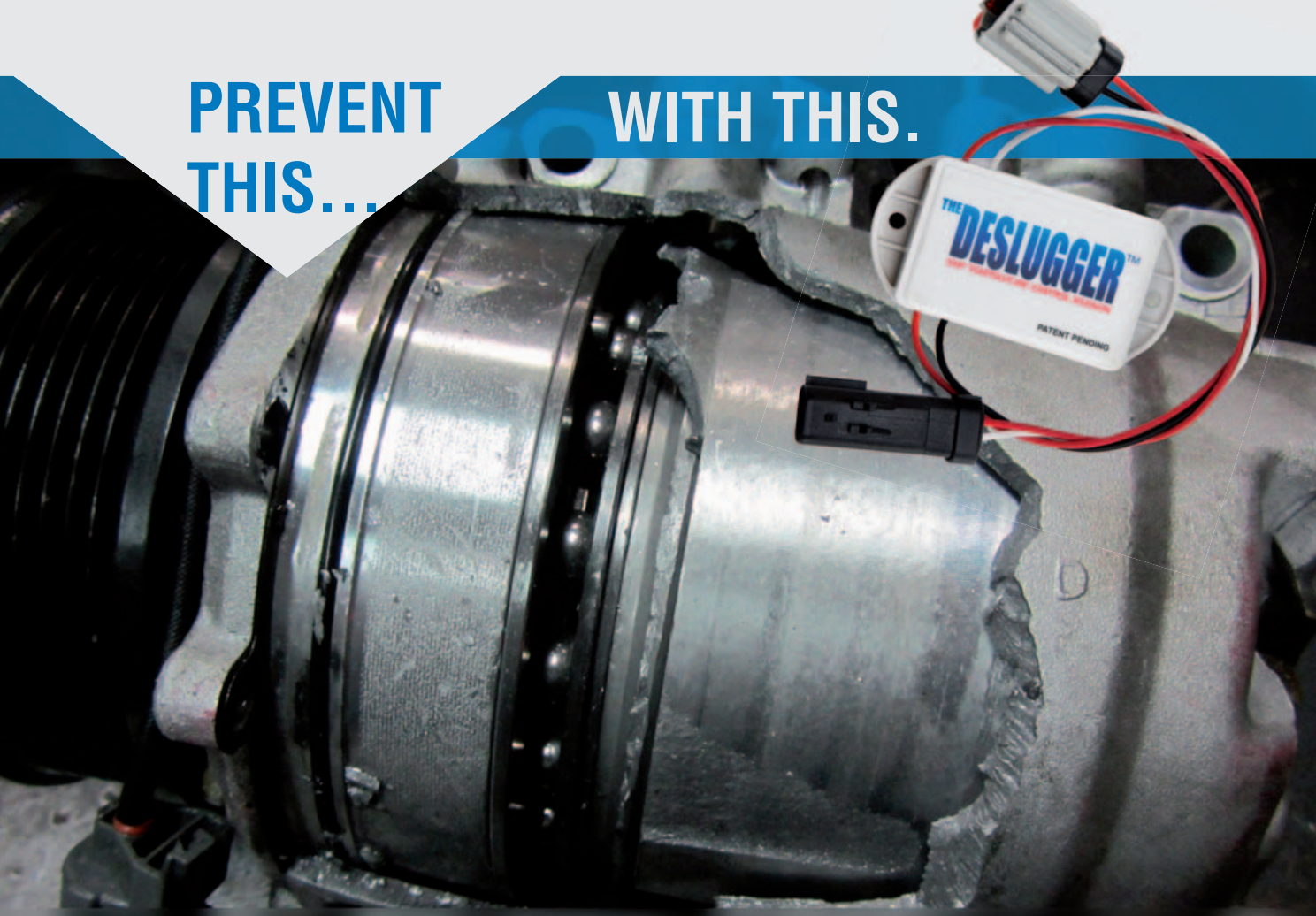
A look back

Several years ago, the folks in Europe decided that R134a was a bad thing for the environment and passed a mandate requiring the OEMs to come up with an alternative if they wanted to continue to sell cars in their market. To our initial relief, these rules didn't apply to the U.S. market. One rule that did apply, however, was the increasingly stringent CAFE requirements that OEMs had to meet. And one way to meet those requirements, in lieu of actual improvements in fuel economy, was to make other systems on their cars "greener," and that included adopting these new refrigerants.

Well, refrigerant (singular) may be more accurate. The one candidate that eventually rose to the top and gained nearly universal acceptance was one produced jointly by DuPont and Honeywell — HFO1234yf, also known as R1234yf. There is still much debate over the mildly flammable classification of the new gas, but OEMs across the board have spent millions on testing the safety of R1234yf under every conceivable condition they could imagine. Now, with three years and millions of miles of actual use on these systems, those dollars have proven to be a wise investment with no safety issues related to the new gas reported to date.

I only mention this issue to bring you this next tidbit of information. It is no secret in the industry that the good folks at Daimler took exception

Photos: Pete Meier



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to using the new replacement, insisting it was unsafe and instead, continuing with its development of another alternative, CO_2, also known as R744. The environmentalists love the idea, because the Global Warming Potential (GWP) of R744 is 1 — the lowest rating you can get. But some members of the SAE Interior Climate Control committee point out that there are drawbacks to the use of CO_2 in cars. One is the high system pressures needed for the system to work, nearly 10 times what you're used to in today's R134a systems. Another is the higher cost of producing these systems, and a third is the reported inefficiencies of the system when used in climates with high ambient conditions (like most of the southern United States). Regardless, Daimler has announced that it will start producing models equipped with R744 systems, starting with select MY2017 "E" and "S" class models offered for sale in Europe. Thankfully, though, there are no reported plans of sending these models to the U.S. market (yet).

ASA's Tony Molla was a featured speaker at the MACS conference, and he shared his vision of the future challenges the industry will face.

This simple aftermarket add-on pulses the compressor during initial start up to help clear it of any excess liquid and is available for select models.

So, is that it? Not quite. There were additional candidates and last year at this time, I was honestly concerned that we might have as many as five or six different refrigerants to deal with in our shops, including some potentially dangerous blends. Today I can share that the EPA has narrowed down the list of "acceptable use" refrigerants to four: R134a, R1234yf, R152a and R744. So which ones will you have to contend with?

The service picture today

The EPA has announced a "phase down" for R134a, with all new model passenger cars and light-duty trucks to be equipped with an alternative by the 2021 model year. To date, in the North American market there are 18 OEMs using R1234yf in 47 different product lines. The market use is higher in Europe, with 33 OEMs offering 83 model lines equipped with the new gas. Considering that GM was among the first here in the states (and that that was three years ago now), the need for your shop to add R1234yf service capability has definitely arrived.

For those of you who lived through the transition from R12 to R134a, you'll be happy to know that those in charge learned from that experience. R134a is not being phased "out" but "down," and that's an important distinction. First, R134a will be available as long as there are vehicles on the road equipped with it. Second, there will be NO requirement to retrofit an R134a car to one of the new alternatives. Thank God, too, because the leading replacement choice (R1234yf) isn't cheap.

With some models nearing the end of their warranty periods, it is time for your shop to consider investing in the equipment you'll need to properly service these systems. Of course, that means a new Recovery/Recycling/Recharging (RRR) machine will be on the top of your list. Because of the mildly flammable classification and the high cost of the refrigerant, these machines differ in design and function from the RRR machines you are used to, even if you've invested in an R134a machine certified to the J2788 SAE standard.

R1234yf machines require you to first perform a refrigerant identification test prior to recovering the vehicle's charge. We've been promoting that as a best practice for a number of reasons and still do, even if you're servicing R134a. Once you've completed that phase and performed whatever repair you needed to make, these new machines will then perform a few leak tests before allowing you to recharge

Every manufacturer that makes an RRR machine was represented, highlighting their R1234yf offerings for attendees.

the system. Specifically, a vacuum hold test is first performed and if that passes, the machine will allow a charge of 15 percent of the specified charge for that system. Then a pressure hold test is performed. If that passes, you can charge the rest of the way, but if not, you'll need to find that leak before you can return the car.

That means no system top offs and no recharging a customer's system unless he's prepared to fix the leak that caused the loss in the first place.

Have an RRR machine that is not rated for hybrid use? This product can help you prevent accidental contamination if your hybrid services are few and far between.

We've encouraged you to always identify what's in a system before you recover it into your equipment. This model identifier is inexpensive and could save you money in the long run.

Other service notes

Also discussed at the MACS conference was an SAE letter sent to the EPA recommending that technicians currently certified under Section 609 of the Clean Air Act be required to recertify. This is not the same thing as your ASE A7 certification; this is the little card you are required to have in your wallet saying that the EPA certifies you in the safe handling of refrigerants. Many of us took the certification decades ago and have never updated it, and the safety concerns surrounding the service and repair of R1234yf and R744 systems certainly need to be addressed. The letter further recommends that the certification be updated periodically, just like your ASE certs are.

Don't have your Section 609 certification? It's not that big of a deal and is available from several sources. Getting caught working on an air conditioning system without it, though, could cost you and your shop plenty.

Not only are there new gasses you need to know about, but system designs have changed significantly over the last several years. Among the changes is the adoption of lower refrigerant charges. That means a few things for your service process. First, recovery and recharging must be done more accurately. Gone are the days of relying on gauge readings to know when you've properly charged a system, as are the days of using a set of gauges and scale alone. Second, the

need to find and repair even small leaks is important to the continued efficiency of the system and the continued happiness of your customer.

In addition to lower refrigerant charges are lower oil charges. The old rules of thumb we used to use when replacing a system component (2 ounces for an evaporator or condenser, for example) are no longer applicable. Too much oil in the system will have a dramatic effect on system performance and that includes any oil you add when adding a leak detection dye. You must use the OEM-specified oil-balancing procedure to insure proper lubrication and operation. It was also noted that some RRR machines are removing excessive oil during the recovery process. It is imperative that you measure what is removed and replace with fresh oil of the same type when charging the system back up.

It's only a 10-lb. R1234yf container, but it will set you back quite a bit. The high cost is one reason the RRR machines won't let you charge a leaking system.

Speaking of leak detection dye, many new compressor designs retain the majority of the oil charge in an internal sump. These systems pass very little oil along with the refrigerant charge. That keeps the oil off of the innards of the heat exchangers, preventing heat transfer losses caused by the oil coating. At the same time, though, it makes it more difficult to circulate the dye through the system. If you're hunting for that small leak, you may need to tell your customer to drive the car for a few days to allow the dye time to get around.

But wait a minute — I can't recharge an R1234yf system that doesn't meet the leak test. How do I know there's a small leak present before I recover the charge? Good question! See what I mean about rethinking your service processes? Hopefully, help for this question and others is on the horizon. Some members of the SAE committee have requested that the committee consider establishing standards for air conditioning service. If undertaken, it will set standards for best practices, as well as strive to standardize component names, Diagnostic Trouble Codes (DTCs) and diagnostic processes.

Don't forget about hybrids!

Servicing hybrid air conditioning systems that use a high-voltage electric compressor or combination HV/belt-driven compressor is not new news. But it is worth pointing out for those of you who have yet to tackle one of these jobs the importance of avoiding any possibility of contaminating the system with PAG oil. It's easy to do if you're using your RRR machine to inject oil into your customer's system. Even that relatively small amount that remains in the hoses

RRR machines are available in a variety of styles and features. There's one to fit your shop's needs and budget.

can cost you a ton of money if it gets in a system requiring POE oil. Understand that PAG oil is conductive and even a small amount could set an HV Leak code. If the compressor has engaged and run, that means you'll be replacing every part in the system to correct the code. Explain that to your customer!

Trade show tidbits

A trip to MACS wouldn't be complete without a few turns around the trade show. One product that caught my eye pretty quick was an offering from Four Seasons called "The Deslugger." It's an aftermarket solution to an increasingly common problem — compressor damage caused by oil and liquid refrigerant collecting in the compressor, especially on those models where the compressor is mounted low on the engine.

The combination can cause hydraulic lock on initial compressor engagement, and if you've ever seen the insides of an engine that suffered a similar fate, you know what the inside of the compressor looks like immediately after. The Deslugger is an electronic compressor "timer" that pulses the compressor clutch multiple times on initial engagement to help gently purge any excess liquid before full engagement is allowed. Currently, there are three part numbers available: P/N 36140 for 2002-2006 Honda CRVs with scroll compressors, P/N 36141 for GM vehicles using the Denso 10S compressor, and P/N 36142 for Chrysler Voyagers and Dodge Caravans also using the Denso 10S compressor.

Another product that looks like a time saver is the blend door repair kit offered by AirSept. This kit cuts down the time needed to replace broken blend doors on 2006-2009 Equinox and Torrent models, 1997-2004 Ford F-series pickups, 1999-2004 Jeep Grand Cherokees and is also available for the driver-side doors on 2005-2007 Explorers and Mountaineers. Another product from this same vendor is RecycleGuard, a filter that can be used in line with your existing RRR machine to capture any sealants that may be present in the system. And if you have a lot of DIY customers in your area, take a look at what they're buying at the local big box store. In my area, at least, every little can of DIY R134a has sealant included. The last offer from AirSept I want to be sure is on your radar is their ChargeGuard product,which is a system for you guys who only do occasional hybrid service and want a way to insure that you don't accidentally contaminate the system with PAG oil.

Of course, there were RRR machines galore on display, including the latest from MAHLE, Robinair, Yellow Jacket and FloDynamics. If you're in the market for a new machine, these companies had a variety of offerings to cover nearly any budget.

In addition to all these great products were a variety of service tools, leak detection dyes and sniffers, even ultrasound diagnostic aids. Unfortunately, (and with apologies to all the vendors that were on hand) space does not allow me to mention them all.

For the last few years, I've been telling you that new refrigerants and new service challenges were on the horizon, and I advised you to hold off on any major investments for a bit unless your shop serviced area body shops or dealers were few and far from your customers. With the rapid growth of vehicles using R1234yf and the increasing age of those first introduced, now is the time to prepare for the inevitable and to welcome that change with open arms.

PETE MEIER
DIRECTOR OF TRAINING

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.

Email Pete at pmeier@advanstar.com

GET THE DROP ON ELECTRICAL PROBLEMS

A SHORT COURSE ON ELECTRICAL TROUBLESHOOTING TECHNIQUES YOU CAN APPLY TODAY

BY **PETE MEIER** | DIRECTOR OF TRAINING

Does chasing down the cause of an electrical problem stress you out? Does it keep you awake at night? Let's see if we can make things a little easier for you with a short selection of tips and techniques you can take back to the bay immediately!

Applying voltage drop

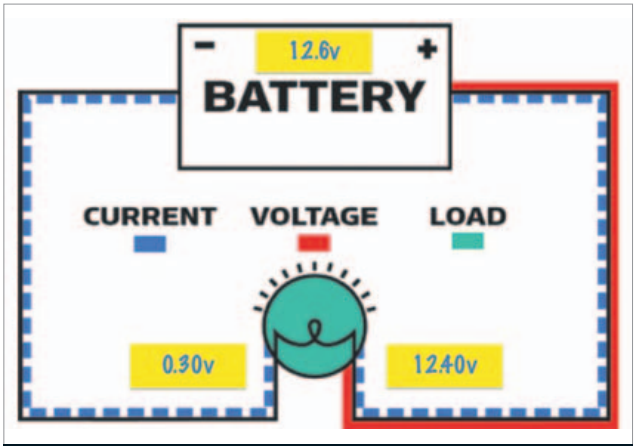
This is a topic we've tackled a number of times, and I invite you to search the term "voltage drop" on the *Motor Age* website and YouTube page for a ton of information that can help you fully understand this valuable testing method. The idea behind the test is simple enough — applied voltage will "drop" across every resistance present in a circuit. The only real source of resistance in a circuit should be the load, or the component that is performing the "work" the circuit was designed to do. Therefore, system voltage should be almost entirely present going in and should be almost entirely gone coming out.

Now understand that every part of the circuit has some resistance. Wire has resistance, switch contacts have resistance, and even the fuse protecting the circuit has some resistance. That explains why you won't see all the applied voltage on the positive side of the load and why you should never see a perfect 0.0 volts on the ground of the same load.

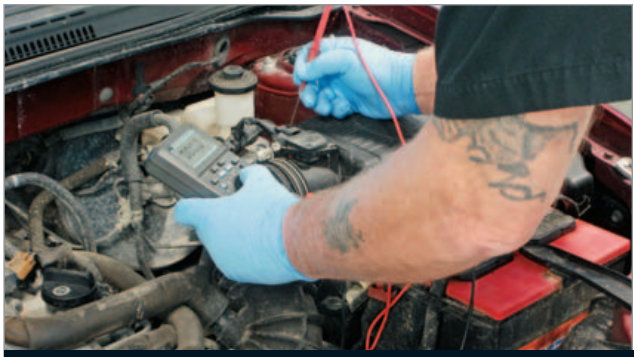
All of this is based on the premise that you're taking all your measurements with your positive meter lead and leaving your negative meter lead on the negative battery post. Maintaining your reference at the battery is the only way to ensure that you are testing the entire circuit path. Moving that ground meter lead to a spot in the trunk, for example, to test a component located there is going to leave a large part of the path back to the battery unchecked — and that may be exactly where it's hiding!

Additionally, the circuit you're testing must be "on" when tested. If no current is flowing, voltage won't drop across anything. That means someone has to hold down the horn button if you're testing the horn, or keep their foot on the brake pedal when testing the brake lights — you get the idea.

There's also a little bit of math involved. When measuring the applied voltage going into the load, we already talked about why it won't be the same as what you measure at the battery. The difference between the two is the amount of voltage drop that occurred across the circuit parts on the way to the load — the fuse, the wiring, splice points — anything that is located between the battery and the load. If you want to avoid doing the math, let the meter do the math for you. Simply move the meter lead you have at the battery (the meter's negative lead) to the positive battery post. Now your meter will read the voltage potential between the two leads and you should see something



Voltage drop is a simple concept: nearly source voltage going in and very little left over going out. The leftover amount means there is some resistance downstream that wants a taste, and the loss going in means there was some resistance that stole a bit already.



Most of us struggle with understanding what the meter is trying to tell us. Practice on a controlled circuit where you alter the conditions before you try to figure out a real-world problem.

Photos: Pete Meier

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less than 0.5v for most applications.

I bet most of you are wondering right now if that 0.5v number is the "spec" for normal voltage drop. The short answer is no. It's been my personal experience that you'll get meter readings way higher than that if there is a problem in the circuit. Don't sweat over a few tenths one way or the other.

The key is to practice taking these measurements on a controlled circuit. Take the time to put together a simple lighting circuit, using two different bulbs to avoid confusing yourself. Wire it up with one bulb first, and measure the voltage potential on either side of the bulb as we've discussed. Then replace the good bulb with one that you know is bad and measure again. Notice the difference in the readings, especially on the ground connection. Once you're comfortable with those readings, add in the second bulb; first on the ground leg of the first bulb's circuit and then on the positive side. Measure at the first bulb again and think about what the meter reading is telling you. I guarantee that you'll get that "aha" moment and you'll become confident in applying your knowledge to the next electrical concern your service writer hands you!

Using current

Current can be applied as a testing tool to a variety of electrical concerns. If you understand the math behind Ohm's Law, for example, you can use it to calculate the expected current draw for many of the circuits on the car. Then measure the actual current draw with an ammeter or amp clamp. If there is no current flowing, there must be an open in the circuit somewhere or you don't have it turned on. If the current flow is lower than you expect, there must be a source of resistance in the circuit that shouldn't be there and the voltage drop testing method will help you (in two measurements!) identify which side of the circuit the fault is hiding in. And if the current is higher than expected, suspect a shorted load (like an A/C compressor clutch coil that is shorted internally).

Current can also be used to help isolate what leg of a relay-controlled circuit is at fault. Relays are a junction point in two different circuits when you think about it. One circuit is responsible for turning the relay "on." The other uses the relay as the switch that completes the circuit to the component that is actually doing the work. Let's use that A/C compressor clutch as an example of how this works. If I first measure for current flow in the coil circuit, I'll get one of two readings. If I get a reading of 3.0 – 4.0 amps (roughly), then I know that, electrically, the coil is working just fine. If the clutch is not engaging, there's a mechanical issue with the clutch that I need to take care of. No current means there is an open somewhere; either the relay isn't closing or there is a problem in the coil circuit path.

Next, I'll measure the current flow on the relay side. No current flow here also indicates an open circuit, but since a control module closes the relay, it could also mean that a needed condition has not been met and the ECU is not allowing the relay to close. In the case of an air conditioning system, it could be a low refrigerant charge or a problem with a pressure sensor input. Current flow of under 0.5 amps means that the relay is being turned "on," so I'm back to looking for the open circuit on the coil side, perhaps a failed relay.

This method can be applied to nearly any relay-controlled circuit. Can you think of one?

A fuse is a resistance and there will be a voltage drop across it if current is flowing. That can be good to know when trying to find a battery drain.

Another use for voltage drop

Remember when I said that every part of an electrical circuit has some resistance? Fuses, fusible links and circuit breakers are included in this list. And since there can be no voltage drop unless current is flowing, measuring the drop across these resistors can tell us when current is flowing when it's not supposed to.

This allows a testing method for isolating the cause of parasitic battery drains without having to open the circuit and is another method you can apply, especially if you are chasing down a control module that won't "go to sleep," an increasingly common cause of battery drains.

You'll need a decent meter because the amount of voltage drop is minimal and you'll be measuring in millivolts rather than volts. Small amounts of under 30 mv is not unusual, and the amount of voltage drop will vary depending on the type of fuse you are measuring. Do we care what the exact conversion to amperage is? Not really — I just want to see what circuit is flowing when it's not supposed to be. Then I'm going to try the thermal imaging technique Albin Moore talks about (see the related article on page 36!) to narrow down the source!

PETE MEIER
DIRECTOR OF TRAINING

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.

Email Pete at pmeier@advanstar.com

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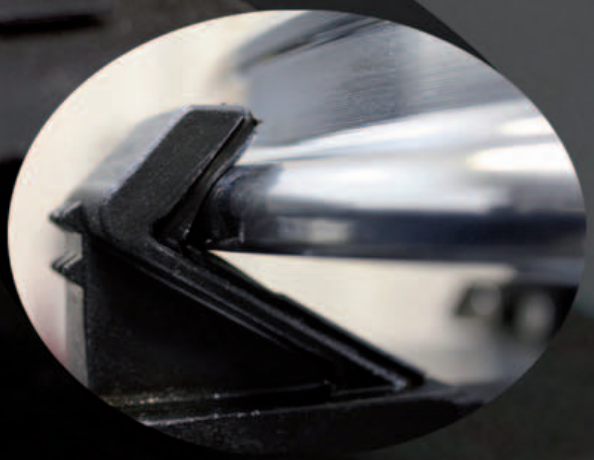

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PARASITIC BATTERY DRAINS

ONE JOB I NEVER LOOK FORWARD TO GETTING IS A PARASITIC BATTERY DRAIN ON A LATE-MODEL VEHICLE.

BY **MICHAEL MILLER** | CONTRIBUTING EDITOR

For the most part, it will almost always be a long process to track down the cause of a parasitic battery drain in a late-model vehicle, as there are so many modules, accessories and networks involved. In any case, there are a few things that I have found will help more quickly narrow down the possibilities and also prevent overlooking some basics that cause severe headaches for some technicians.

The first step to diagnosing any parasitic draw starts with what's being drawn down to begin with — the battery. I think more than any other component, the battery is the most overlooked item when it comes to testing for a parasitic drain. Where I live, most summer days are 100 degrees F or higher, which definitely takes its toll on the life of a battery. In fact, a large portion of batteries that I find worn out are only 2-3 years old. So before any testing can even start, we need to make sure the battery is sufficiently charged. Unless the open circuit voltage of the battery is 12.45V or higher, the battery needs to be charged before testing. While the battery is being recharged, this is also a perfect time to multitask and check for TSBs, hotline archives and groups like iATN for similar vehicles that have experienced the same problem. Many times techs will try to diagnose a system draw with a battery that will barely crank the vehicle's engine over to start it; this can cause inaccurate test results.

Some signs of battery problems are obvious, like visible leakage, especially across the top of the battery, which will cause case drain. The leaking acid creates a conductive path that can easily drain a fully charged battery overnight.

DRAINED

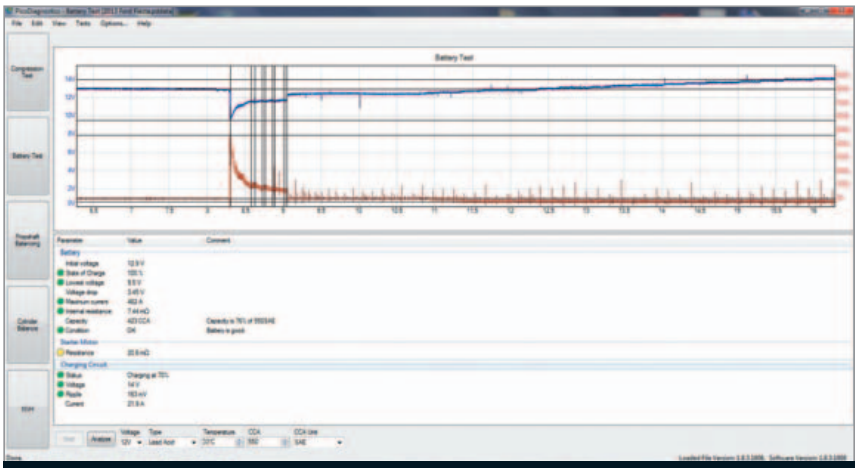
2013 CHEVROLET TAHOE
Vehicle Year/Make/Model

55,291
Mileage

4.8 LITER
Engine

AUTOMATIC
Transmission

NO START AFTER DAYS' REST
Complaint



One of the most important but overlooked steps in diagnosing a battery drain problem is verifying that the vehicle has a good battery. If recharging is needed before testing can begin, it is a good idea to use the time to multitask and research the problem looking for a TSB, hotline archives and on technician sites like iATN.

Photos: Michael Miller

Then there is a problem you can't see, at least with the naked eye, which is a shorted battery. When measuring the open circuit voltage of the battery and the DMM reads in the area of 10.5V, you have a bad or shorted cell and it must be replaced.

If the battery checks out OK, the next check to make is for codes. While not ignoring powertrain codes, look for modules that have stored UXXXX (communication) codes. Why? While most modules on the bus power down as they are supposed to at key off or a specified length of time thereafter, there may be a single module that never goes to sleep, AKA a babbling node. This module continues to send and/or looks for state of health (SOH) or other data from the remaining modules that have gone to sleep. When those messages are not received or responded to, that module sets a Loss of Communication code. If this is the case, you have significantly reduced the field of possible causes; however, don't automatically condemn the module, as there may be inputs that are causing that module to stay awake. There is also a possibility of the one module waking up another module on the bus, creating an even larger current draw.

While it's sometimes tricky to attach the ammeter inline, this does provide a more accurate and stable measurement of lower amperage draw than a clamp on ammeter. Here is the original current draw on the 2011 Dodge Challenger.

Some tips before you begin to test for a draw:

- Open the hood, doors and trunk and flip the latch to the closed position. More than likely you will need to access components in these areas, and if you open one of them you will wake up a module(s) and then have to wait for it to go back to sleep.
- On vehicles that have a push-button type of door or hood ajar switch, if you are certain that it is not the cause of the draw, remove the connector from the switch and jumper the connection so it appears closed to the vehicle.
- Make sure the key is turned to the locked position and removed from the ignition cylinder, as this will help power down the modules more quickly than if the key was simply turned to the off position.
- In the case of proximity keys, make sure the key is out of range of the vehicle or some modules may not enter sleep mode. Some vehicles will remain in an Off-Awake mode when a proximity key is in range, causing a parasitic drain on the battery.
- Not that aftermarket accessories are bad (radio, alarms, DVD players, etc.), but they can be an unintended load on a circuit if they stay powered on when they should not. If easily accessible, these are the first items I try to eliminate and have had a fairly good

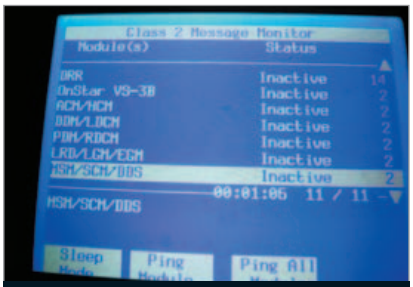
success rate having them be the cause of the battery drain.

Real-world cases

My first case study is a 2011 Dodge Challenger with a draw of nearly 2 amps. I inherited this from another technician who had already changed out the battery because it would not hold a charge, thinking that the Totally Integrated Power Module (TIPM) was the cause of the draw. Well, not that a TIPM failure on a Chrysler is rare, but it does control a lot of circuits and components. Looking at the wiring diagrams and trying to narrow down a fault in a module like that is an arduous process at best. Since the battery was just replaced, I could not retrieve any codes from the vehicle. I checked for draw on the battery and of course, it was now at 0.026A, not the original 1.92A that was measured while the other technician was working on the vehicle with the key off. One problem that can happen quite often is when the battery is disconnected, an electrical problem may mysteriously disappear for a time; this is also something to try to avoid when connecting an ammeter inline with the negative battery cable and post.

Next I checked for TSBs and found one that could save me a lot of diagnostic work and waiting for the problem to reappear. TSB 23-039-11 states that the smart glass feature cycles on its own with the key in the off position, draining the battery. The problem was the windows were not acting up now, so I asked the tech who was previously working on the vehicle if he had noticed the windows cycling. He did notice the driver window moving slightly up and down when he closed the door, but thought it was due to the low state of charge of the battery. Since the problem was not present and the TSB stated that it was an intermittent problem, I decided to check the Julian dates on the door latches. A simple procedure to perform, I had to move a small piece of foam at the striker area of the latch to view the code. Both the driver and passenger door latches had number 0761A, indicating they were produced on the 76th day of 2011, which was in the affected range, so these could very well be the cause of the parasitic draw. The customer stated the problem had happened for the last couple days and after the vehicle sat overnight, the battery needed to be jumped in the morn-

The four-digit Julian Code on the door latch is located just under the foam insert. The first three digits indicate the day of the year and the last number indicates the last digit of the year. The number on this latch is 0761A, which means that it was produced on the 76th day of 2011 or March 17, 2011. Since this was between the Julian Date of 3200 (Nov. 20, 2010) and 0841 (March 25, 2011), it was affected by the TSB.



Using the Class 2 Message Monitor on the GM Tech 2 scan tool, it is easy to see that the Digital Radio Receiver (DRR) is continuously waking up, causing a draw on the battery.

Measuring voltage drop across a fuse is one of the best methods to narrow down a circuit with a parasitic drain. Here the voltage drop of the radio fuse is showing 4.8mV. Using Ohm's Law, Voltage ÷ Resistance = Amperage. So 0.0048mV ÷ 0.00458Ω = 1.048 amps being drawn on the radio circuit with the vehicle off.

ing. Since the problem was not present, I could not confirm this was the cause, but it seemed very likely that the latches were going to be the problem. Since it was Friday afternoon and time was short, I decided to unplug the latches and let the vehicle sit over the weekend. When I came back, the vehicle started immediately on Monday morning. It even sat a couple more days until we received the updated door latches without any further battery draw concern. We checked with the customer a couple of weeks later and they stated no further problems with the battery were experienced.

Next was a 2008 Chevrolet Tahoe that was also given to me by another tech who did some research on a drain, but was unable to narrow down the cause. He had hooked up an ammeter in series with the negative battery cable and stated that the amperage draw was over 1 amp. A lot of times, this large of a draw points to a problem with a module staying awake. The battery had already been replaced, so the next step was to check for codes. In this case, there were some codes in the BCM for headlamp concerns, but no communications codes. I noted the codes and moved on, since they may be a clue to the parasitic battery drain, but wanted to do a little more testing before looking into them. Next I used a great feature of the GM Tech 2 scan tool to watch the states of the modules by using the Class 2 Message Monitor. This feature allows you to see what modules are active and which are asleep or inactive. The number next to each module increases each time the module state changes. For example, when the module is awakened, the number changes to 1; when the module goes to sleep, the number increments to 2. If the module is active again, the number will increment to 3 and so on. At first, when the key was turned off and the doors locked, everything seemed fine as the modules started changing their state from 1 to 2, indicating the modules on the bus were going to sleep mode. Then I noticed the Digital Radio Receiver and BCM turned back on and then went back to sleep. They turned on again, and this continuously reoccurred. So was it a module itself or was something waking up the module?

Even though some manufacturers specify a current draw of 50 milliamps or less, this is the actual reading after the new radio was installed and programmed in the 2010 GMC Yukon.

First, I needed to decide which module was waking up first. With the DRR being directly behind the passenger foot panel, this is the one I decided to disconnect. My logic is that the BCM has multiple inputs such as door locks, latches, lights and other accessories that could trigger it to wake up, but the DRR is only used for receiving Sirius radio. Luckily, when this module was disconnected, the bus no longer woke up. Just to be sure, I let the vehicle sit overnight with the DRR disconnected, and the battery remained fully charged the next morning. I think that the codes that were stored in the BCM were related to either the module being woken up and not having other modules online or a result of false codes that were caused by a weak battery.

My last case study is another GM vehicle, a 2010 GMC Yukon that a customer had brought in to have a battery replaced. They stated that they had to jump start their vehicle in the morning and also noticed corrosion on the top of the battery posts when attaching the jumper cables. Well, the battery was only a year old, but there was some corrosion on the top of the battery that could be the cause of the battery draining overnight. So after charging the battery and cleaning the terminals, it was tested and passed. Although there was corrosion on the posts, I did not measure any case drain across the top of the battery. So after cleaning the terminal, but before reconnecting the negative side, I installed an ammeter in line with the battery negative terminal and post. After almost 30 minutes, the battery draw was still around 1.05 amps. Looking inside the vehicle, everything was turned off and no aftermarket accessories appeared to have been installed. Since I already had an ammeter installed on the battery, I decided to

Mini Fuse	Resistance
5A	17.75 mΩ
7.5A	10.85 mΩ
10A	7.42 mΩ
15A	4.58 mΩ
20A	3.21 mΩ
25A	2.36 mΩ
30A	1.85 mΩ

Regular Blade	Resistance
5A	17.85 mΩ
7.5A	10.91 mΩ
10A	7.70 mΩ
15A	4.80 mΩ
20A	3.38 mΩ
25A	2.52 mΩ
30A	1.97 mΩ

Maxi Fuse	Resistance
20A	3.10 mΩ
30A	1.95 mΩ
40A	1.42 mΩ
50A	1.10 mΩ
60A	0.89 mΩ
70A	0.64 mΩ
80A	0.54 mΩ

J-Case Fuse	Resistance
20A	4.29 mΩ
25A	3.28 mΩ
30A	2.12 mΩ
40A	1.30 mΩ
50A	0.99 mΩ
60A	0.76 mΩ

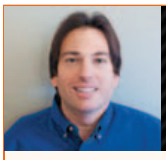
Use the milliohm rating next to the fuse that voltage drop is being measured on. For example, a voltage drop of 2.8mV across a 15-amp mini fuse would be 0.0028V ÷ 0.00458Ω = 0.611 amps, or 611mA. To make things a little easier to read, move the decimal three places to the right (2.8mV ÷ 4.58mΩ = 611mA). *NOTE: Depending on the fuse manufacturer, there will be some variances in the cold resistance values of their fuses, which will change the results slightly.*

check the voltage drop across the fuses in the underhood fuse block. One of the benefits was it was easily accessible; then I could just use Ohms Law to figure out if the draw from one fuse was equal to the amount of current draw I was reading with my ammeter. The theory is that if a fuse has a voltage drop, it must have current flowing through it. The cold resistance of the fuse, which is measured in milliohms or thousandths of an ohm, is used in the Ohm's Law equation to determine the amount of current flowing in the fuse's circuit. Keep in mind that each type of fuse has a different cold resistance value. For example, a 20-amp rated Mini Fuse has a cold resistance of 3.21 mΩ, and a standard 20 Amp ATO Blade fuse has a cold resistance of 3.38 mΩ. A 20-amp Maxi Fuse has a cold resistance of 3.10 mΩ, while a 20 Amp J-Case fuse has a cold resistance value of 4.29 mΩ. I have created a chart of the cold resistances from a popular fuse manufacturer and included it above.

After measuring for voltage drop on fuses in the underhood fuse box, I found a voltage drop of 4.8mV on fuse 42, which is labeled Radio. Using Ohms Law and dividing volts by ohms, or millivolts by milliohms in this case, we have: 0.0048V / 0.00458Ω=1.048 amps (or to make things easier, 4.8mV ÷ 4.58mΩ = 1.048 amps) being drawn on that single fuse with everything turned off. Well that looked right, so checking out a wiring diagram shows the fuse powers the radio, the rear-seat radio controls and the digital radio receiver. Well the easier one to disconnect is the controls for the rear at the back of the center console. Popping the cover off and disconnecting the controls shows that there is no difference in the amount of current draw. Next is the radio itself. When the power to the back of the radio is removed, the amperage draw drops to 13mA. So it looks like this is the cause of the draw.

A replacement radio was installed and programmed and as any of you who have installed a radio in a newer GM vehicle know, there are an incredible amount of options to choose from. I find it easier to take a picture of the Regular Production Option (RPO) codes with my cell phone and have them in front of me to save time.

Hopefully these examples will help save you some frustration the next time you have to diagnose a parasitic battery drain on a newer vehicle.



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REBUILDING CUSTOMER TRUST CAN LEAD TO MORE BUSINESS

Customers report that it's hard to find trustworthy mechanics. But they are more willing to trust technicians in a uniform.

New customer growth brings unique challenges to the automotive repair industry.

Over 13,000 shops have opened since the beginning of the recession, and the auto repair and maintenance industry is forecast to grow annually by 4% through 2019.*

The twin challenges of new growth.
This creates two challenges for shop owners. First, increasing competition means there's a necessity to set your shop apart. And second, how do you keep an image of professionalism as you bring on new technicians? A cleaned, delivered uniform from Aramark is one way to tackle both.

What new customers want most: to feel good and trust you.
A recent study shows that many new customers surveyed don't walk through your door in a positive state of mind: half of them report that an unexpected auto repair is their biggest source of financial anxiety, and 68% say that finding a trustworthy mechanic is difficult.**

So how do you put your team in a position to succeed? How can you help that prospective customer feel good about your shop and trust you?

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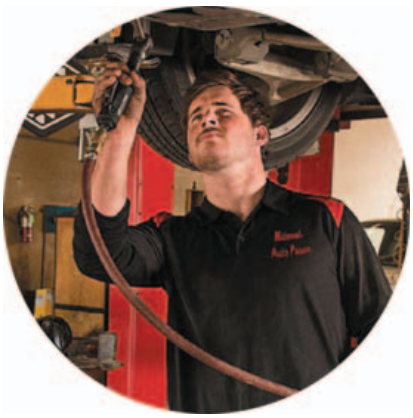

*First Research, February 2015.

**Study conducted by ORC International, funded by Aramark, 2016. Based on qualified respondents who had automotive repair service in prior 12 months.

SELECTING THE RIGHT PULLER

You're working on a customer's vehicle and once all the nuts and bolts are off, the part's still stuck. It could be a ball joint, wheel bearing or even a brake drum or rotor. What are your options? You can grab a pry bar, a hammer or whatever else is in the shop. Or you can grab a puller, break the parts loose and get the job done faster.

To find the right puller:

- What are you trying to pull? Are you trying to pull a shaft out of something, pull something out of a hole or pull something off a shaft? This will help you determine if you need a push-puller, jaw-type puller, slide hammer or one with internal or external-internal adapters.
- Determine the reach and spread you need. This will make sure your puller is long enough and the jaws, if applicable, open wide enough to exert enough force to pull the object.
- Estimate the force required. Normally, if you account for reach and spread, OTC's pullers will have enough force. When in doubt, always use the next larger size to account for frozen or rusted parts.

Now that you've determined what you're trying to pull, find a corresponding puller to finish the job.

- If you're pulling something off a shaft, you can use a jaw-type, push-puller, slide hammer [https://www.otctools.com/products/9-way-slide-hammer-puller-set] or bearing puller with attachment.
  - o This includes removing a gear, bearing, wheel or pulley
- If your job includes pulling something out of a hole, look for internal pulling attachments coupled with a slide hammer or a push-puller.
  - o This option helps remove internal bearing cups, retainers or oil seals that are press-fitted
- When you need to pull a shaft out of something, look for threaded adapters, internal or external, for use with slide hammers or a push-puller.
  - o Typically you need these pullers when removing a transmission shaft or pinion shaft from a bore or housing.

Regardless of puller selected, always keep the tool clean and frequently lubricate the forcing screw fully to extend the tool's life. With tons of force, we can't stress safety enough when using pullers. Before using one of our pullers, we recommend reading the OTC safety puller information sheet, which can be found at otctools.com/puller-safety.

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2016 SPRING TRAINING ISSUE

STEERING NOISES OR LEAKS?

Check out these videos highlighting quick tips that will help you properly diagnose steering issues and avoid common installation problems. Simply scan these QR codes, and the videos will automatically play!

Power Steering Noise? Check Your Remote Reservoir

Are you trying to troubleshoot a power steering noise? It can be very frustrating when replacing a noisy pump to have the new pump make the same noise. This video encourages you to check and make sure the issue is not with your remote power steering reservoir.

How to Properly Install a Power Steering Pulley

Prevent damage to your power steering pump back-plate by properly installing the pulley.

How to Use a Pressure Gauge to Pinpoint Power Steering Issues

We show you how to eliminate the guesswork when diagnosing power steering issues by using a pressure gauge.

How to Correctly Fill and Bleed the Power Steering System

Are you replacing a power steering system component? This video shows you the proper way to fill and bleed the system for optimal performance.

Simple Power Steering Contamination Test

Nothing lasts forever, including hard-working power steering fluid and hoses. Here is a quick way to show your customers why they need to flush their steering system and/or replace their steering hoses. Visual proof works best!

GM Rack & Pinion Noise Issue

This video discusses a common noise complaint with 2004-2011 Chevy Malibu, 2005-2010 Pontiac G6 and 2007-2009 Saturn Aura vehicles.

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DO YOU HAVE THE SKILLS TO SOLVE GDI-RELATED PROBLEMS?

BY **CHRIS CHESNEY,** SENIOR DIRECTOR OF CUSTOMER TRAINING, CARQUEST TECHNICAL INSTITUTE BY ADVANCE PROFESSIONAL

It's spring again, and that means Spring Training for all you baseball fans. Spring is also a great time for automotive service facility managers to put together a game plan for improving employees' skills. Before the summer rush hits, prepare yourself and your team for battling hard-to-solve challenges by learning new skills that increase efficiency and effectiveness. It's also a great time to tackle new vehicle technologies that are already on the road and will appear soon in your service bays, if they're not already.

Technologies such as Gasoline Direct Injection (GDI) have been racking up miles and abuse for years now, and they'll ultimately suffer a breakdown or cause MIL ON (check engine light) issues that bring them to your bay. Are you ready for GDI? Have you thought about how it might affect productivity? While GDI still burns gasoline in a four-cycle, spark-ignited engine, their operating strategies are significantly different. If you're not already working on GDI vehicles to become familiar with the PIDs or haven't researched or attended training that helps you understand GDI's unique operating strategies, now is a good time to do so. Being service-ready means having a plan in place to solve problems before they arrive. Service readiness doesn't mean learning about GDI on a customer's vehicle, at their expense. GDI is becoming the standard fuel delivery system on all manufacturers' vehicles, and as a result, there are many varieties, adding to the diagnosis complexity and need for additional training.

So, how should you approach GDI problems?

At Carquest Technical Institute, we created a process that can be applied to any GDI-equipped vehicle and that ensures consistent success in finding the right direction to applying pinpoint tests. Our recently released GDI Analytic Test Drive course assists technicians with the following questions:

- Can the engine breathe?
- Is airflow being measured correctly?
- Is the system providing the correct fuel mass at the right time?
- How hard is the PCM working to maintain control?
- Is the system in a default or depower mode?

The course's goal is to provide technicians with the ability to use scan data for improved analysis of engine-management problems on vehicles with GDI. While these problems can often be diagnostic trouble code (DTC) directed, they sometimes present themselves as symptoms without any DTCs. Effective use of PID groups is key to wading through the vast amount of data available to focus on the few PIDs providing the most accurate diagnostic direction. Developing a personalized, repeatable drive cycle is also a necessary part of the diagnostic puzzle. A consistent drive cycle, coupled with a well-chosen PID group, allows technicians to follow the diagnostic direction leading to the problem's root cause.

To find a GDI Analytic Test Drive class near you, visit www.ctionline.com and click on the Class Schedule tab. Then contact your Commercial Account Manager or Carquest Representative to sign up for a CTI regional or standalone class. We also invite you to register with our online system, TACS, where all your CTI classroom-training records are kept and where you can access our best-in-class, online training content. If you've attended a CTI class previously, simply click on the TACS tab at www.ctionline.com, then click Create My Profile. Enter your information and you will be asked to create a password. These credentials allow you to login to TACS and print your certificates and transcripts, view your training calendar and subscribe to online training. For support, contact CTISupport@carquest.com.

Advance Professional™ DRIVEN BY CARQUEST

CARQUEST Technical Institute®

ASSURANCE. IT'S WHAT MAKES FEL-PRO®, FEL-PRO

When you select parts for any repair, you should expect that the manufacturer has gone to the extreme to ensure exceptional performance and reliability. Frankly, it's what your customers, and your reputation, deserve.

At Fel-Pro®, going to the extreme is something we do every day. All of our team members in Skokie, Ill., share a passion for designing, manufacturing and validating the industry's leading brand of sealing products. This passion can be seen in each of the dozens of quality assurance steps associated with every part that carries our name. Because meeting extreme standards in our facility ensures that Fel-Pro gaskets will exceed your expectations in every sealing repair.

Cracking the code

Every Fel-Pro sealing innovation begins with an extensive analysis of the engine or other application, its operating environment and the corresponding original equipment part. That's why if you were to tour our Skokie R&D lab, you would see an ever-changing array of engines from which Fel-Pro team members collect critical data for use in product development.

This analysis even extends to the rubber used in each engine's original equipment gaskets and seals. Fel-Pro engineers apply sophisticated Fournier transform infrared spectroscopy (FTIR) to determine the type of rubber utilized by the OE supplier. They can then either match the original material, if appropriate, or, more commonly, specify an enhanced formulation better suited to the aftermarket repair environment.

"Almost any supplier could offer a rubber compound that looks like the OE material, but the performance characteristics can be vastly different," explains Steve Kueltzo, director of aftermarket engineering, Federal-Mogul Motorparts. "Fel-Pro gaskets outperform our competitors' products because our in-house materials lab has mastered the chemistries required to ensure a reliable seal."

Fel-Pro PermaDry® and PermaDryPlus® gaskets feature proprietary rubber or FKM (fluoroelastomer) formulations engineered to provide industry-best temperature resistance, compression set (ability to maintain proper shape) and compatibility with the latest engine oil and coolant packages.

Extreme Testing. Superior Results.

The assurance of quality that comes with every Fel-Pro product also is the result of exhaustive testing conducted on lab-based engine dynamometers; highly sophisticated, product-specific test rigs; and in one of the most extensive field test programs in the entire automotive parts industry.

"We validate every part that goes in a Fel-Pro box, whether that part is our latest PermaTorque® MLS head gasket or an O-ring or valve stem seal," Kueltzo says. "There might be 50 individual pieces in a Fel-Pro gasket set, but each and every one of those products has been examined and approved by an engineer to ensure that it meets our standards."

This comprehensive product validation process aligns each functional area within the nearly 1 million-square-foot Skokie facility. Design engineers work hand-in-hand with chemists, process engineers, tool and die makers, manufacturing specialists and, ultimately, the staff of the Fel-Pro Field Test Garage to validate that every gasket and seal will outperform competing parts under real-life conditions.

"These are the steps that have helped make Fel-Pro the predominant sealing brand among automotive professionals across North America," explains Andrew Sexton, senior vice president, global sealing, engine and underhood service, Federal-Mogul Motorparts. "We simply do not and will not take shortcuts when it comes to developing, manufacturing and testing products. Each sealing repair is too important, and our heritage of nearly a full century of success demonstrates that at Fel-Pro, we do things the right way."

FEL-PRO

www.felpro-only.com

HOW TO SAFELY REMOVE A CORRODED NUT NEAR FUEL LINES

Have you ever been faced with the problem of removing a rusted, corroded nut in an inaccessible space, near a fuel line? The traditional approach of using an Oxy-Acetylene torch is obviously out of the question as its use in a confined space vastly increases the consequential fire risk — plastics, wiring, trim and fumes around the part to be removed can catch fire, causing potentially costly damage.

Safely remove inaccessible corroded nuts with Invisible Heat®

Good news, help is at hand. The innovative Mini-Ductor® Induction Heating tool uses Invisible Heat® to quickly heat ferrous and some non-ferrous metal, providing a safe and viable alternative to using a torch. Some parts can be also be reused as the Invisible Heat® is localized on the part and not the surrounding area, with less collateral damage.

Bendable coils provide access to hard-to-reach nuts near fuel lines

The Mini-Ductor is supplied with 3 bendable coils, ideal for getting into awkward areas and thin enough to wrap round the nut and heat it in seconds for easy removal. For example, a 19mm nut is heated red hot in 15 seconds. The heat expands the nut and breaks down any corrosion bonds.

Before use - Equipment needed: Heat resistant gloves, overalls, goggles and a respirator mask (if smoke will be produced from heating).

Knowledge required: A well-reviewed proficiency of the tools safety and operating instructions.

Step 1: Make sure fuel lines are not leaking or creating a vapor.

Step 2: Select the correct Coil. Coils come in various sizes. Bend Coil to the correct shape for ease of use. **Warning:** Do not use Coils with breaches in the insulation.

Step 3: Tighten preformed Coil.

Step 4: Only heat the nut enough to expand and loosen. Red hot is too hot!

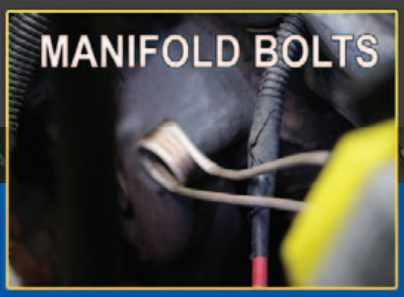
Step 5: Select correct tools, such as a wrench, to loosen nut. **Caution:** Remove nut while still hot.

Step 6: The nut is safely removed.

The Mini-Ductor is available in 110V and, portable 12V (MD-500) version, which works off a 12-volt battery pack, or off a car, van or truck battery. It's designed and manufactured by leading US manufacturer Induction Innovations, Inc. the trusted market leader for induction heating tools worldwide.

INDUCTION INNOVATIONS™

INVISIBLE HEAT®



MINI-DUCTOR®

The MINI-DUCTOR® is the professionals hand held flameless torch. Leverage the power of technology with Invisible Heat®. The flameless solution for releasing corroded or frozen hardware and other metalic components from corrosion and thread lock compounds. All without the collateral damage normally associated with torches. Heats nuts red hot in seconds!

VISIT THEINDUCTOR.COM FOR VIDEOS, RESELLERS, & TO LEARN MORE

INDUCTION INNOVATIONS™

Made in USA

DIESEL INJECTOR REPLACEMENT, DONE RIGHT

Diesel motors are the top choice for hard working vehicles as they provide enhanced durability, torque, and towing capacity. Diesels are designed to work harder and last longer than their gas counterparts, and in order to achieve that desired lifespan they must receive regular maintenance. Just as these motors are specifically chosen for their role, techs must often utilize specialized tools in order to properly service them.

Diesel injector replacements are one of the most common service items, and while not an overly complex job, there are several finer points that must be addressed to avoid comebacks and potential lost business. In particular, ensuring a proper seal, which is critical to avoiding lost compression, fuel leaking into the coolant, and carbon contamination. Like any job where a tight seal is paramount, the key is properly cleaning all seating surfaces. This task required a bit of improvisation in the past, most often with rags, but with IPA®'s new Professional Diesel Injector-Seat Cleaning Kits, a truly professional solution is now available.

The 17-piece brush kits are available in Stainless Steel (#8090S) and Brass (#8090B) to provide hardness options. The included Helix Brushes, Two-Stage Brushes, Bore Brushes, various extensions, and SWAB-EEZ® cover most common light/medium and heavy-duty diesel applications. If you've ever pulled a diesel injector, you've noticed a series of successive O-rings typically along with a copper crush washer at the tip. These components are designed to seal with the injector cup (which may also need to be replaced at this time) and keep cylinder gasses out of the injector bore, and fuel out of your coolant/oil.

To prep, start by draining the fuel, removing the valve covers, and blowing any debris out of the way to avoid it ending up in the cylinders. It is now time to remove the injectors and strip off the old O-rings and copper washer. After the injectors are inspected for faults and cleaned properly, the new seals are installed. The selection of smaller bore brushes in the #8090 kits are great for cleaning here, as well as the included SWAB-EEZ® low-lint, industrial swabs. Once the injectors are done, it is time to address the injector cups. These will either need to be cleaned very well, or replaced. If the old cups are being retained, they should also be inspected for any cracks to avoid diesel leaking into coolant.

Whether you are replacing or just cleaning the cups, the IPA® Professional Diesel Injector-Seat Cleaning Kit truly provides the ultimate tools to ensure the process is done correctly. To clean, simply match up the injector body with the proper size/taper brush and use either the included ¼" hex hand driver or a low speed drill. Be sure to go slow, as aggressive, high-speed cleaning may do more harm than good. Again, the SWAB-EEZ® included in the kit will be a huge help here. If replacing cups, the seating surface must be cleaned well using the appropriate tapered brush. You will need an injector-specific cup puller and seating tool for optimal results, and be sure to utilize a sleeve retaining compound for added insurance. The last critical step in the process is properly torqueing down the injectors to ensure the copper washer functions as designed.

Your job is now done, and most importantly, done right with the help of the IPA® Professional Diesel Injector-Seat Cleaning Kit. These kits provide a professional solution, and save a great deal of time and frustration compared to improvising with rags, etc. to perform the most critical aspect of injector replacement.

IPA® FUTURE NOW®

#8090B - #8090S

PROFESSIONAL DIESEL INJECTOR-SEAT CLEANING KIT

Specially Designed to Clean Injector-Seats and Bores on Most Light, Medium, and Heavy-Duty Diesel Motors

- New, innovative-design Helix-Style and Two-Stage Brushes
- Brushes are specially engineered to fit injector seats
- Removes rust, carbon and other debris from seats and cups without damage
- Driver handle features a spring-loaded, quick-lock coupler
- 3", 4" and 6" brushes
- Intended for hand use - Do NOT exceed 600 RPM - Clockwise rotation only
- SWAB-EEZ® for cleaning and polishing injector bores and cups

13 Custom Brushes, Driver Handle, 6" Rigid and Flexible Extensions, 400+ Assorted SWAB-EEZ®, Custom Blow-Molded Case

Available in:
#8090B Brass
#8090S Stainless Steel

#9038A **RELAY BYPASS SWITCH KIT WITH AMP LOOP**

Allows Circuit Bypass and Current Testing for 12V DC Relay-Controlled Motors and Components

- Control relay circuit independent of "key-on/key-off" systems
- Run all automotive, 12V DC motors with a push of a switch
- Simplifies fuel injection testing
- Covers most makes and models

#9101 **LIGHT RANGER MUTT®**

Test Your Trailer Without the Truck

- Tests lights and electric brakes on 7 spade, 6 round and 4/5 flat pin trailers
- Short circuit protection
- Uses standard motorcycle battery (battery not included)

#9101 Includes:
3-Way Trailer Adapter and 500mA Battery Charger

Also Available:
#9102 **HEAVY RANGER MUTT®** (7 ROUND PIN MODEL)

#8043 **MICRO MALE ELECTRICAL PIN CLEANERS**

Cleans Round Electrical Pins

- Durable diamond coating
- Innovative, contoured design

#8050-8053 **AIR COMB®**

90º Multi-Port Air Gun

- Cleans air filters, condensors, and radiators
- Focused, high pressure output
- Four sizes: 12", 24", 36", 48"

PATENTS PENDING

#7862 **GREASE JOINT REJUVENATOR® PROFESSIONAL MODEL**

Can't Grease a Joint? Now You Can!

- Forces light oil into the joint and flushes out old hardened grease
- Lifetime Warranty

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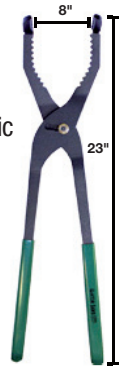
#7899 **GATOR JAWS®**

Versatile Filter Piers

- Works on oil, fuel and hydraulic filters, fuel sending units and more
- Snakes around hot exhaust manifolds



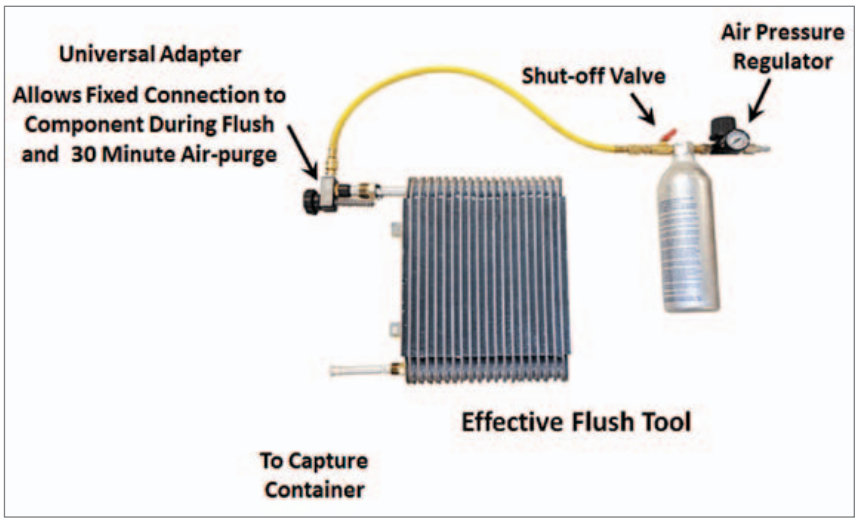
FOUR SEASONS OFFERS AC SYSTEM FLUSHING TIPS

When a vehicle's air conditioning system has suffered a compressor failure, it is essential that when the repair is complete, every inch of the refrigerant path is either new or flushed – this includes the evaporator.

Flushing is needed to remove the failed compressor's debris from all the components that are not being replaced and to remove dirty oil from the system, especially from the evaporator.

Successful flushing requires high quality flush solvent and an effective tool or machine. A good solvent should be effective at removing oil and debris. It must also evaporate rapidly. Any residue remaining in the system can affect system performance and cause chemical deterioration in the system over time. It should be safe, have low flammability and not be a health hazard.

Note: products such as brake cleaner, de-greasers, carburetor cleaners, denatured alcohol, etc. should not be used as flushing agents.



Effective Flush Tool

A good flush tool should propel the flush solvent through the component being flushed and maintain the solvent momentum throughout the flush process.

When all the flush solvent is dispensed, it should be possible to transition from flush to air-purge without allowing airflow through the component to stop. This prevents the flush solvent from "dropping out" inside the evaporator (or other components). Even a small amount of residual solvent or dirty oil can cause rapid failure of the replacement compressor.

This tool meets these requirements by using an air pressure regulator, a shut off valve and a universal adapter. The adapter enables a fixed connection to the component to be made. This allows air-purge through the component to be continued for 30 minutes after all the flush solvent is dispensed. Air-purge is necessary to ensure that all solvent and oil residue are completely removed.

1. Inject a shot of flush and let it soak for 10 minutes.
2. Flush at 40 PSI until all the flush is dispensed.
3. Increase to 80 PSI and allow air to flow for 30 minutes.

Don't try to flush debris from condensers

Flat tube, multi-pass condensers cannot be flushed for debris removal. They should be replaced due to the fact that the internal tubes are extremely small.

In addition, the condenser header tanks at each end are dammed in several places forcing the refrigerant to follow a winding path through the condenser. Flush solvent would have to follow a similar path. If there is already a restriction in a condenser, the flush will circumvent the restriction and not do any good. This is why it is important to replace the condenser each time there is a compressor failure.

Likewise, hoses and lines with in line filters or mufflers cannot be flushed – they should be replaced.

Components such as the evaporator must be disconnected from the system and flushed individually. Make your next AC job a successful one and do a proper flush job, along with replacing the necessary components.

Four Seasons, the world's largest remanufacturer of mobile air conditioning compressors, manufactures and distributes a comprehensive line of replacement climate control products for passenger cars, SUVs, trucks and fleets. Visit www.4s.com for more information.

4 SEASONS Your Automotive PARTner

GUMOUT® LEADS THE FUEL ADDITIVE INDUSTRY WITH A PATENTED BOTTLE DESIGNED FOR CAPLESS GAS TANKS

Starting in the late 2000s, drivers began seeing something new when filling up — the capless gas tank filler. In the first few years following its appearance on new vehicles, the capless technology remained a novelty of sorts. Today, though, more than 10% of vehicles feature the capless gas tank, and an increasing number of manufacturers are embracing the growing trend.

Why the change? Mainly to help eliminate fuel vapors, but also to help prevent fuel theft and gas tank tampering, plus reduce check engine lights caused by gas caps not being tightened completely.

However, the technology doesn't come without some issues. A perfect fit is essential with capless gas tank fillers. The design involves internal and external flaps that only open when the gas nozzle is inserted. Any wider or narrower and the system will not work.

Another challenge is for those who use fuel additives as part of their preventative maintenance schedule. Many fuel additive bottles either do not fit or the threads on the end of the bottle get stuck in the flaps.

While this may seem as a minor inconvenience, too large of a bottle can result in product spilling down the side of the vehicle and onto the ground causing a potential fire hazard; however, when the threads of a non-capless compatible bottle get stuck, pulling the bottle out can result in broken flaps within the filler.

This can result in plastic parts going into the gas tank, which could require costly removal, and once the capless filler is damaged, it can result in complete failure and inability to refuel the vehicle. The cost to replace a filler can be up to $700, and that doesn't include labor!

One brand changing with the times and technology is Gumout®. They have a patented packaging design for use in capless gas tank fillers. The bottle necks of Gumout® fuel additive products, like Regane® Complete Fuel System Cleaner, have been specifically developed for use with capless gas tanks, giving them a precise fit into the fuel filler — just pour, twist and remove. It's that simple.

Of course, this change does not mean Gumout has left the other 90% of vehicle owners behind. The new bottles still work with traditional capped gas tank fillers, and those with obstructed fillers often found in European models, ensuring those car owners the same important benefits provided by Gumout performance additives.

Having a bottle that works in capless systems is a great innovation, but the main reason to use Gumout® Regane® Complete Fuel System Cleaner is to remove power-robbing deposits because cleaner parts result in better performance. Gumout sets itself apart from the competition by using the highest concentrations of P.E.A. (polyetheramine), which is the most potent cleaning agent on the market.

It's strong enough to withstand the 495° temperatures in the combustion chamber, which is the hardest part of the fuel system to clean. This proven science can even clean some of the newest technologies, such as direct injectors found in GDI fuel systems, and it prevents new deposits from forming for up to 3,000 miles. The result is maximized fuel economy and performance.

Learn more about the science behind Gumout at Gumout.com.

GUMOUT® PERFORMANCE ADDITIVES

Science in. Performance out.

WHEN IT COMES TO FLUID CONNECTORS: GO WITH THE ORIGINAL

Repairs can be costly, timely and frustrating. Chances are, whether you are repairing an automatic transmission, or building a replacement heat exchanger, the OE used Jiffy-tite fluid fittings. More than 24 OEMs across the world trust Jiffy-tite fluid fittings for transmission and heat exchange applications, so in order to maintain premium quality - replace the original Jiffy-tite with a Jiffy-tite!

Comebacks… No shop owner wants them. When installing or repairing a radiator, transmission, or engine the importance of using a quality fluid fitting can't be understated. Why risk customer satisfaction and your reputation when you can replace the connection for a minimal investment using our ready to install, fully assembled, Jiffy-tite quick-connect fitting. Jiffy-tite fittings can decrease comebacks and increase the repeat business.

With more than 450 million parts in service worldwide, Jiffy-tite is the global leader in fluid connectors. All Jiffy-tite fittings are 100 percent leak tested and proudly made in the USA. Jiffy-tite manufactures over 260,000 parts per day, with a wide range of products such as transmission oil cooler fittings, engine oil cooler fittings, glycol connectors, in-line transmission filters and more.

Produced from precision machined aluminum, steel, or injection molded plastic; Jiffy-tite products provide many features and benefits, including: improved ergonomics with a simple push-to-connect line set installation, an error proof connection that you can hear, see, and feel and outstanding performance with 100 percent leak test prior to shipment; guaranteed. Jiffy-tite fittings are easy to service by disengaging the line set using a disconnect tool and provide outstanding value achieved by a low total product cycle cost. Choosing a Jiffy-tite product means you are selecting the same validated and tested solution as the OEMs.

Jiffy-tite®

CHEMICAL TOOLS JUST FOR PROFESSIONALS

LIQUI MOLY's Pro-Line series exclusively for workshops, a range of special additives for use by professionals. They have a stronger dosage than the freely available additives and were developed for special applications. With the help of Pro-Line additives a whole range of problems can be quickly, efficiently and simply solved. A wise addition to the tool box.

In the event of problems with transmissions, German LIQUI MOLY recommends early use of additives. They have the advantage of being low in cost and achieve good results in many cases: When faced with problems such as hard shifting, high temperature or excessive noise, it is not worthwhile wasting time on detailed diagnosis and trouble-shooting; start using an appropriate transmission oil additive immediately. Often that is all that is needed to remedy the problem. "Many transmission problems are associated with increasing friction and corresponding wear," explains Reiner Schönfelder, Applications Engineer at LIQUI MOLY.

This is precisely where additives come in. And, even if this doesn't solve the problem: "Our additives are exceptionally compatible and can never damage a transmission," continues Schönfelder. The material costs for the additive are minimal, and the time required for use equally low. "That is exactly why they are so attractive," says Schönfelder. "That's what makes it worthwhile to take a shot in the dark to try and solve the problem before going through a complete diagnosis." If it doesn't work, it costs almost nothing, but if it does work, you avoid long standstill times and high labor costs for trouble-shooting — not to mention the expenses for replacement parts.

More general applications of Pro-Line additives include cleaning of the injection system and the combustion chamber. Combustion residues encrust the injectors and increase piston friction. LIQUI MOLY Fuel Injection Cleaner for gasoline engines and LIQUI MOLY Diesel System Cleaner for diesel engines dissolve these deposits ensuring combustion becomes cleaner, engine running becomes quieter, starting problems are minimized, emissions improve and the whole fuel system is protected against corrosion.

LIQUI MOLY Engine Flush is a cleaning additive. It is added to the oil immediately prior to an oil change and has to react for several minutes. In this time it dissolves contamination and deposits in oil drillholes, in repositories and in piston ring zones. The dirt is drained together with the old oil. The new motor oil enters a clean engine and can then deploy its maximum performance.

Automotive mechanics complained how difficult it was to clean the throttle valve, when it no longer operated properly due to deposits from fuel residues and exhaust gases. Although the actual mechanical cleaning process itself was very quick, removal and installation cost a great deal of time. Thereupon LIQUI MOLY developed the Throttle Valve Cleaner. The long, flexible application probe allows the specially formulated cleaning fluid to be applied directly on the throttle valve, without removal. Instead of time consuming removal and installation, it is now only necessary to provide free access for the probe.

Overall, the Pro-Line series by LIQUI MOLY includes many different products that can all be recognized by their black can. These additives are more strongly concentrated than the freely available versions and require special care in application. That's why they are only available to professionals.

Additives are not a miracle cure and cannot remedy major mechanical damage. "We would never claim that - we know the capabilities and the limits of our additives very well and are very honest to our customers about this", says Schönfelder. But additives are helpful, chemical tools that can make life easier for workshops.

LIQUI MOLY

Performance made in Germany

MOTOR OILS & ADDITIVES

LIQUI MOLY offers manufacturer approved motor oils for every car. Since 1957, demanding car owners in Germany have used and trusted LIQUI MOLY.

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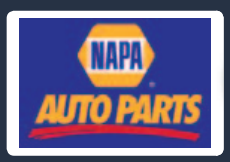

POWERING YOUR PERFORMANCE

Mighty has set the quality standard for the industry providing OE quality parts, chemicals and lubricants, value-added services and technology solutions, exclusively and directly to the automotive professional, for over 50 years.

It's empowering for an owner or manager to have a partner who is always there to ensure that high performance is an integral part of your business. When it comes to high performance — your high performance — Mighty brings you the highest caliber of customized service support.

We recognize that each of your employees, from service technicians to managers, is pivotal in driving the success of your business. That's precisely why we invest our time and resources in extensive training and educational development. Custom-tailored to your operation, Mighty training programs instill the confidence to take on new challenges to make your operation more efficient and generate many more sales opportunities.

Your local Mighty representative is your; inventory manager, business consultant, consumer education source, marketing advisor, problem solver, parts expert and partner and can provide you and your team all of the following training to help grow your business:

- **In-shop technical training:** under hood, undercar, tire service and TPMS, vehicle system servicing with state-of-the-art Mighty VS7® chemicals and equipment, etc.
- **Preventive maintenance training:** how to perform consistent and thorough vehicle inspections.
- **Sales training:** what to say to your customers and how to say it.

Your local Mighty representative has a personal interest in helping you improve your business and looks forward to the opportunity to power your performance. Give Mighty a call to learn how to make it happen.

Contact Information

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— NATIONAL OIL & LUBE NEWS

WHY?

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CHEMICALS & LUBRICANTS

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Mighty AUTO PARTS®

POWERING YOUR PERFORMANCE

SAVE TIME DIAGNOSING WITH REAL-WORLD INSIGHTS

There are times when a perfectly logical diagnosis just isn't enough to fix the vehicle in your bay.

You have probably encountered a vehicle that defied logic and experience, where you needed a little help from your fellow service professionals to get to the heart of an issue. This common scenario is being transformed by repair information systems that deliver real-world insights from professional techs right alongside OEM specs and procedures.

Here's an example of how this scenario might play out: A 2005 MINI Cooper 1.6L S pulls into your shop with the check engine light on. Upon reading the code, you find a P1688 – electronic throttle control monitor level versus mass airflow calculation. The code set condition is because the flow of air going through the mass airflow sensor (MAF) is different from the flow of air going into the throttle body.

Where to start with the diagnosis? Well, common sense and experience might lead you to the MAF, suspecting a faulty sensor. This makes perfect sense most of the time, but not in this particular vehicle. And this is where real-world knowledge can keep you from wasting time and going down the wrong diagnostic path.

Instead of picking up the phone to consult with a colleague, a little research will reveal the actual root cause of the problem. When you look up the P1688 code in Mitchell 1's ProDemand, the SureTrack diagnostic module provides a Common Replaced Parts Graph based on real experience in the aftermarket. The graph shows you that for this vehicle, the harmonic balancer is much more likely to be the main culprit.

In addition to common replaced parts, you also find a "Real Fix" for this issue — a nugget of insight based on actual repair orders and experiences from other expert technicians. The Real Fix gives you a lot of valuable information presented in a concise Complaint-Cause-Correction format (see figure) that guides you to an accurate diagnosis.

After verifying the customer's complaint and the code, you discover that the cause of the issue is very likely to be the crankshaft pulley that has separated from the harmonic balancer. The damaged crankshaft pulley caused the digital electronics module (DME) to miscalculate the vehicle's engine speed, which caused the DME to miscalculate the engine load parameter and set the trouble code.

So, with this information in hand, you feel confident in replacing the harmonic balancer. Then you verify the repair: the vehicle operates properly, with no check engine light illuminated and no fault codes. Success!

What is the lesson? Real-world information is essential in diagnosing and repairing today's vehicles. ProDemand groups its Real Fix content by "probable component," giving you flexibility to search the most common fixes first, or if you are more interested in "rare fixes," you can also invert the list and show the least common fixes first, making it quick and easy to find what you need.

In the case of the 2005 MINI, the Real Fix in ProDemand pointed you in the correct diagnostic direction from the very start, saving you time and keeping you on schedule with the repair.

P1688, REPLACED HARMONIC BALANCER

Complaint

The customer states the check engine light is on and the vehicle lacks power on acceleration.

Cause

Confirmed the customer's complaint and found the vehicle lacked power on acceleration. Connected a scan tool and found code P1688 - Electronic Throttle Control Monitor Level 2/3 Mass Air Flow Calculation. At idle, backprobed the mass airflow sensor and monitored the sensor signal on a lab scope. The mass airflow sensor signal observed on the lab scope was within specifications. Performed a second road test of the vehicle, heard a slight metallic noise from the front of the vehicle, and smelled a burning rubber odor. Hoisted the vehicle, inspected the front of the vehicle, and noticed the crankshaft pulley had separated from the harmonic balancer. The crankshaft pulley is integrated into the harmonic balancer and is replaced as an entire unit. The damaged crankshaft pulley caused the digital electronics module (DME) to miscalculate the vehicle's engine speed, therefore the DME miscalculated the engine load parameter and set the trouble code.

Correction

Replaced the harmonic balancer, cleared codes, performed a road test and verified the vehicle operated properly. The check engine light did not illuminate and no fault codes returned.

ENHANCE YOUR EMPLOYEES' KNOW HOW WITH NAPA AUTOTECH

Vehicles are becoming more technologically advanced. What used to be an easy repair has suddenly gotten a little more complicated. As a shop owner you are going to need your technicians to be up to date with the latest automotive advancements. To help you accomplish this NAPA Autotech offers the the latest high-tech training. Not only are each three to four-hour class held in the evening, but they cover topics important to your business, such as hybrid maintenance, no code diagnostics, diesel issues, scan tool dynamics, electronic circuit testing and more.

Learn from the best

All NAPA Autotech classes are led by experienced trainers who are certified technicians. They will use their work experience with the latest technologies to provide your technicians with the best training currently available. Their instruction will enhance your technicians' understanding of vehicle systems and increase first-time repair capability, which leads to increased customer satisfaction.

With ClassPass, training doesn't end when class does

NAPA Autotech wants you to have continuing education at your fingertips 24/7. So, after completing a course, you can access additional information online with ClassPass. When questions come up, just go to napaautotech.com. There your employees simply enter their ClassPass ID and have unlimited access to supplemental materials, such as slides and notes, step-by-step procedures and common fixes for repair situations.

Autotech helps improve the bottom line

There are a lot of reasons for your employees to go through NAPA Autotech training, but the most important is that it can help make your shop more successful. Shop owners who previously attended classes boasted that it helped their technicians speed up diagnostics testing times and increased employee productivity, which can help improve your operation's bottom line.

Sign up for a class

NAPA Autotech wants to help keep your employees up to date with the latest automotive advancements. To find out more about the classes being offered, go to napaautotech.com and search for classes in and around your ZIP code. Keep your business running longer, stronger with NAPA KNOW HOW.

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NAPA AUTOTECH™
Training You Can Get Your Hands On

PREVENTING YOUR HIGH END TOOLS FROM ATTRACTING DUST

It's an age-old issue that we have all came across in our years of working in the automotive repair industry. You may not be guilty of it, but you do know someone who is. You get sold on a brand new piece of equipment that is supposed to solve all of your issues for you, however the tool never seems to leave its cabinet. Why is this? Is it because that tool is impossible to use? In most cases, no. It is simply sometimes a tech needs a helping hand when it comes to getting the ball rolling to taking full advantage of using the device.

To keep up with technology, a technician needs to be constantly engaged in advancing their skill and knowledge regarding the systems we need to troubleshoot and repair. A scope is not only a great way to diagnose complicated engine mechanical and electrical systems, but it also gives you eyes into these systems to visualize, analyze and better understand these systems.

With our automotive applications, we understand there was a generation gap. Shops went from everyone having a big box engine analyzer to the use of scopes fading out, until automotive electronics caught up. Now we are back to full force needing a scope to diagnose some extremely complex automotive electronic systems. So, what do you do if you stopped using a scope and need to get back into it again or you are fresh out of school and you weren't lucky enough to be taught them? Enter the training world.

In the modern age of technology, we are extremely blessed with the fact that we can receive some very high end training materials, all without leaving our house. For example, online at our website (www.picoauto.com), we have training material loaded up. This starts with entry level content for people that have never used a scope before, let alone our scope. You can view videos on what the different buttons in the software do to looking at top 10 tech tips which show you some very basic tests that you can do quickly to capitalize on the scope.

Sometimes, the best way for technicians to learn is by attending live training classes. You are still in luck if you wish to get an education this way. The best way money wise to achieve this is to look for the next big automotive trade expo that you can attend. Not only will you be able to see and learn about the latest equipment at the trade show, but these events typically have live hands on scope classes also. Your local parts chain also typically puts on local classes — sign up for one. What happens if they don't have a PicoScope specific class? Don't worry — a scope is a scope. They all work the same way, they have different specifications making some better for automotive than others, but they all work on the same principles. All you have to learn is where the different functions are located on the device. We have extremely good distributors located across the United States that are extremely proficient with our devices – give them a call. They are more than willing to give you virtual training on the scopes or some offer training events at their locations. Join iATN.net for a wealth of information.

In the end run, a tool you have purchased is only a good tool to you if you use it. Sometimes it does take a helping hand in order to get you up and running. We are here to help with that.

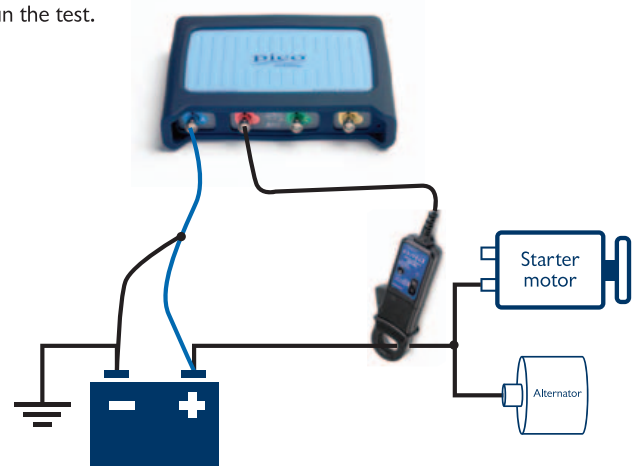
pico® Technology

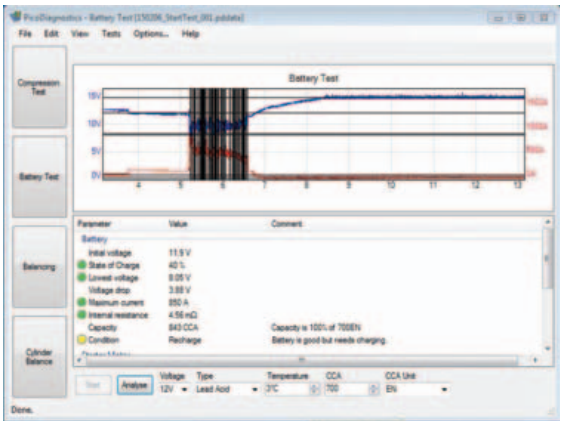
PicoScope® Test not guess

Top 10 tests: 2: Battery, alternator and starting

1. Connect A BNC cable on Channel A of PicoScope to the battery + and ground point on the vehicle. Then connect our 2000 A current clamp to PicoScope and position it around the starter motor feed cable.

2. Run Follow the setup wizard in our PicoDiagnostics software to run the test.





3. Read The test result is given to you in a simple traffic light system and covers all the starting and charging components. This result can be printed out on a report for your customer. This report can be customized with your workshop details and logo, as well as of course your customer's information.

Guided tests

PicoScope 6 contains over 150 guided tests which include example waveforms and scope settings. Available both in the software and online.

Waveform library

Did you know PicoScope Automotive includes a fantastic feature that allows the Pico Community to benefit from each other's experience? The Waveform Library Browser enables you to search a global database of waveforms uploaded by PicoScope users from around the world, and contribute yours to share with others.

Explore our diagnostic solutions online at www.picoauto.com or call 1-800-591-2796

ORIO INTRODUCES THE SAAB ACADEMY

Orio Auto Parts North America is pleased to introduce the Saab Academy. The Saab Academy utilizes our Global Learning Management System that is designed for easy access to Saab-specific designed training courses. The Saab Academy features curriculum that is tailor made to each employee's discipline and level of experience.

Saab courses will be delivered online as Web Based Training Courses (WBT). This is to ensure we use the most effective and efficient form of training to maximize learning and minimize the amount of down time.

General product training and specialized technical training is available. The training will include general product knowledge courses for Service and Parts personnel as well as specialized training for Service Technicians.

Our Product Overview training courses we have available are ***Saab 9-3 & Saab 9-5 < MY2010, Saab 9-5 MY 2010 –*** and ***Saab 9-4X***. These 3 courses describe the different technical functions in the Saab models and help your technicians (and anyone else) learn the basics of Saab vehicles. These courses concentrate on how the driver can operate the individual functions and are a great resource for anyone seeking to learn more about Saab vehicles.

Orio's most valuable training is our Saab Technical Courses. We have multiple training paths to fit each individual shop's needs, they are Technician, Associate, Qualified and Master. The courses are laid out in such a way as to mimic the technician's development from a brand new technician to seasoned veterans; everyone will find something to fit their level of experience.

Beginning with the Technician/Associate training path there are eight courses designed to teach the student the basics of Saab vehicles. Starting with the WIS (Workshop Information System) course, there are two separate Tech2/TIS2Web/GDS courses, 2 technical courses specific to the new 2010-11 9-5, one for the 9-4x and 2 key programming courses on the old (1999-09) /new (2010-11) 9-5.

The Qualified path is next with seven separate courses. Beginning with the Body Electrical courses there are two CAN Buss courses, a technical news course, a Convertible top course and a XWD system course.

Our Master level courses provide users with the much desired new 9-5 and 9-4X courses. The master level has the new 9-5 and 9-4x Technical News and three other courses featuring the new 9-5. They 9-5 courses offered are Diagnostic Tools & Programming Practical Edition, Diagnostic Tools & Programming Web course, Saab 9-5 Technical News MY2010-2011 - Practical Edition.

Our Saab Academy is another example of initiatives we continue to roll out as an independent organization, bringing you learning modules designed specifically for your OSC personnel from Orio Auto Parts North America. We are excited to roll out the Saab Academy, and we are confident you will see the value in the training curriculum.

THE GENUINE RED KAP CREW SHIRT

Say hello to the ultimate automotive work shirt — and the first one purpose-built for auto guys. Garage tested for durability and comfort, it's loaded with auto-specific features designed to make any job easier. The Crew Shirt is now available in lime green/black and orange/charcoal color ways. These latest additions are sure to be a hit within the automotive community.

The Crew Shirt is packed with tons of premium features meant to enhance daily performance while maintaining all-day comfort. For example, the Red Kap exclusive rip-stop fabric is lightweight yet breathable and 75% stronger than other poplin workwear fabrics on the market. Plus, Touchtex™ fabric technology resists stains, improves moisture wicking to keep the wearer cool and dry and retains color for a vibrant, clean appearance wash after wash.

Spending time in garages with mechanics helped the Red Kap design team develop innovative features like a sleeve pocket that keeps small tools and pens within reach and covered buttons to keep paint jobs polished and protected. The shirt is engineered to maintain its integrity after multiple washings in industrial-grade laundry facilities. The reinforced seams and stitching help extend the life of the garment even through the most rigorous working conditions. The color block design strategically places darker colors in areas that most frequently come into contact with grease, oil and grime, helping mask stains until the next wash. The Red Kap Crew Shirt leads the workwear pack in its ability to maintain its performance under the most adverse conditions.

Consumer testing also produced positive results. With a large approval rating after wear test surveys with real-world mechanics, feedback for the Crew Shirt is extremely positive. This shirt is preferred to existing automotive work shirts by more than 85% of those surveyed, proving it was designed with the automotive worker in mind.

Red Kap is dedicated to improving and expanding this line of workwear that appeals to hard-working professionals, auto repair hobbyists and weekend road warriors.

The Crew Shirt will be a proven winner for your shop!

For more information check out **www.redkapauto.com**

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EASY ONLINE TRAINING FOR DIAGNOSTIC SKILLS

It can be tough to keep up with training and technology. To make it more convenient, Snap-on offers several sources of training to help professional technicians advance their diagnostic capabilities.

Snap-on Live Training Seminars are delivered across the country by diagnostics experts. These hands-on learning classes cover a variety of topics using the latest diagnostic strategies, techniques and tools. See your participating Snap-on Franchisee for local schedules and details.

Snap-on Training Solutions® Videos are offered at http://diagnostics.snapon.com/trainingsolutions or on the Snap-on YouTube channel. Modules provide product training 24 hours-a-day, seven days-a-week. Training is free-of-charge and technicians can revisit the training sessions as often as necessary to learn at their own pace and comfort level. Training Solutions videos show how to maximize the capabilities and functionality of Snap-on diagnostic tools. Each 3-5 minute module offers instruction on a specific topic, such as: Tool Setup, Scanner Codes, Scanner Data, Technical Service Bulletins, Troubleshooter, Functional Tests, Global OBD-II, Graphing Multimeter and Guided Component Tests. Technicians can select the topics of their choice or the view the complete series for any Snap-on diagnostic tool, including VERUS® Edge, MODIS™ Ultra, SOLUS™ Edge, Vantage® Ultra, PRO-LINK® Ultra and ETHOS® Tech. Each module is hosted by National Field Trainer Jim Moritz. With over 30 years of experience in automotive diagnostics, engineering, training and technical support.

Snap-on Quick Tips Videos are available at http://diagnostics.snapon.com/trainingsolutions or on the Snap-on YouTube channel. The videos, available at no charge, provide training in an easy to watch format so technicians can use their Snap-on diagnostic tools to address specific problems on a vehicle. Over 30 Diagnostic Quick Tips videos are based on real case studies, and show how to apply diagnostic tools to specific vehicles and challenging problems. Each Quick Tip is a short 2-minute demonstration of diagnostic tools solving common problems, such as: Ford PATS Key Programming, MINI Battery Relearn, Air/Fuel Ratio Sensor Test, Alternator Ripple Test, Fuel Pump Current Ramp and Relative Compression Test. Hosted by Snap-on National Field Trainer, Jason Gabrenas, the complete Quick Tips series is free of charge and available 24 hours a day, seven days a week online so technicians can watch the videos when it is most convenient for them.

Snap-on Diagnostics is part of Snap-on Incorporated, a leading global innovator, manufacturer and marketer of tools, diagnostics and repair information and systems solutions for professional users performing critical tasks. Products are sold through the company's franchisee, company-direct distributor and Internet channels. Founded in 1920, Snap-on is headquartered in Kenosha, Wisconsin. To learn more about any of Snap-on's diagnostic solutions, talk to a participating Snap-on Franchisee or other sales representative or visit http://diagnostics.snapon.com or call 800-424-7226

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Snap-on

SERVICING THE WHOLE VEHICLE

BY **PAT BURROW** | TECHNICAL DIRECTOR, LUBEGARD

The art of servicing vehicles has evolved into a process, driven by new technology, creating new opportunities and new responsibilities. These technologies allow us to hook up a vehicle and determine what fix or maintenance is needed. One of these new responsibilities we commonly fail to fix is the air quality inside of a vehicle. When the service technician moves a vehicle into a service bay, it is very simple to turn on the heater or A/C and smell the air that comes out of the vents. The air quality inside of a vehicle is determined by the presence of unwanted contaminates that accumulate and live in the ducting and condenser box of A/C and heater systems. These concentrated contaminants can degrade air quality in a vehicle, causing foul smelling odors often composed of health-threating mold and mildew deposits. This is when one of those "new opportunities" aligns with new responsibilities.

There are ways to fix the problem from complex, expensive and temporary to inexpensive, easy, and effective. Many of the products used are simple perfumes that temporarily remove the bad odor but do nothing to fix the problem. Soon the perfume loses its masking odor and you are back at square one. Other products that are more effective (often expensive and not perfumes) are difficult to apply and may actually require disassembling the dash and spraying several chemicals through the system. These chemicals have the potential to stick to vent control systems and still do not prevent the return of the same contamination that caused the problem. This is a common solution used by OEM dealerships and is very costly and time consuming. There have been expensive systems that generate a fog that is blown through the heater and A/C system temporarily removing the bad odor but still not fixing the root cause: organic contamination.

One of the more efficient and cost effective methods involve delivering a cleansing /disinfectant foam directly to the areas of active contamination. These foams are easily introduced once the service technician has secured the permission of the owner to eliminate the bad smell permeating his environment every time he turns on the heater or A/C. These foam cleaners are easily introduced into the smelly system (with the vehicle not running!) using an installation tube that is inserted into the evaporator box or heater (normal source of problem) by way of the drain tube (all vehicles have a drain to remove the condensation that provides the ideal medium for contaminates to grow in your heater or A/C). The drain often becomes plugged and the tube will clear it, allowing the water to leave the system properly. Once the tube is in place, the can of foam can be discharged into evaporator boxes or heater enclosures. The foam fills the system and the tube is removed. It takes about 15 minutes for the foam to collapse and turn into a disinfectant liquid as the foam bubbles implode, scour the system and flow out the drain tube, taking the bad smell and the contaminates at the same time. It's simple, easy, effective and usually performed while you are servicing another system on the vehicle.

When the vehicle is returned to the owner, not only has the driveline been serviced but the environment for the owner has been restored. A new responsibility — total vehicle service, including the cabin — has resulted in a new opportunity. Most vehicle owners are grateful that there is a safe, economical solution for the problem. They will also appreciate being able to avoid health-threating contamination. Because the problem returns in time (hot or humid climates will need service more often), it creates the opportunity to not only maintain the mechanical health of the vehicle but the health and well-being of its owner. It creates the opportunity to perform the service again because they now know how and where to get the problem fixed. It's amazing how your nose can create a new opportunity because you decided to assume a new responsibility — taking care of your customer like you take care of their vehicle.

PAT BURROW

Pat Burrow is Technical Director at LUBEGARD with 34 years of experience in automotive fluids, including OEM certification testing, new product development and technical training.

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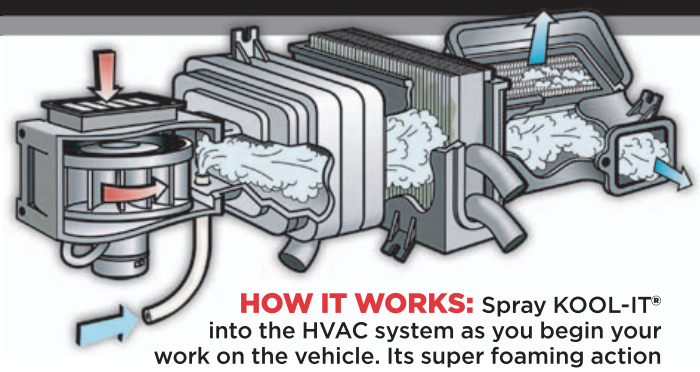

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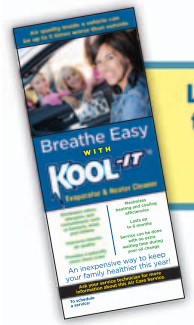

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WHY IS MY CAR'S A/C BLOWING HOT AIR?

The air conditioning system in your car is designed to cool down the air in the cabin of your vehicle to keep you comfortable on a hot day. When you only get hot air instead of cold air, it can be frustrating and extremely uncomfortable. In this article, we're going to look at how your car's A/C creates the cold air so you can more accurately diagnose what's going wrong.

The cool air is created by blowing air from either outside your car, or from the cabin over cold coils. This cools down the air before it gets blown out of the vents into your car to keep you comfortable. Most systems are designed to blow very cold air, between 32 and 40 degrees! These cooling coils, called the evaporator, is where the actual cooling of the air happens. These coils are cooled by cold refrigerant flowing through them.

Most cars today use a refrigerant called R-134a which is a special refrigerant designed to work at the temperatures and pressure standard in a car's A/C system. As the cold refrigerant passes through the evaporator it absorbs the heat in the air which warms up the refrigerant. This warmer refrigerant now needs to be cooled back down so your A/C system can continue to operate. This is accomplished by first compressing the refrigerant to a high pressure which also heats it up to a high temperature.

This hot refrigerant is then cooled down by running it through the condenser. The condenser is cooled by ambient air in the front of your car just like the coolant in the radiator is cooled. On most cars the condenser is actually in front of the radiator and gets cooled first to make sure your A/C system gives you consistently cool air. This high pressure, now cooled, refrigerant is then allowed to expand quickly as it passes through an orifice or expansion valve. The expansion valve is a simple device that takes advantage of the fact that quickly expanding liquids and gases get cold. The process of liquids and gases getting cold during expansion is a scientific phenomenon you can prove by using an entire can of spray paint in one sitting and seeing how cold the can gets.

Now the cold, low-pressure refrigerant can return to the evaporator to cool it and along with it, more air keeping your car comfortable. There are a few other components in the system like temperature and pressure sensors, hoses and the dryer or accumulator. The dryer is where any moisture is removed from the refrigerant, the refrigerant is filtered to make sure it all enters the compressor as a gas, and the oil for the system is equally distributed through the refrigerant passing through.

If your car's is blowing hot air then one of these systems isn't doing its job properly. Since there are two components that require air to be moving through them, the evaporator and the condenser, it is possible one or both of these are clogged and not getting the proper air flow. Check the front of your vehicle for debris, the engine cooling fans for proper operation, and your cabin air filter for debris and dirt. The refrigerant in your system also needs to be able to flow properly through the system. Check your compressor for proper operation, clogs in your system and the proper amount of refrigerant. All of these can be checked by observing the pressures around the system both before and after the compressor and all the other components. This can be done with set of A/C gauges to measure both the high and low pressure sides of your A/C system.

If you find unusually high pressure before any particular components and unexpectedly low pressures after them, there is a good chance there is a clog in that component. If this is the case, you will most likely find the clog in the accumulator or the condenser. If you don't have a large enough pressure increase across your compressor you may be in need of a new AC compressor. If you have lower than expected pressures on the low pressure side of your system, may simply have a low refrigerant level.

If you do not have enough refrigerant in your car's A/C system the compressor may not be able to raise the system pressure high enough for the expansion valve to be effective in cooling down the refrigerant. Due to the high pressures of your air conditioning system and the volatile nature of the R-134a refrigerant used, it is not uncommon for some of the refrigerant to leak out over time causing a low pressure condition in your system. If you discover this to be the reason why your A/C is blowing hot air add Red Angel A/C Stop Leak to your vehicle's air conditioning system to seal any leaks no matter how small they are before you recharge the system.

Red Angel A/C Stop Leak One Shot comes in an easy to use aerosol can that can be installed quickly and easily without any tools and also contains 2.5 ounces of R-134a to help bring your system back up to normal operating pressure.

To learn more about Red Angel A/C Stop Leak Aerosol visit our product information page at www.gobdp.com

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When the hard part repair just isn't an option...

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Red Angel A/C Stop Leak & Conditioner / Aerosol repairs leak points in automotive A/C systems. Red Angel "One Shot" is intended for the retail customer seeking a quick and easy installation. Complete with an attached coupler, Red Angel "One Shot" is a complete delivery system. Red Angel's aerosol product is for R-134a systems only. Each unit also includes a refrigerant charge. Permanent repair or your money back.

- Repairs leak points in condensers, evaporators, connection hoses, gaskets, and o-rings
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ROTARY LIFT RECOMMENDS "LIFTING IT RIGHT" ONLINE TRAINING

As the world's leading vehicle lift manufacturer, Rotary Lift has always strongly supported training technicians on the proper use of lifts. In fact, Rotary Lift was a founding member (the only one still in business) of the Automotive Lift Institute (ALI), the trade association focused on lift safety. Rotary Lift recommends that every lift operator take ALI's *Lifting It Right* interactive online safety training course hosted by NASCAR legends Richard and Kyle Petty.

Lifting It Right teaches technicians how to properly use vehicle lifts. It also provides shop managers with easily accessible training records and the opportunity to schedule training at optimal times.

With the *Lifting It Right* web-based format, lift training has never been easier, more convenient or more cost-effective. A narrator guides technicians through information about lift types, the vehicle lifting and lowering process, and lift maintenance. Throughout the presentation, real-world scenarios are presented in an engaging, interactive format to provide a positive learning environment and reinforce the technician's understanding of each topic presented before moving forward. Participants have up to 90 days after registration to take the course and pass an online test. At the conclusion of the program, a certificate of completion is generated. The certificate is stored online and also can be printed, if desired. Each participant also receives a copy of ALI's Automotive Lift Safety Tips card and the *Lifting It Right* safety manual (a $10 value) by mail after successfully completing the course.

The ability to manage training records online is a big benefit to shop owners. With online records, there is no need to print and score a written test and then store a certificate. When training compliance needs to be demonstrated, the shop manager can just pull up each employee's record online. Because the class is web-based, there's no need to schedule time away from the bay for everyone to take it at the same time. It can be scheduled with minimum disruption to shop productivity on an individual basis. Most technicians can take the course and pass the test in less than an hour.

Over the last two years, this course has helped train nearly 12,000 people on proper lift use and maintenance procedures for safer workplaces. To make the program more accessible, ALI has lowered the price of the *Lifting It Right* online course to $24 per person in 2016. *Lifting It Right* can be purchased at **www.autolift.org/ali-store/**.

"With health and safety officials increasing their focus on vehicle service providers throughout North America, it is crucial that members of the service and repair industry take ownership of safety issues and embrace a proactive approach to accident prevention," says R.W. "Bob" O'Gorman, ALI president. "Safety materials developed by ALI, such as this training program, allow employers to take a leadership role in service bay safety instead of simply reacting to penalty-based enforcement programs."

Founded in 1945, the Automotive Lift Institute is a trade association of North American-based lift manufacturers. ALI's mission is to promote the safe design, construction, installation, service, inspection and use of automotive lifts. In 1947, ALI developed the first Commercial Standard covering vehicle lifts published by the National Bureau of Standards. Today, ALI sponsors several national lift safety standards and offers third-party certification programs for automotive lifts and automotive lift inspectors. Rotary Lift offers more ALI certified lift models than any other manufacturer and its distributor network includes more ALI Certified Lift Inspectors on staff than any other manufacturer.

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Email: userlink@rotarylift.com
www.rotarylift.com

WORLDPAC TRAINING INSTITUTE (WTI) PROVIDES ADVANCED TECHNICAL AND BUSINESS EDUCATION

WORLDPAC Inc. and the WORLDPAC Training Institute (WTI) is focused solely on providing the Aftermarket with the highest quality advanced technical and business training available in the industry, are committed to supporting independent professionals through education.

"Our mission at the WORLDPAC Training Institute (WTI) is to assist customers in growing and increasing the profitability of their business through education," says Mario Recchia, WORLDPAC Senior VP of Marketing. "WTI OE-style course materials are created explicitly for the independent service center, and are designed and taught by our experienced, professional automotive instructors. Our goal is to establish and maintain relationships with our customers that generate long-term sustainable value."

The WTI technical training program provides advanced level diagnostic training for independent repair professionals. The complexities of properly diagnosing and repairing late model vehicles requires training that, until recently, has not been readily available to independent service center professionals.

The WTI business development program provides training in the management of the repair shop business. The tools provided in these classes help managers increase productivity, increase profits, and assist with improving troubled areas of the business.

Established in 1997, the WORLDPAC Training Institute (WTI) has trained over 40,000 independent repair professionals. In 2009 the WTI also launched a biennial Supplier & Training Expo (STX) that currently hosts over 1600 WORLDPAC customers and offers 500 total hours of training presented by more than 50 of the industry's most respected instructors.

"WORLDPAC is dedicated to providing our customers the very best training in our industry," said Bob Cushing, WORLDPAC President and CEO. "We take great pride in continuing to offer training curriculum designed to meet the demands of growing the independent repair professional's business."

"WORLDPAC's total value proposition focuses on an ease of doing business." says Mario Recchia. "We have a vested interest in the success of our customer. The WORLDPAC Training Institute (WTI) is a great opportunity to help us better serve today's and tomorrow's business owner and technician."

The WORLDPAC Training Institute (WTI) is just one part of WORLDPAC's total value proposition. The company specializes in an advanced wholesale distribution model with complete inventory of original equipment automotive parts for import and domestic vehicles, as well as a comprehensive WORLDPAC Tools & Equipment Services (TES) division. WORLDPAC also offers a suite of amenities such as speedDIAL, the company's industry leading online catalog and fulfillment ordering software, the WORLDPAC app and VIN scanner, OE Detailed Schematic Parts Diagrams, proprietary Digital Delivery systems, customer marketing solutions (CMS), and a vast company-owned fleet of vehicles and drivers providing multiple same-day deliveries from over 120 regional distribution centers across the USA, Canada and Puerto Rico.

Headquartered in Newark, CA. USA, WORLDPAC is an importer and distributor for original equipment and quality aftermarket replacement automotive

parts. With over 120,000 sku's and 11 million applications covering 40 plus car lines, the company provides brand recognized automotive parts directly to independent import and domestic service centers in the US, Canada and Puerto Rico, and also offers customer services such as their highly praised technical and business training, as well as targeted marketing solutions.

WORLDPAC, Inc.
37137 Hickory St.
Newark, CA 94560-5522
(800) 888-9982 ext. 5470
www.worldpac.com

WTI WORLDPAC Training Institute

WORLDPAC Wholesale Distributor of Original Equipment Automotive Parts

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TWO-POST LIFT

The Spot-Rite™ design of the Forward I10 two-post lift provides the best lifting setup to handle the widest range of passenger cars, trucks and vans. The 10,000 lb. capacity lift has one three-stage front arm and one two-stage arm on each column to accommodate heavier vehicles symmetrically and lighter vehicles asymmetrically. This helps shops get the most profit out of each work bay. The Forward I10 two-post lift wears the ALI gold label that demonstrates it has been independently tested and proven to meet industry safety and performance standards.

Rotary Lift

NEW BENDPAK LOW-RISE LIFT PICKS UP WHERE OTHERS LEAVE OFF

BendPak recently unveiled its new LR-5T — a 10,000-lb. capacity low-rise lift that accommodates passenger cars and trucks thanks to a newly designed lift platform, specialty adapters, wider driver capacity and increased lifting capacity. Convenient built-in storage trays mean lug nuts and other small parts are always within reach.

BendPak

TEXTAR HIGH CARBON BRAKE DISCS

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

WORLDPAC

ENGINE, TRANSMISSION MOUNTS

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

NAPA AUTO PARTS

REAR BLADE LINE

TRICO Exact Fit.
REAR BLADE

The TRICO Exact Fit® rear blade line offers three new part numbers. The 10-B blades replace OE integral blades on Infiniti, Mitsubishi, Nissan and Suzuki vehicles, the 10-E blades fit snap claw wiper arms on Chevrolet, Dodge, GMC and Saturns, and the 15 blade is designed to fit pinch tab and trunnion wiper arms on Audi, Porsche and Volkswagen models.

TRICO

UNIVERSAL COOLANT DYE

Tracerline® Rite-Blend™ is a concentrated, universal trace dye that makes finding engine cooolant leaks fast and simple. The GM-approved formula works with both conventional and extended-life coolants, won't change the color of the host fluid and fluoresces brilliantly using any leak detection lamp. It's available in one ounce, eight ounce and larger size bottles.

TRACER PRODUCTS

TOUGHONE A/C COMPRESSORS

ToughOne A/C compressors, available exclusively from Advance Professional and Carquest, are performance-tested premium products. Stringent testing ensures a superior quality, leak-free and quiet compressor that meets or exceeds OE specifications and are backed with a limited lifetime warranty. For more information on hot A/C deals this summer, go to advancecommercial.com or contact your local delivery location.

Advance Professional

SIDE MOUNT RIDECONTROL AIR SPRING KITS

Now providing Ford pickup owners with more choices, Air Lift offers side-mount RideControl™ suspension kits for non-fifth-wheel or gooseneck towers and haulers. The side-mount RideControl kit (part #59556) is compatible with 2011-2016 Ford F-250 2WD and 4WD pickups and work with the vehicle's existing leaf spring suspension to deliver up to 2,000 lbs. of load levelling capacity.

Air Lift

APG

SYNTHETIC POWER STEERING FLUID

BlueDevil's power steering fluid is synthetically formulated with conditioners to rejuvenate seals and repair leak points and formulated to meet service requirements for all domestic and foreign manufacturers including Honda® Power Steering Systems. It is an excellent substitute for any normal power steering fluid. For more information call 1-888-863-0426 or visit www.gobdp.com.

BlueDevil Products

ENGINE IGNITION ANALYZER

The GTC505 is a complete ignition system analyzer, compatible with all common types of spark ignition systems. The GTC505 can:

- Display waveforms in real time
- Compare readings between cylinders
- Detect and display dwell angle and primary current ramp time
- Chart burn time, spark plug voltage, dwell/ramp time, and RPM for each spark, allowing for detection of misfires
- Display all this data on its 3.5" color TFT LCD screen
- Provide 6 hours of continuous use with its long-life rechargeable Li-Ion battery
- Survive and pass the rigorous "MIL-STD-810" drop test

GTC

AD INDEX

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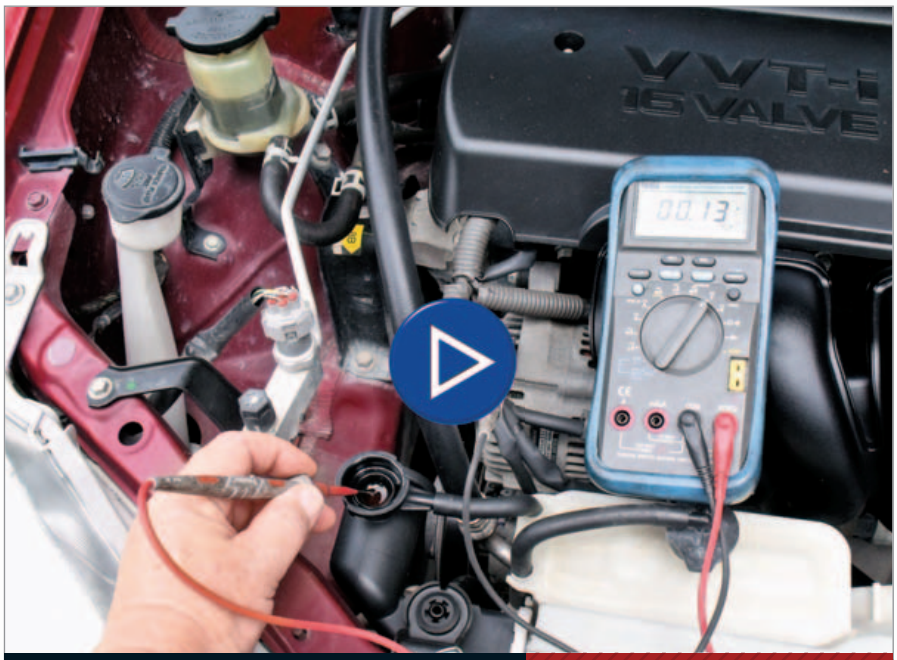
DO NO HARM

DON'T BE THE CAUSE OF A COOLING SYSTEM PROBLEM!

BY **PETE MEIER**
Director of Training



You can test the condition of the coolant using a voltmeter. Or can you?

MotorAge.com/may16trainer

Take a stroll down the coolant aisle at any big-box parts retailer and you'll see dozens of choices. Of course, there are the various brands being offered, but in addition to brands, there are different formulations. Think adding a green coolant to a green coolant is OK? Think again!

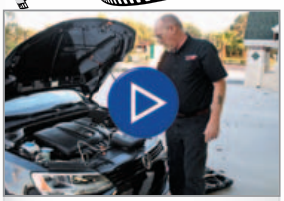
Now add in the idea of "lifetime" coolants. Are they truly able to last the life of the vehicle? How do you know when a lifetime coolant (or any coolant, for that matter) needs to be replaced? The service manual specifies a time/mileage interval, but it is often possible that the coolant has lost its ability to do its job long before that service interval is reached. And if the coolant is found to be deficient well before it should be, it is just as important to identify and correct the reason for the premature death.

Coolant has important work to do. In addition to aiding in the removal of damaging heat, it is also there to lubricate moving parts in the system and prevent the build up of nasty deposits that could choke the system's ability to move the coolant in and out of the engine, heater core or radiator. Different engine designs require different additive packages and using the wrong one in any given application could actually lead to premature component or system failures.

And the coolant is only half the equation — literally. Since coolant in the engine is a 50/50 mix of coolant and water, the water you use can also be the cause of more problems than you started with.

In this edition of The Trainer, we'll talk about the different types of coolant and how to test them for serviceability. We'll also show you how to identify and correct the most common reasons coolants die a premature death using tools you likely already have in your toolbox. While coolant service appears to be something that is "routine," it is anything but — and failure to do it right could cause your customers more harm than good.

[VIDEOS]



Handling a hot customer

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How to check volumetric efficiency

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Understanding why circuits fail

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Make your job easier; let the tools take over

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MY CURE FOR INFORMATION OVERLOAD

Today's high-tech vehicles require high-tech repairs — and that means you need more detailed repair information than ever before. But the real challenge is sorting through it all to quickly to find exactly what you need. And that's where **ProDemand**® can help.

ProDemand cuts through the clutter with user-friendly features and a logical layout that makes it quick and easy to drill down to the information you need right now. Like SureTrack® Real Fixes, legendary wiring diagrams, common replaced parts trends, and so much more.

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