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Vol. 132, No. 5

Advancing the Automotive Service Professional Since 1899

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TRENDING

IT TAKES 'VISION'

We take a look back on the annual VISION conference hosted by ASA Midwest.



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GROWING YOUR DIAGNOSTIC SKILLS

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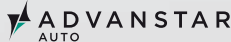
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Just because there are apps for this and that doesn't mean it's for your shop.

plus **Stats & Trends**
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BEST OF THE BLOGS
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RE-RACKS, RECALLS & RERUNS

You take on the responsibility of the repair, but if something isn't right, you have more responsibility.

[KEY: reracks]

16-YEAR-OLD WINNER

Bobby Pierce, a 16-year-old high school student, is the \$50,000 grand prize winner in the "Search for a Champion" racing sponsorship contest from Champion.

[KEY: 16winner]

APA CONFERENCE WRAP

APA recently wrapped up its annual conference, which had 66 member companies and 74 manufacturers attend. In the last year, APA has added 6 new member companies to its group.

[KEY: apawrap]



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Upcoming Webinars & Archives

See information on a technical and a management webinar in May.

MotorAge.com/webinars



Read new technical content for general repair and specialty shops.

MotorAge.com/POWERTRAINPRO



Pete Meier has hours of videos from this feature ready for you to view.

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The Trainer Electrical need-to-know

This month, we look at ways to strengthen your troubleshooting foundation.

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- Couldn't trust the left pedal ➤ The road to the perfect shop

TECHNOLOGY

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GROWING YOUR DIAGNOSTIC SKILLS

BY PETE MEIER
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BATTERY/STARTING/CHARGING SYSTEM TIPS

How would you answer this woman's call about a Ford Explorer that would not start?

[KEY: [testingtips](#)]

DIGGING DEEP ON A JEEP

More real life experiences, this time with a 2001 Jeep Grand Cherokee Limited that's giving someone fits. Can you solve this problem?

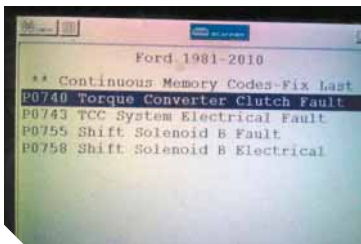
[KEY: [digdeep](#)]

PEERING INTO THE FUTURE

Delphi's Unitary Heat Pump Air Conditioner increases efficiency and reduces emissions while keeping passengers comfortable.

[KEY: [future](#)]

POWERTRAIN PRO



POWERTRAIN PRO COLUMN

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TECH PRODUCTIVITY: A SHARED RESPONSIBILITY

Tech productivity is our job and our responsibility as owners or service managers and needs to be central in designing our shop process.

[KEY: responsibility]

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Now that 88 percent of U.S. adults have cellphones, it's important that your message look good and be readable on their phone's email.

[KEY: mobilefriendly]

WHAT YOU WISH THEY KNEW

Your business depends on your prospects and customers knowing what you wish they already knew. But how do you convey that?

[KEY: wishtheyknew]

TRENDING



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CHANGES TO ASRW ANNOUNCED

6 Beginning with the 2013 event, ASRW will become a two-day expo with three days of educational training.

RAYBESTOS ACE TRAINING INTEGRATES E-LEARNING ASPECT

8 The new training module is available online and can be studied for free.

IDENTIFIX ADDS VW, AUDI, HYUNDAI TO DIRECT-HIT

8 The new additions boost the company's technical resource.

IT TAKES 'VISION'

BY PETE MEIER | TECHNICAL EDITOR

6 ASA Midwest's annual VISION wrapped up, with attendees taking advantage of 79 training offerings.

read it on

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A NEW LOOK FROM MOTOLOGIC

Advance Auto Parts Professional rolls out coverage increases for Motologic Repair.

[KEY: motologicrepair]

PROPOSED LAW WILL PROHIBIT SALE OF UNSAFE USED TIRES

A Texas Senate committee is looking at this new bill.

[KEY: unsafetires]

TELEMATICS & THE AFTERMARKET

Charlie Gorman, NASTF chairman, delivered this presentation at the NASTF spring general meeting.

[KEY: nastftelematics]

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Mitchell 1's SureTrack is an easy-to-search system of diagnostic repair information.

»» MOTORAGE.COM/STPREVIEW

FAMILY BUSINESS SURVIVAL SESSION SET FOR GAAS 2013

Business advisor Susan Rounds says all business owners struggle with the "keep vs. sell" decision.

»» MOTORAGE.COM/FAMILYBUSINESS

CONSOLIDATION CONTINUES AMONG HEAVYWEIGHTS

This year's annual Auto Chain Report reflects the consolidation seen among distributors in 2012.

»» AFTERMARKETBUSINESS.COM/HEAVY

TIME TO START PRACTICING CATEGORY MANAGEMENT

Check out tips from Vision Conference speakers on how to actually implement this practice.

»» AFTERMARKETBUSINESS.COM/CATMGMT

TOYOTA, HONDA, NISSAN RECALL FOR AIRBAG ISSUES

Recall includes 3 million vehicles globally for air bags on the passenger side whose inflator may burst, sending plastic pieces flying.

»» ABRN.COM/AIRBAGRECALL

I-CAR'S DECISION ON REPAIR PROCEDURES REQUEST

I-CAR will not proceed with implementation of a solution in response as originally presented.

»» ABRN.COM/ICARREQUEST

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Monroe offered VISION attendees the chance to compare worn out suspensions to new on an outdoor course.

TRAINING

It takes 'VISION'

KANSAS CITY, Mo. — In order to maintain a successful business or technical skill set in our industry, you need to invest the time and money into continuing your education. Nothing beats attending a live class where you can interact with instructors and fellow students.

One example of this is the ASA Mo/Kan (now ASA Midwest) VISION Hi-Tech Training and Expo. In its 21st year, it brought more than 3,500 automotive service professionals to Kansas City, Mo. Representing 37 different states (and a few foreign countries), attendees chose from 79 separate training offerings covering a wide range of management, technical and educator training topics. Technical classes included not only the standard presentation formats, but also live, on-car and hands-on opportunities. New for this year was a Ride and Drive challenge presented by Monroe, giving VISION attendees the opportunity to compare two identical cars' ride quality, one with an aged OE suspension and one with a fresh Monroe suspension.

Twenty-eight new exhibitors added more to see to the sold-out trade show, where VISION participants walked the 60,000-sq.-ft. hall and interacted with aftermarket suppliers covering every aspect of the business.

"This was my first VISION experience," says Sarah Bargo of Seeburg Muffler and Brake in Springfield, Mo., "and my favorite part was leaving with a new sense of pride in the industry I've dedicated much of my life to."

— Pete Meier, technical editor

BREAKING NEWS EVENTS

CHANGES TO ASRW ANNOUNCED

This fall Automotive Service & Repair Week (also known as NACE/CARS) will become a two-day expo, with three days of education. The show floor will be open Thursday, Oct. 17 and Friday, Oct. 18 from 9:30 a.m. to 4:30 p.m. daily. The ASRW Conference Program will take place Wednesday, Oct. 16, through Friday, Oct. 18, and the event remains at the Mandalay Bay Convention Center in Las Vegas, according to the Automotive Service Association (ASA).

The change is in response to feedback gathered from loyal exhibiting companies as well as attendees, and will offer significant business and financial efficiencies for all ASRW participants, ASA states. With this updated schedule, participants will

[ASRW] CONTINUES / PAGE 8

Discussion is on-going in MotorAge.com forums

Photo: Pete Meier



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[ASRW]

CONTINUED FROM PAGE 6

enjoy the same number of Expo hours as in the past, but streamlined into two action-packed days.

To deliver the maximum experience and value to ASRW attendees, several key events will evolve for 2013, including the ASRW Industry Forum panel discussion and the creation of a new on-floor networking event.

"After diligently compiling, researching and examining feedback from our loyal participants, these changes reflect the culmination of months of work, and we are so pleased

"This new show structure was carefully crafted to foster a deeper level of networking and community among attendees and within the industry, and provides a solution to a longtime industry need identified through our research," – Ron Pyle

to reveal our plans," stated Ron Pyle, ASA president. "This new show structure was carefully crafted to foster a deeper level of networking and community among attendees and within the industry, and provides a solution to a longtime industry need identified through our research."

The new ASRW Expo Schedule for 2013 as it stands now, is as follows:

Thursday, Oct. 17

8:00 a.m. – 9:30 a.m. – General Session

9:30 a.m. – 4:30 p.m. – Expo

4:30 p.m. – 6:00 p.m. – Welcome Reception

Friday, Oct. 18

9:30 a.m. – 4:30 p.m. – Expo

RAYBESTOS ACE TRAINING INTEGRATES E-LEARNING

Technicians can further enhance their installation and service skills with e-learning training modules from Raybestos® chassis parts – a member of the Affinia family of brands. The training module is available at www.RaybestosChassis.com and can be studied free of charge.

The Raybestos Advanced Certified Education™ (ACE) program increases educational opportunities for technicians and service writers who sell Raybestos chassis product. The e-training module offered by Affinia Tech Training presents ideal customer service engagement when assessing chassis repairs and addressing customer concerns.

The e-training modules offer technicians time-saving and money-saving benefits:

- Identify and resolve undercar problems more effectively.
- Make it easier to present and sell appropriate parts and service.

- Learn key advantages of Professional Grade® products.
- Reduce comebacks for work that doesn't meet customer expectations.
- Increase loyalty with existing customers and grow business with new customers.

The training module takes approximately 25 minutes to complete and is followed by a brief quiz to ensure the technician has mastered the concepts taught during the training. The module begins by addressing appropriate customer interaction at the beginning of the repair cycle. They move through each step of the entire repair phase, which includes discovery, verification, inspection, recommendation, repair and finally the test drive and delivery of the completed work. As an added benefit, technicians can return and review the training materials at any time.

At any time during the training module, technicians can click on the ACE tips for additional information and advice to make the brake work more effective and complete. Chassis system overview buttons allow techs to review the functionality of the items that make up a chassis system.

For more information on the Raybestos ACE Training Program, the e-learning training modules or on becoming a Raybestos Rewards member, visit www.RaybestosChassis.com or call 800-323-3022.

Identifix adds VW, Audi and Hyundai to Direct-Hit

Identifix has added genuine Volkswagen, Audi and Hyundai service and repair information to its award-winning online tool Direct-Hit.

Delivering information that comes straight from the factory, Direct-Hit allows professional technicians to diagnose and repair vehicles with greater speed, accuracy and confidence from a single online tool.

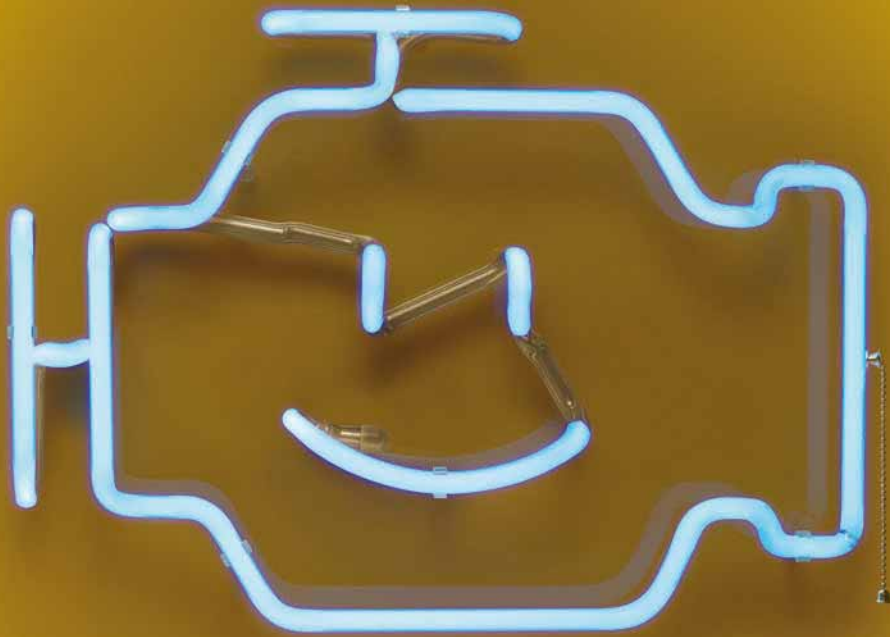
"Direct-Hit is now the only site that combines the time-saving power of over 550,000 experience-based, short-cut test and confirmed fix procedures with service information from eight OEMs, totaling more than 25 vehicle makes," said Jeff Sweet, president of Identifix. "This latest enhancement illustrates our continued commitment to helping automotive repair professionals determine what's wrong with a specific vehicle and the best way to fix it."

Identifix customers have embraced the addition of the three vehicle manufacturers, quickly liking the post

announcing the news on the company's Facebook page and personally writing Identifix to express their enthusiasm.

"When I opened my Identifix program this morning, I was delighted to see the additional information now available to me for OEM," wrote an Identifix customer from Alberta, Canada in an unsolicited email to his service representative. "Identifix will now be my one stop-shop for vehicle information," he added.

"This is obviously music to our ears, and what we strive for when evolving Direct-Hit," said Sweet.



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ASE GUIDES

QUESTION OF THE MONTH



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SURVEY: A customer comes to your shop complaining that the car's temperature gauge starts to read higher whenever he's driving in the city, but quickly returns to normal once he's on the highway. The most likely cause of this problem is:

- A. a thermostat that is stuck open
- B. an electric cooling fan that isn't working
- C. a restriction in coolant flow
- D. a failed water pump impeller

Visit MotorAge.com/may13survey to answer the question and register for the monthly prize drawing from our sponsor, Federated Auto Parts.



Are new technologies the way to go for you?

Just because there are apps for this and that doesn't mean it's for your shop.

BY **GBUCKLEY** | WORKSHOP MEMBER

There seems to be a huge amount of eye-candy technology coming at shops today. An app for this, an app for that, an app that will take a picture, send it, dial the part store to order, show it up on Facebook, send a Tweet, email their mother, sister, brother, father, build the estimate, make a movie and offer it to Hollywood, make them pay for it, calculate the labor time for it and finally wrap it all up and for the customer to evaluate and make a decision.

I'd like to think that in all of my 45-plus years of selling service and

building personal relationships, all of it can be placed inside any software solution. Mobile or otherwise. I think I've been around the Internet block a few times enough to use my experiences to flatly deny anything of the sort exists.

If you can't collect email addresses or contact numbers on a regular basis at this level of the game, how do you think you're going to understand and then continue to grow with a fully loaded app program? I know we're all smart, but it's not about that. It's about developing a process around that application. It's about speed and productivity in the bays. It's about saying yes and getting a yes back. Fast.

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BEST OF THE BLOGS

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BEST OF THE BLOGS are articles written by bloggers on Motor Age's community pages

How do you check for worn belts?

BrianLWheeler/Michigan

Those of us who work in the automotive industry should continue to keep maintenance at the top of our communications priority list. The average vehicle owner in the U.S. probably does not think about vehicle maintenance the way those of us who work in the auto industry do. And one of the most overlooked maintenance items on vehicles is the serpentine belt.

About 20 percent of vehicles on the road have a worn belt that needs to be replaced and about 90 percent of all belt failures happen on vehicles that are over 8-years-old. Another interesting stat: 80 percent of belt failures happen on vehicles that have more than 85,000.

Due to advancements in belt technology to achieve better performance under those

extreme winter and summer temperature conditions, and to get more mileage out of the belt, EPDM in 2000 became the material of choice for all major belt suppliers because EPDM compounds provide excellent life in all temperature conditions.

These new EPDM belts resist cracking unlike the older OE belts, but they do wear. They lose rubber like a tire. Many people are caught off-guard by this and need some help understand the best way to check for worn belts today.

Mobile-friendly emails

Mitchell_1/Poway, Calif.

Have you ever played phone tag? You know those times when you received a voicemail message and return the phone call only to get someone else's voicemail, and then you declare, "Tag, you're it!"?

This scenario is the perfect illustration for how email can be a better alternative. The person writing the message can do it on their own schedule, while the person reading can do the same. It just makes good sense. What if you could confirm an appointment request without picking up the phone – would it save you time?

The Mitchell 1 SocialCRM team spent a good part of 2012 making sure your service reminder and thank-you emails look good on your customers' phones. In addition, we made sure that when your consumers click on the "Request Appointment" email link while on their phone, they will be delighted by your new mobile appointment page. It's a fact that consumers respond better when the message received on their phone is formatted for mobile.

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Take a look at new ways to better your A/C service this summer in a free webinar with TST.



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IT TAKES VISION

EVENT RECAP

We recap the ASA Midwest's expo.

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Q+A WITH TIM ROSS

MUDLUCK MAIL PRESIDENT

Not tracking is half of marketing today.

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THE TRAINER VIDEO

PETE MEIER

Electrical stuff every tech should know.

Secondly, did you ever think how many people actually use all of the functions of a smartphone? Just because it's a smartphone, it does not mean that's its owner is anything like it. That means that whatever you send

them won't get opened. That hurts. Also note that in some cases, videos and pictures can't even be opened in workplace desktops. Firewalls slam them shut. You can read more on this at MotorAge.com/measure. *ZZ*

MotorAge TOP VIDEOS



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Speakers discuss 'service readiness'

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MotorAge.com/readiness

Virtual serviceability

This video will show you how one manufacturer tries to foresee service issues before the first prototype is built.

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Seeing what a difference fresh makes

Monroe showed differences in new and worn shocks and struts to a group of techs.

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Three step-by-step diagnostics videos we produced along with Shopware.

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Noteworthy

comments from MotorAge's online communities

Each month, we scan the Workshop, the *Motor Age* Facebook page and our Twitter feeds to see what you're saying. Comment today to be heard.

MASTERMECH48:

I have found with any customer that "SHOW & TELL" works wonders. We both photo and ledger document the recommended work with set priorities when inspecting any equipment we work on. When it is laid out from safety of equipment/personnel to cosmetics, we have very few problems.

alfordteck:

Without change, we become stagnant and cannot reach our goals! Some don't have reachable goals, and some do. Even

if it seems impossible, it takes small steps towards that goal or those goal(s) everyday. It doesn't mean they are not achievable, it means dedication on the leader to help drive the direction you are heading is a positive one.

begeorgejr:

The first objective in these virtual studies is reducing warranty payments; the technician is also benefited by this process! Never ran into too many headaches while I was with Ford thanks to this process

RichieRichBor Tweets:

Tough for aftermarket shops to reset TPMS at times!!!

Wayne Sweet via Facebook:

Put some gloves on, those industrial toxins will kill you and a dirty nose will be the least of your worries.

Rabindranauth A. Rajaram via Facebook:

Seems to me that Daimler is more concerned about public safety than the European Commission.

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JUNE 2013

Pros and Cons of Rebuilding Continuously Variable Transmissions

Produced in cooperation with ATSG.

NOVEMBER 2013

Electrical Testing Techniques

Produced in cooperation with TST.



STREAMING PROGRAMS

Dan Risley to learn the mechanical side

With experience more focused on the collision side, new ASA executive VP Dan Risley said he does plan to learn more about the needs and challenges of mechanical members.

Ford explains MPGe

This short video explains the new EPA efficiency comparison, MPGe. This allows consumers to compare hybrid, EV and conventional powerplants when making their buying decisions.

Growing shop revenue

Communicating regularly with current and new customers is vitally important to growing your shop, but how do you do this efficiently and effectively? Is there a way to automate communications to save costs and increase business? Yes.



2013 INDUSTRY CALENDAR

MAY 21-22

GAAS 2013

GAAS and the Aftermarket eForum co-locate this May in Chicago.

MAY 22-23

Aftermarket eForum 2013

The Aftermarket eForum begins with an afternoon general session addressing executive-level IT and ebusiness topics.

MAY 25-29

Autopromotec 2013

This biannual event is in Bologna, Italy.

SEPT. 20-22

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Q+A WITH TIM ROSS

PRESIDENT, MUDLIK MAIL



AS YOU MARKET YOUR REPAIR SHOP TODAY, TARGETING AND TRACKING BOTH ARE IMPORTANT.

BY TSCHANEN BRANDYBERRY | MANAGING EDITOR

No matter what type of marketing you do for your shop, there are some important components you must not overlook: communication, targeting and targeting.

Tim Ross, president of Mudlick Mail, recently spoke to *Motor Age* about marketing in general and how to make sure employees are in the loop.

MA: How can owners avoid “shooting from the hip” with their marketing?

TR: The technology is so improved over the last several years on tracking your advertising and how well it's doing, that shop owners now who shoot from the hip in marketing and don't really have a plan in place on what they're expectations are, that is where we see a lot of problems. You can't separate your marketing from your staffing, from your operational set-up. One of the biggest questions I get from these shops is do I advertise first and then hire people? Do I hire people then I advertise? ...

I think a lot of marketing is negatively impacted by the fact that the owners aren't spending the time to have their shops staffed and prepared and trained and ready handle the marketing that's going out. Whatever that shop has chosen as its marketing vehicle or vehicles, one of the things that's really important

to make sure your staff completely understand the program, the pieces that are going out. Some owners don't even share with their staff what programs, what specials, whatever they're trying to use as a component of the compelling offer.

MA: How is direct mail evolving to meet the changing needs of shops?

TR: It's the only vehicle that you can really target on a neighborhood level. It can really target at that income and distance level. And you can be certain that the product reached the household. Now people might pick up the ad and throw it away, but now through postal receipts and delivery confirmation reports, you can track and code that direct mail piece almost all the way to the mailbox. When you're talking about spending valuable marketing dollars, we want to avoid the guesswork. And when you use some of these broader-based marketing vehicles, the certainty of it getting to the right person becomes a bigger question mark. On top of that, there's some great, robust call-tracking programs out there.

MA: What are some of the main areas people should make sure they cover in their marketing plans?

TR: What we've learned in the automotive industry, there is some certain dis-



tance requirements that fall into the auto repair industry. We'll drive so far to go to a grocery store, or will drive a little farther to go to a restaurant. Most people do a lot of their day-to-day spending in a two-, three-mile radius around their house. In rural areas, you can expand out farther. In auto repair, what we have found is that about 85 percent of our customers with our shops live within that two- to three-mile radius of a store. In auto repair, it's real critical that when you focus in on income, you want folks that come in with expendable income that can spend on more than just an oil change, but distance becomes a key element, because people will only drive so far for auto repair. When we work with owners around the country, the biggest thing for us is the targeting. You have to have the right kind of customer. *ZZ*

Photo: Tim Ross

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- 16 Management
- 18 Profit Matters
- 22 Financial Figures
- 30 Shop Profile



THE TAKE AWAY

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MANAGEMENT

CAR COUNT & SEO



INTERNET SEARCHES CAN DRIVE CUSTOMERS TO YOUR DOOR, SO YOUR SHOP BETTER SHOW UP.

BY BRIAN CANNING | CONTRIBUTOR

THERE might not be a more important marketing tool out there than search engine optimization (SEO). It is all about being visible to our customers or potential customers on their desktops and especially on their mobile devices (smartphones, tablets and even laptops in this case), and that obviously is an important undertaking. Doing it halfway will leave you no better off than when you started down this path.

Before I launch into the role of SEO, I want to discuss the challenge facing most tire and repair shops and why efforts toward more cars and more visibility might fall short of the lofty expectations we have set in launching this effort. The vast majority of shop owners and managers I talk to insist they need more cars. In the overwhelming majority of cases, they simply need to do a better job with the cars they currently are seeing. They have to develop and live by a profit structure that allows them to generate reasonable profit margins and reasonable profit dollars on the parts they sell, on the labor they sell and on the tires they sell.

They also need to go beyond doing the things their customers come in and ask for and develop a comprehensive inspection process that includes selling maintenance and our checking repair and maintenance history. And we have to find ways to make our shops more productive. Productivity in the automotive world is depressingly low. Not because we have bad technicians, but because as an industry we set very low expectations for production and reinforce this planned mediocrity by setting up pay plans that reward

and encourage attendance over production and quality work over a balance between quality work and reasonable production times. To these we add procedures that control shop flow but hinder production. It is not illegal to be productive and profitable, at least not in most states. If you are having trouble getting cars out now, SEO is not your most immediate need.

Search engine optimization is nothing more or less than assuring that we are very visible to anyone out in the broad world looking online for the types of repairs and services that we provide. "Online" being the operative word here, it is important to note this is how most among us shop, hunt for a house, try to find a mate and communicate with the rest of the world. SEO makes us very visible to the buying public by putting us where consumers are looking.

Going With Your Customers

You might not realize that in 2012 the number of people signing onto the Internet from a mobile device outpaced desktop users for the first time ever. That's significant, and for us in automotive repair it is critical to note and react



to. This is our new reality, and we must tailor our marketing efforts toward SEO.

Having said that and knowing how taxed most shop owners and managers are for time, I suggest you explore all that SEO could do for you, all the ways it could highlight and make your operation more visible and find somebody accomplished to do it for you. It is crucial to your long-term viability and it demands a thorough and consistent effort.

My strong suggestion would be to spend some time searching out who is successful at SEO in your market and in your sector of the industry and negotiate a comprehensive plan that matches their ability with your immediate and long-term needs. SEO is one of those things best left to the professionals.

Now, so I don't feel guilty about not presenting you with a 52-step process toward SEO, I would direct you toward your favorite search engine and have you type in "SEO." Within seconds, you will have access to every tip and strategy known to man. I am still going to tell you to find somebody qualified to do it for you. Not all of this is rocket science

and, looking at the various steps and strategies, you are going to be sorely tempted to do it yourself.

Please take my advice: Remember how important this is and how busy you are and find a successful professional to do it for you. Your car count and your bottom line will thank you again and again and again. Your time will be much better spent improving shop flow and your counter operation to handle the anticipated volume increase.

The days of that big yellow book are long gone and, in truth, the process and rationale behind SEO is nothing more than acknowledging that most of us search online for purchases we would make and the services we would buy. SEO is making ourselves visible to those looking for the automotive repair and maintenance services we provide and doing this in such a way as to stand out on the various search engines used by consumers in our home market.

SEO is not magic. By itself it is not likely to make an appreciable difference. However, combined with customer relationship management (CRM), a great

retention marketing plan and your willingness to finally take on a leadership role within your organization, you can take several large steps forward and assure the viability of your shop.

Organizational optimization as a precursor to SEO is not nearly as exciting as a plug and play solution. Somewhere beyond the exaggerated claims you will likely discover a very important and useful tool. And like any tool, if used correctly, it can simplify your life and improve your results. *MA*



**BRIAN
CANNING**
CONTRIBUTOR

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.

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TRACKING THOSE YOU SERVE

DO YOU KNOW HOW MANY TIMES YOUR CUSTOMERS ARE VISITING IN A YEAR?

BY CHRIS "CHUBBY" FREDERICK | CONTRIBUTOR

DURING the past year, even the best shops have been battling with trying to stabilize car count. It hurts technicians, service managers and families of shop owners all across North America. We all know what is causing it. But what can we do about it?

I was listening to Rick Johnson, a Nebraska shop owner and ATI coach, explain how to solve the problem. He began by asking, "Do you know how many times a year your customers are coming in to visit your shop?"

In today's fast-paced world, it is amazing how easily we can lose track of customers. And when we finally realize, "Boy, it's been a while since Bob was in," it often is too late. We have lost Bob to another shop, and we wonder, "How did that happen?"

What do you think is a good number for visit frequency in your shop today with the longer mileage intervals between oil changes? Of course the good old standby number was four times a year, with oil changes being scheduled for every three months or 3,000 miles.

With today's ever-increasing intervals between oil changes, I believe that the minimum number is now 2.5 times a year. We need to see our customers that often to ensure we are properly taking care of their needs and maintaining their cars. A few shop management systems out there will allow you to run a report to see just what your visit frequency is, and I would encourage you to do that. However, a large percentage of the shop management systems do not have that function.

Another important number to know is your customers who visit you once and never come back in a year's time. We spend a lot of time and money on marketing and promotions. To have a customer respond to that effort and then never return is not only costly, it hurts. And to not track this number and not be able to follow up on it is insane.

I know what you're thinking — numbers, numbers and tracking. We have all heard these things. But you know what? The numbers are where it's at. Every successful business that I know of tracks its important numbers and can refer to them at the drop of a hat.

Your doctor is all about numbers as well, right? Your blood pressure, cholesterol numbers, heart rate, etc., all are important for evaluating your health. The doctor watches those numbers, and when something is not right, he or she checks into it and makes corrections to keep you running and healthy. The same needs to be done with your business. Learn the numbers of your business. And starting with visit frequency and one-time visits is a great way to evaluate your shop's health.

What can we learn from a shop that has a visit frequency of less than 2.5? What could that mean? Almost every time, it means to me that we have a



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“WHAT IS THE MOST IMPORTANT REPORT TO USE FOR STABILIZING CAR COUNT? ANSWER: THE CUSTOMER FREQUENCY REPORT IS ESSENTIAL TO CREATE ACQUISITION AND RETENTION STRATEGIES THAT ARE EFFECTIVE FOR YOUR PARTICULAR SHOP.”

CHRIS “CHUBBY” FREDERICK [ATI CEO]

problem on the counter. We have a service advisor who is just not doing his or her job. This can be from many different causes. We can have an advisor who needs more training; we can have an advisor who is trained but has burnt out. It also can mean that the advisor has no faith in the techs and so cannot and will not sell to avoid the problems that go with poor workmanship. There can be many reasons, but first we have to start by knowing those visit frequency numbers, don't we?

Once we find we have fewer than 2.5 visits, we have our work cut out for us. We need to make some calls and ask our customers what is going on. Maybe observe the counter and listen in on some phone calls. And man oh man, can you learn a lot from some mystery phone shopping. But you better be sure your blood pressure and heart can take the stress of what you might hear!

I know it's tough out there today; believe me, I see it and hear it every day. These advisors have to be on top of their game each and every day. But you have to realize that if your customers are not visiting your shop at least 2.5 times a year, they are going somewhere else.

Someone else is taking care of your customers and selling them the maintenance and repair that you should be getting. After all, no one can take as good care of your customer as you can, right? I mean, your advisor is exit scheduling (setting up next appointment) as the customer is cashed out, right? I am quite confident that the advisor is doing fol-



low-up calls on all customers to let them know how much he or she appreciates them and loves them, right?

Lonely Visitors

Now on the one-time visits in a year, if one number tells us something is wrong, it is the one-time visit. A customer finally responds to our advertising efforts, they come to the shop and for whatever reason we don't "wow" them. We show them that we are just like every other shop and they choose not to come back.

That hurts. We can have the best website, the best Google presence, the best location, the nicest waiting room, etc. But if the advisor does not wow that customer and make them feel wanted, then the customer may decide to keep looking for "his shop" or "her shop." What a waste of money and time for us.

Of course some one-time visits are fine; we all have the tourists that break down, and they obviously are not coming back. We unfortunately lose customers to death, and some move away or buy a new car. And some we just flat out cannot make happy and we are glad that they don't come back! But the others, the ones that used to be great customers — what happened to them? The ones

that should have become great customers — what happened to them? First off, we have to find out who fits these categories. Then we need to start making calls to see what happened and see if we can correct it and get them back.

I hear all the time from shop owners that they sure wish it was like it was in 2007 or before. I understand that to mean it was a lot easier to make sales before the recession. But sadly, I have news for you: Those days are not coming back! It will never be like that again.

And to this I say, "Good!" For those shops that will make changes, it can be better than ever, and you will have so much less competition. I would suggest that we can have the sales like 2007 or even better. But we simply cannot run the business with 2007 sales techniques. We have to know the numbers better than ever now if we expect to have great sales. We also have to do the things we maybe did not do in 2007.

I hear things like "I never had to exit schedule before" or "I never made follow-up calls before." You better be doing those things now if you want 2007 results. What are we to do if our sales management system won't give us the visit frequency report or the number of one-time visits? Go to www.ationline.com/2013-5 for the free ATI Customer Link Frequency Report. It's free, and priceless in diagnosing your business, and will help you get a handle on your shop's health at the counter. **ZZ**



Chris "Chubby" Frederick is the CEO and founder of ATI, the Automotive Training Institute, founded in 1974. ATI's 99 associates train and coach more than 1,150 shops every week across North America to drive profits and dreams home to their families. Our associates love helping shop owners who have had 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 Rick Johnson, a Nebraska shop owner and ATI coach.

E-mail Chubby at
cfrederick@autotraining.net

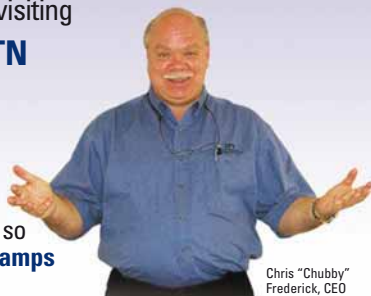
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CRUNCHING THE NEW NUMBERS

IT'S TIME TO CONSIDER BASIC OBJECTIVES AND GUIDELINES FOR YOUR INDEPENDENT SHOP TO SUCCEED IN THE NEW AFTERMARKET.

BY **BOB GREENWOOD** | CONTRIBUTOR

MEASURING an independent shop has changed in so many ways if the owner is looking for a proper return on the

investment made. Just as the vehicle has changed in the past 10 years, so too has the analysis of the shop business.

When the business is measured correctly and analyzed properly, it will

define every problem the shop has, and therefore a definitive plan to correct the problem(s) can be made. I always have taught my clients and students to “do the math – and follow the math because the math does not lie.” Too many owners run their businesses with their emotional bank account and end up regretting their decisions later on. That’s not to mention the lost net income due to their emotional decisions.

Consider these six basic shop objectives and compare them to your own operation.

1. The shop should now be billing a minimum of \$1.25 in labor to every \$1 in total parts sold. Labor billed is made up of maintenance labor, diagnostic and re-flash labor. Parts are aftermarket parts and dealer parts only. It does not include oil/fluids, tires or batteries.

2. Diagnostic labor billed should be an additional 10 percent minimum of maintenance labor billed. For example if the shop billed \$40,000 in maintenance labor for the month, there also should be a minimum of an additional \$4,000 in diagnostic billed labor for a total labor billed of \$44,000 for the month.



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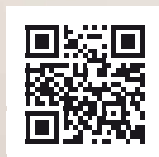
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3. The shop should be billing an average of 2.5 billed hours per repair order (RO) for basic consumer vehicle maintenance work, an average of four to six billed hours per RO for 1 ton/cube van mid-duty type work, and 10 to 12 hours average for heavy duty type work.

4. The shop should be billing a minimum of \$1.20 in labor (as defined in No. 1 above) for every \$1 it pays out in the entire wage/payroll package of the shop. The wage/payroll package of the shop includes all owner, management, technician, helper, service advisor and administration wages paid in the shop as well as all wage burden paid by the shop, which includes all staff benefits, workers compensation and the shops additional payroll taxes legislated by state and federal government.

5. The shop should have a minimum of three labor rates today, namely, a maintenance labor rate, a diagnostic labor rate and a re-flash labor rate. The better shops are up to five rates today including a tire install rate and a fluid installation rate. All rates are set to the consumer based on the competency of the individual performing the work.

6. The shop should be averaging a minimum of 75 percent site efficiency. Don't confuse this with proficiency. Site efficiency is the measurement of the team working together compared to the individual measurement with proficiency.

These are the very basic measurement objectives that should be performed weekly and monthly by management and all technicians and service advisors should be trained as to their importance and what it means to them, the shop and to the consumer.

Time to Change?

Consider the changing business model entering the aftermarket this year. We came from a break down and repair world 40 years ago to a preventative maintenance world eight years ago, and now we witness the introduction of the service on need world in 2013 thanks to the introduction of aftermarket telematics. Technology changes our industry and we must always re-learn to adapt.

The business model has and is changing, and therefore the measurement of the shop must change as well. It no longer is about total sales

in a shop, it is all about billed hours in a shop. Do the math.

Stop attending courses that promote sales and activity and being busy all the time by trying to get you to be the most competitive lowest price in the market. A shop does not want to be busy; it wants to be steady. There are only three ways to run a shop business: price, service and quality — pick two. A professional independent shop is not the cheapest priced business; it is in the knowledge business and, therefore, focuses in on service and quality by hiring, training and retaining competent staff.

When the consumer hires the shop to professionally inspect the vehicle for "safety and reliability," and proper estimates are presented for counseling the consumer about their vehicle based on how they use it and their expectations with it, billed hours are created. When billed hours are sold with preventative maintenance or repairs, commodities are sold also. Too many companies in the aftermarket have taught, in essence, "sell some parts and you might get some labor."

Today, when a shop sells its knowledge (labor), in most cases parts just follow along with it. Commodity sales alone will not save a business, however the right billed hours in a business will provide a proper bottom line, income security and a fine life for all connected with the shop. The math says in order to create and build net profit the independent shop cannot discount itself into prosperity. Do the math. I can assure you of one thing in this industry — no one, absolutely no one, will prevent you from going bankrupt.

Building a TAP

The above paragraphs are just the tip of the iceberg in shop management today. Today's professional shop owners and managers realize they must take the time and learn to build a TAP. This is a full culture shift in the Independent business.


"T" stands for team. No longer can a shop owner do it all him or herself. Management must hire competency, not just a body. A knowledgeable team must be built and this is becoming more prevalent than ever before

as the diagnostic world continues to grow. The shop talent will be diversified with various skill levels within the depth of staff hired.

"A" stands for accountability. Too many owners/managers do not hold their team accountable out of fear they may quit so they end up as baby sitters for the staff. This is unacceptable and unprofessional. Great employees want accountability because accountability will prove how well they will shine. It is when management let's weaker employees get away with things that others can not that great employees keep looking for the right business to join.


"P" is for perseverance. Changing a culture of a business or company does not happen in 30 days, six months or one year. On average, expect three to five years to get this done and it will first start with the owner/manager, not the employees. If the team cannot see and witness through their actions management moving to a different level of thinking and acting, the team will not follow. Management must lead through example. Walk the talk. This culture change is not something you buy into; it must be something that you believe in.

I will end with this thought: Are you building a career-oriented shop or a job-oriented shop? A career is an environment where you go and feel you can use your talents, and those talents are appreciated. A job is an environment where you go each day and degrade yourself for a paycheck.

The choice is yours. Welcome to the new aftermarket. 



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 AAMI approved instructors.

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OPERATIONS

SHOP PROFILE

A snapshot of one of the industry's leading shops

DESERT CAR CARE SERVICE / CHANDLER, ARIZ.



Triumphant Trombonist

Making the move from Carnegie Hall to the military to the bay.

BY **ROBERT BRAVENDER** | CONTRIBUTOR

How does one go from playing trombone in Harlem to running three repair shops in Arizona? Well, let's see. Frank Leutz grew up in Harlem and became a jazz salsa musician accomplished enough to play Carnegie Hall.

Then he joined the Navy doing mine sweep operations in the Persian Gulf until he was transferred west. Then he drifted into auto repair after getting a job at a Chevy dealership, met and married his wife, who encouraged him to go independent, and opened the first of his Desert Car Care Service Centers in 2004. Whew.

"Before you leave an industry you can't give up on the time (invested)," says Leutz of his last career move. "You've got to try it on your own, and that's when I went into business. Eighteen hour days of doing everything wrong — not to say that we're doing everything right now, but we are always growing." To the point he recently opened his third store in the populous Chandler suburb of Phoenix.

Affable and gregarious, Leutz is not the least bit shy. Unlike some repair shop websites that run generic videos from a service, he produces and hosts a few of his own, giving practical and

up-to-date advice on consumer topics such as preventing catalytic converter theft or buying cars online. And while nothing in his varied background includes a formal education in business, Leutz has developed a philosophy on the subject.

"Entrepreneurial spirit, with (an) attitude of gratitude and pride of our industry," writes Leutz, led him "to successfully launch Desert Car Care Service Centers in 2004 by having a meaningful relationship with the staff and their families (through) the promotion of higher levels of communication for growth, attaining personal goals, and a balance to life that is rewarding."

He also cites his company's "exceptional ability to tune in to a team culture and the strength of team, created by input from all levels of [the] staff. While adhering to the mantra of a value-driven company culture and providing higher levels of service experience

AT A GLANCE

Desert Car Care Service Centers

Shop name

Frank & Josephine Leutz

Owner

Chandler, Ariz.

Location

3

Number of locations

9

Years in business

11

Total number of employees

7

Number of technicians

4,900 square feet (Chandler)

Shop size

6 (Chandler)

Number of bays

65 (Chandler)

Average vehicles per week

\$311 (Chandler)

Average weekly repair ticket

\$1.8 million (total)

Annual gross revenue

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Photos: Desert Car Care



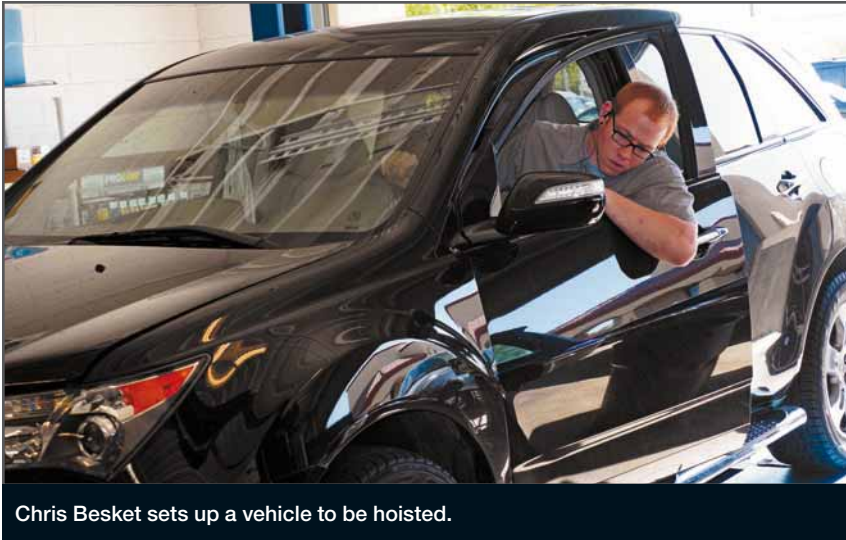
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Chris Basket sets up a vehicle to be hoisted.

ics. Core beliefs: adherence to success is not final, failure not fatal; it is the courage that counts.”

Heady stuff, especially when you consider it's spread out over three stores. But Leutz has established a baseline of expertise through industry-sponsored training, augmented with nearly equal amounts of in-house training.

“It would be very easy for me to bring in an outside expert regarding phone skills, for we'll improve to a sort of plateau,” he gives by way of an example. “But once or twice a month, the service advisors will actually cross-check phone calls, listening in on each other. My thought is when it comes to

creating that higher skill set, we can learn a lot from each other.”

In return, the staff and their families are perked with company outings like weekend cabin getaways, boating excursions and concerts, affording team members time to bond. “The emphasis is on employees not working for me, but with me,” Leutz states.

Some of this new age thinking reflects old-fashioned common sense. Charity work is a priority, like refurbishing cars for the needy. Leutz kills two birds by assigning this to a less experienced technician. “He may have less than three years,” he explains, but under the shop's direction is tasked with overhauling the car. “It's about giving back that skill set and time that's huge.”

It's all a part of Leutz's “three legged stool:” message, media and market. “In identifying the type of clientele we are attracting,” he writes in a company profile, “our message and the medium of that message becomes clear.” Besides rewarding referrals with a complimentary oil change, one remarkably simple exit marketing tool, which Leutz says compliments their 75 percent repeat business, is giving away travel toothbrushes with the note “Maintain your teeth, and we will maintain your vehicle.”

“We understand that when somebody comes in they are not just here to check an oil leak,” Leutz says of his relationship with the clientele. “They are here because we are going to get caught up on what their Uncle John is doing, how the daughter is doing through her first year in college.”

A carefully maintained customer database with this kind of info provides the foundation upon which Desert Car Care builds their image, i.e. their authority, with events like car clinics and appearances on car talk radio shows. To that end, the company has a publicist and a communications director, who currently are working with Leutz to create future promotional opportunities like a possible automotive merit badge for the Boy Scouts and high school speaking engagements before first time drivers.

“We also do a lot of work via the internet because we get a pretty good client base on the website,” Leutz reports. “Reputation management is very important to what we do; we invite any of our shortcomings to be put into a review because it is not only an opportunity to correct it but to be transparent. The internet consumer is very smart and they realize that the bulk of reviews might be massaged. When they see shortcomings blasted with a response, a productive response, that is also part of creating authority in your marketplace.

“I think what makes us unique is the promotion of our culture,” Leutz resolves. “We have to do all the right things regarding the health indicators of our business, having trained on key systems and procedures so we are consistent. But underlining that is the strong culture that we are trying to promote throughout the whole organization. You know the pied piper? If he is playing his tune right (i.e. creating a culture), he's going to get a ton of folks to follow him. Our mantra and our culture are like that, and some of the things we do as an organization allows us to continue the promotion of that culture.” **TM**



The bays at the Chandler, Ariz., location.



One of four technician workstations utilizing radio headsets and shop operating software.



ROBERT BRAVENDER
CONTRIBUTOR

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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THE TAKE AWAY

WHILE YOU MIGHT NOT BE READY TO DO DIAGNOSTICS, THOSE WHO HAVE TRIED ARE PROFITING. START WITH THE OEM WEBSITES.

52 ATSG Technical Training

An Essential Diagnostic Tool

THERE ARE PROS TO A SILVER BULLET, BUT WHEN THEY BLINDSIDE YOU, THE PROS ARE HARD TO SEE.

BY **WAYNE COLONNA** | POWERTRAIN PRO PUBLISHER

OFTEN times, I have wondered who coined the phrase “silver bullets” as it applies to the automotive service and repair industry. Unless of course the malfunctioning vehicle was to be considered a werewolf! But there is no doubt that knowing what is causing a malfunction and its remedy before the job comes into the shop is welcomed information. When you experience a silver bullet fix, you think to yourself, “It sure would be nice if

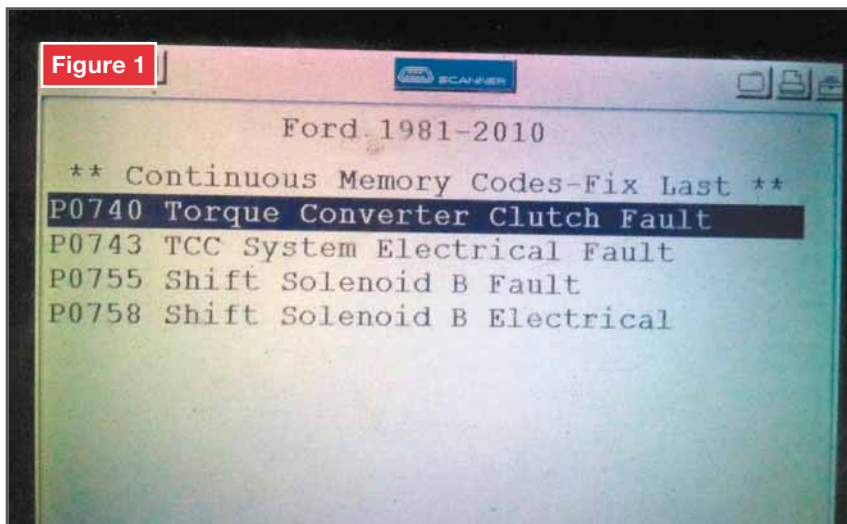
I had a silver bullet for every job that comes in.” This of course should not be confused with a cold Coors Light, as I think in reality, it might already be a “case” for some!

I must say that as nice as silver bullets are (and understandably so), there is a down side. This can and may dull ones diagnostic skills, encouraging pattern failure repairs. A silver bullet typically is the result of someone who had a job that kicked their butt, but they eventually identified a common resolu-

tion for the problem. It then became a bulletin, a seminar piece or an article, and now you know the answer to a problem that took someone days to figure out. On one hand, how do you put a value on that? Without question it makes for a nice and profitable day. Yet on the other hand it can blindside you from a different cause that will produce the same complaint. If by this time the job is sold, you have spent time and money on the job and yet the problem remains unresolved.

An uncomplicated example of this is a Ford F550 or 450 producing an intermittent shift solenoid and/or a converter clutch electrical fault code (Figure 1). The silver bullet fix is that a deteriorated internal wiring harness (Figures 2 and 3, page 38) usually causes this. Several jobs are resolved consecutively so that as soon as one of these vehicles comes into the shop, the harness is automatically replaced without any preliminary diagnostics. Then one day it doesn't fix the problem.

With money and time already invested in the job, it's now time to diagnose the problem. Because the internal harness has been replaced, the question now becomes, “Is it a solenoid problem or an external wiring problem?” Usually the solenoids get replaced, which requires dropping the pan and spending more money. When this doesn't fix it, the external wiring



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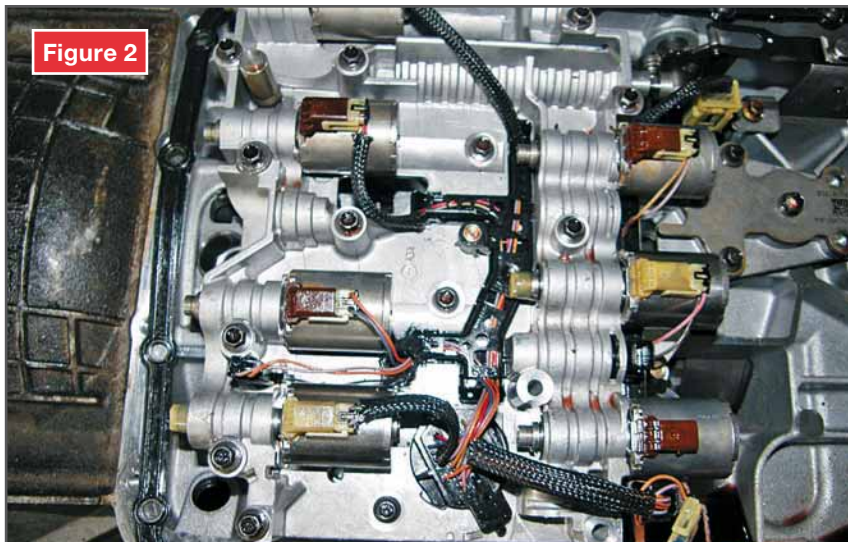
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Figure 2



becomes suspect. But where in the harness does the problem lay? The hours and days it takes to locate this problem now becomes a silver bullet fix in itself, once discovered.

The computer is mounted on the rear inside left fender. The wiring harness travels in a channel under the upper fender. With many of these trucks pulling or carrying heavy loads the body flexes. There is an area near the shock tower (Figures 4 (page 40) and 5 (page 42)) where this harness gets pulled taut causing it to rub into a sharp edge (Figure 6, page 42). The result is that shift and/or torque converter solenoid wiring is intermittently shorted to ground. Funny thing, once this is learned, it becomes the first place to look before thinking solenoids or internal harness problems. I might add to this that in some cases the way the harness is routed up to the engine

compartment, heat from the exhaust system is close enough to fatigue the wires in the harness. This is particularly common with diesel engine vehicles and usually speed sensor codes appear first.

Having considered both the upside and downside of silver bullets, I have to concede, there is a diagnostic approach that I believe has been an essential part of the initial diagnosis but is often times overlooked. Ironically enough, I consider this aspect of diagnostics to be a search for the silver bullet in itself, and that is to see if there are any factory reprogramming procedures available to address the malfunction the vehicle is experiencing. If relevant programming is available, a silver bullet may have been discovered.

Torque converter clutch shudder can be caused by a number of possibilities. These are such as, and not limited to,

Figure 3



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One reason many transmission specialty shops tend to overlook this aspect of diagnostics is that they do not perform the reprogramming themselves nor do they know where to find OEM reprogramming bulletins. In some instances this problem is compounded with being located too far away from dealerships or any other facilities that could perform reprogramming services.

Not knowing where to acquire reprogramming information is the easiest obstacle to remedy. This can be acquired by belonging to a technical hot-line service like ATSG, or online services such as ALLDATA or Mitchell, or go to the manufacturer's site itself (see the vehicle manufacturer service information websites list). Some of these sites you can access for free while others require a small fee for short periods of time.

For those who have yet to put their toe in the water concerning this subject, my suggestion would be to at least start with GM vehicles.

General Motors makes a free site available (<http://tis2web.service.gm.com/tis2web>) where you can enter in the vehicles identification number. You then navigate to the appropriate operating system to see what programming is available. Since this is an easy service at no charge to you, check

every GM vehicle that comes in to your shop and see how well it profits you. You might be more willing to look into the other OEM sites that charge a little money to look around.

The hesitancy for a shop to learn how to do their own in house programming is not as easy to remedy since it does requires an initial investment of time and money. But for those who have taken the plunge, they are profiting well from it. In addition to their own work, they also seem to be busy programming vehicles for many automotive centers hesitant in doing it for themselves.

A suggestion for those who are contemplating in house reprogramming, start with the manufacturer your facility predominantly repairs. In this way you can recapture your investment and be profitable sooner. I should add that learning reprogramming with BMW vehicles might not be the best choice for beginners as they seem to be the most time consuming and tedious to do.

There is no reason to think that reprogramming will not be a viable means of repair anytime soon. In fact to determine if a reprogramming fix exists has indeed become an essential diagnostic tool. And if it's discovered that a programming fix is available, who will shoot that silver bullet? **TZ**



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**WHEN
'F.R.E.D.'
FAILS TO
COMMUNICATE**

Remember, a network failure between an immobilizer module and the ECM can cause a no start complaint.

WHAT TO DO WHEN THE CAN CAN'T.

BY DAVE HOBBS | CONTRIBUTING EDITOR

When communications networks fail to communicate on vehicles, the results can range from mysterious U codes in multiple modules to scan tools unable to display anything beyond Check Vehicle Identification or some other onerous message. The F for frustration in “Frustrating Ridiculous Electronic Device” (F.R.E.D. for short) usually starts about the time these kinds of problems come into your bay.

General Bus Similarities

Most all serial buses used for scan tool communications are shaped square waves. Modern communications (multiplexing) can be accomplished with analog voltage shifts, slight current level shifts and fiber optics, but those communications don't interface with your scan tool and are for communicating between modules.

I used the word “shaped” preceding the term square wave, because a per-

fect square wave is a perfect source of Electromechanical Interference (EMI), so many OEMs smooth out the sharp edges. If you use a lab scope in your diagnostic strategies, you might pay close attention exactly what the waveform looks like such as injector pintle bump, fuel pump current ramping, etc.

Another similarity for vehicle communication networks is the fact that if the bus your scan tool is attempting to communicate with the vehicle on is completely shorted to power or ground you won't see any of those previously mentioned U codes on your scan tool.

Bus Differences

J1850 was applied to Ford vehicles in the mid-1990s in a two-wire protocol (technical term for network language) and assigned to pins 2 and 10 of the 16 pin OBDII J1962 compliant DLC. The two circuits make square waves that are mirror images of each other and typically are twisted pair wiring. Both the double wire



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application and the twisted pair wiring add noise immunity (thereby increasing reliability) to this bus that Ford calls Standard Corporate Protocol (SCP). Each module has a pair of wires running to one of several harness splices. Pin 2 is labeled SCP + and pin 10 is labeled SCP - .

If only one of the two bus wires is open or shorted, the bus might communicate one module to another as well as with your scanner. All bets for reliable messages, proper module operations and a U code free environment are off when this occurs.

GM and Chrysler took a different route to adhere to the OBDII complaint J1850 protocol with a single wire bus in Pin 2 of the DLC. GM termed its bus Class 2, while Chrysler used a bit of imagination and termed its very similar bus Programmable Controller Interface (PCI).

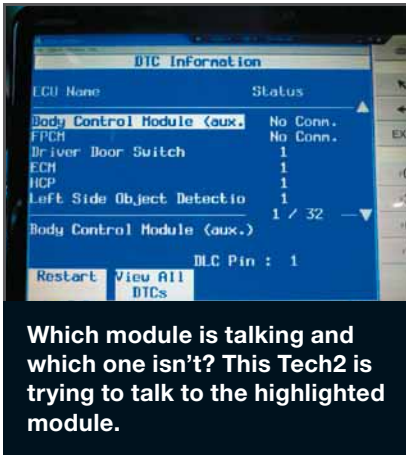
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Which module is talking and which one isn't? This Tech2 is trying to talk to the highlighted module.

Chrysler uses a wiring connection strategy of one wire per module terminating in a common shorting bar/connector called a Diagnostic Junction Port (DJP). This connection typically is located near the DLC in the area of the knee bolster under the steering column. The connection allows for removal of one or more PCI wires making fault isolation much easier. GM's equivalent single wire J1850 bus (Class 2) has a varied

wiring connection strategy depending on the model line.

Some GM models use the single wire per module strategy where each wire connects to a single splice pack connector (called a star connector) in the same general area of the DLC. Termed the Star Configuration, the star connector usually is taped up in electrical tape near the DLC, but is easy to remove for fault isolation. Some models might have a second star connector on the opposite side of the IP area.

Another wiring strategy GM used with its Class 2 bus was the loop configuration. Each module had two Class 2 bus circuits looping them together. Fault isolation is more difficult on the loop configuration. To eliminate a module as being the source of a bus short to power or ground, locate each module one by one.



Controller Area Network

For powertrain and chassis module communications the CAN bus will have two circuits similar to the Ford SCP J1850 bus and are pinned out in pins 6 (CAN High +) and 14 at the DLC (CAN High -). Depending on the domestic OEM and model year, the CAN-equipped vehicle might have one or two other speeds of CAN used for other types of module communications such as body electronics and graphical displays not requiring as high of communication speeds as powertrain and chassis. The Body Control Module (BCM) does not require high-speed dual wire CAN to pop the trunk or honk the horn when other modules are involved in such a process.

Whether a J1850 bus or CAN bus, the network classifications are broken down into three speeds: Type A, (under

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10Kbps), Type B (10-125 Kbps) and Type C. (125 Kbps and up). Pre-OBDII buses most often will be found in the Type A speed, while OBDII J1850 buses will be Type B. GM calls its CAN GMLAN. Its dual wire bus is termed HS (High Speed) GMLAN used for powertrain and chassis communications (a Type C bus), and a single wire medium speed GMLAN bus (Type B) is reserved for other modules and functions on the vehicle. Ford simply calls its powertrain/chassis bus HS CAN (High Speed) and its Type B medium speed body electronic bus MS CAN (Medium Speed).

Some CAN-equipped Chrysler models have an IHS CAN bus (Intermediate

High Speed) Type B bus in pins 3 and 11 for non-powertrain/chassis modules. We bring up letter designations because you frequently will see Chrysler use the CAN C term in its service information. It also is important to note that many Chryslers use a separate HS CAN bus (termed CAN C Diagnostic) to allow for all scan tool communications, through a single module while the rest of the modules on the vehicle communicate on either their dual wire HS CAN C bus (powertrain and chassis modules) or a single wire CAN B bus for most other modules. This strategy is not unique to Chrysler's CAN bus vehicles.

Your 'Gateway' to Logic

If there ever was one single point on a complex subject to pass along, it would be information about gateway modules. Both J1850 vehicles and CAN bus vehicles are known to use one or more gateway modules that each connect to multiple buses used on the vehicle. Besides J1850 and CAN, there are buses call Local Interconnect Network (LIN) that operate at a lower speed for modules not requiring super fast communications. Components such as door and seat modules, HVAC, etc. might use this less expensive bus, which then connects to a gateway module in order for other modules to use and share info with modules on the LIN bus.

These modules are called gateway modules and pull together the different networks on the vehicle. They act as a translator for total inter-vehicle communications as well as scan tool communications. This is essential knowledge for the tech. If a service manual theory of operation or vehicle network communications schematic shows a module with more than one bus protocol connected to it, consider that module a gateway.

This means if a module you want to look at PIDS or DTCs isn't connected to a network that is pinned out in the DLC, your scanner is going to go through a gateway module to communicate with that particular module. In the case of some Chrysler CAN bus vehicles, the Totally Integrated Power Module (TIPM) under the hood is the exclusive communications link between the only network pinned in the DLC (Pins 6 and 14 called CAN C Diagnostic) and your scanner.

On GM and Ford CAN bus vehicles, the DLC might contain other circuits for



No communications? Multiple networks? Check the gateway module, the network translator.



Individual networks may or may not be wired to the DLC.



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It was on an 02 Ford Escape. Other other had a wide band, similar to a clip on the back that you use. It seemed to have retainers on two sides myself, I'm fairly competent, but it was an issue where I'm in over my head. It should be straightforward. I can't get it and containment. I don't want to call a would require professional help. I'll be in my garage. Your TV video is great. I have customers (I work in a retail auto shop) that showed the different types of fuel pumps to replace. One would think that a mechanic in would have a reference, but I don't and my customers. I have given good feedback many people. It's about the best

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one side had the 'horse shoe' the
to one in the video where you had
d a screwdriver to release. This one
two sides. I could have probably done it
t on the other hand, I hate to get into
head. I think a simple filter replacement
n deal with the issues of fuel pressure
o deal with a broken connector that
o, particularly when the vehicle is in

Most of the parts we get from... aftermarket are getting worse but
I know that when I install an Airtex pump it is going to work, end of
story. So thanks for that. Anyway, on to my question. I have a 1975
Arctic Cat snowmobile that uses an obsolete mechanical fuel pump.
I have found several models you make that fit in its place, but I would
like to know if there is a significant difference between them, so that
I can decide which would be the closest match. The following pumps
made by Airtex use the same mounting design: 1075, 1081, 1123,
1124. I see that the 1075 has a different top half than the others,
and the remaining numbers seem identical on the outside except
for the locations of the inlet/outlet. There is plenty of room for fuel

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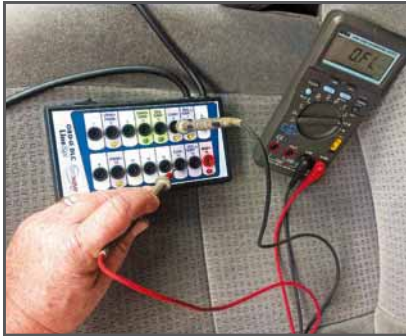
h that. However, if there is a...
sure, or any other significant...
at can't be seen on the outside,
that would be very beneficial to know. I hope you can clarify. Thank
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Avoid damage to the DLC by using a breakout box to access the bus pins.

other networks such as a single wire CAN. Late-model GM vehicles, which fall into its Global A architecture, might add an additional dual wire CAN bus called a chassis expansion bus. This bus is for modules such as electric power steering and intelligent stability control sensors. This bus will be pinned out in the DLC in pins 12 and 13 allowing some scan tools to communicate with that bus directly.

The modules on that bus can still communicate to the modules on the main dual wire CAN bus (pins 6 and 14) via (you guessed it) a gateway module function of the ABS module.

Diagnosing F.R.E.D.s

Your first order of business is knowing what networks are on the vehicle, which networks are involved in modules related to your vehicle’s symptoms, which networks are pinned in the DLC and which network your scan tool is attempting to communicate with if it eventually says No Communications. Everything mentioned except for that last item is easy enough to determine by studying the vehicle communications schematics. That last item might not be hard to determine depending on the scan tool.

Typically, older platforms of tools go to the network the scanner “thinks” that vehicle’s system should have (according to how you’ve built the vehicle when setting up the tool) and sends a message out on that network essentially saying, “Hey, I’m another node (engineer talk for module) on the bus and please send me some data.” You might have no idea which network(s) the scanner is trying to address. Some of the newer scan tools will show which network the tool is attempting to communicate on. If

only one module is not communicating on a bus while others are OK, check for a blown fuse first followed by a lack of good power and ground to that module’s connector. You can’t communicate when you don’t have power or ground.

Next look for an open circuit in the network between the proper DLC pin and that module or between the gateway module your scanner is attempting to communicate through and that non-communicating module. Keep in mind your scan tool (unless it is a factory scan tool) simply might not be up to the task of communicating with certain body and chassis modules. If U codes are present in other modules, follow published diagnostics. As a general rule, the modules with U codes that point to failure to communicate in general (U1000 on J1850 networks for example) are the last to suspect as being the culprit.

This is especially true for a module specific U code. Let’s say you do a DTC scan of a CAN bus equipped vehicle and find DTC U2111 (Electronic Steering Control Module Not Communicating) in several chassis related modules. Don’t suspect those modules. Suspect the module they are unable to communicate with by the definition of that code. CAN networks have an abundance of very definitive DTCs when the bus has voltage level problems such as intermittent shorts to power or ground, open circuits and accumulated errors in communications that can temporarily cause a module to pull itself offline.

Another important thing to remember when interpreting U codes on CAN bus vehicles are non-consequential history

codes that set. Sometimes when there has been a service procedure where a module has been without power codes will set in history. They mean nothing if not accompanied by a real complaint with the vehicle. Simply record the DTCs for possible referral in the future then clear them. Some scan tools might cause U codes to set in select modules when they are unplugged from the DLC while still in a linked-up communication condition. This isn’t a condemnation of the car or the tool, just a reaction to two parties not wishing to part ways yet. Avoid this anomaly by simply backing out of the communications screens with your tool prior to disconnecting.

Total bus failures like shorts to power or ground by a network circuit or module on the network can occur on a CAN HS network. This can prevent the vehicle from starting, (immobilizer) cause the entire PRNDL to light up all at once or induce multiple IPC telltale lights to illuminate. A short to power might be 12 volts measured at DLC pin 6 or 14, but don’t assume a short to ground is 0 volt or 0.1 ohms between ground and the network pin. I’ve seen 50 ohms of resistance between ground and a network circuit due to a faulty aftermarket accessory wired into one of the bus wires causing communications failures with some modules while others still would communicate. My scope showed a perfect pattern on that vehicle too but a quick measurement between ground and both network circuits revealed several thousand ohms of resistance on one of the two wires but only 50 ohms between the bus and ground on the other wire.



You can accidentally set the stage for a U code by coding a new module with incorrect information.

Terminating the Bus

Some networks including CAN buses require termination resistances at each end of the bus. If the bus is a vehicle-wide bus such as a GM or Ford HS dual wire CAN bus, there will be a pair of 120 ohm resistors either in two modules or a single resistor in one module and the other resistor wired in the network harness somewhere. If the vehicle uses one resistor in the harness as opposed to locating them internal to two modules, the resistor might be a simple stick lead resistor soldered into the harness and taped up with electrical tape or it may be in a small plastic housing.

I have seen cases with GM where the terminating resistor was in a black plastic housing about the size of a small relay and located under the vehicle near the fuel tank. The reasoning for this location was for the resistor to be near the end of the line of the HS CAN bus where the fuel pump control module is located. This has led to corrosion in the field which means resistance build-up. The resistors are there for noise immunity (EMI) so if the total resistance isn't right – reliable bus communications suffer and phantom U codes and strange symptoms can be the result.

Because these two terminating resistors are 120 ohms each and they are wired into parallel, the total resistance should be 60 ohms \pm 5 percent. Because you are using your ohm meter, make sure the vehicle and the bus are asleep meaning no current draw and no bus activity. Measuring this terminating resistance is simple; apply your ohm meter between pins 6 and 14 and look for 60 ohms. If you see 120 ohms, there is a module unplugged or another type of open circuit in the network. If you see some other resistance much higher than 120 ohms, you have a complete open on the bus.

If you are using a DLC break out box (they are invaluable), check to see if a DLC pin has backed out as this has happened before. If you see something between 60 and 120 ohms, look for corrosion in places such as at that undercar resistor location (if used) or even a connector in the network being dripped on courtesy HVAC condensation.

On the subject of bus terminators, a note specific to Chryslers with CAN bus networks involving the use of that Diagnostic CAN C network as the exclusive bus for scan tool communica-

tions must be pointed out. These vehicles use a single 60 ohm resistor in the gateway module (usually the TIPM) as opposed to two 120 ohms resistances in two separate locations wired in parallel. The resistance measured at the DLC is the same: 60 ohms. To get to the terminating resistors total resistance on the regular Chrysler CAN C bus, you must back probe both CAN C bus circuits at a module or in the harness somewhere as there are no pins for this bus actually in the DLC. *ML*



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A Transmission that gives a Hoot

EVEN THOUGH A NOISE ON THESE MODELS IS 'NORMAL,' THAT DOESN'T MEAN YOUR CUSTOMER IS GOING TO ACCEPT THAT ANSWER.

BY WAYNE COLONNA | POWERTRAIN PRO PUBLISHER

Customers who own a 2009 to 2011 Ford Escape or Mercury Mariner using the 6F35 front wheel drive transmission (Figure 1) might complain about a hoot type noise on light acceleration just before the 1-2 up-shift. As

in other features in the POWERTRAIN PRO section online this month, this is yet another problem that is not a problem.

Ford/Mercury considers this to be a normal characteristic of the transmission (Ford TSB 11-7-23), making this the first transmission ever documented that gave a hoot! However, should the customer insist on hooting himself saying, "It wasn't there before," you can hazard a partial repair, as there is an updated chain snubber (Figure 2) part number BL8Z-7J387-C that will reduce the noise. This repair will require transmission removal and dismantling, so it's a big job just to reduce a noise complaint.

It might go a long way to replace

this snubber when doing a major overhaul. The driver will notice a quieter ride, giving the perception of having a better transmission than what they had previously.

Focusing on a Fusion

The same vehicles including the Ford Fusion also might experience a harsh 2-3 up-shift and a flare 3-4 when cold. This complaint has a reprogramming fix per Ford TSB 10-21-9. If the 1-2 shift is harsh and 2-3 shift is hard for the first couple shifts of the day along with an intermittent harsh first engagement (reverse especially) and there are no codes, this too can be remedied by reprogramming (TSB 11-12-8). Some of these vehicles also

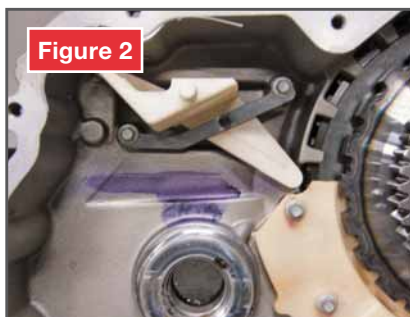


Figure 2


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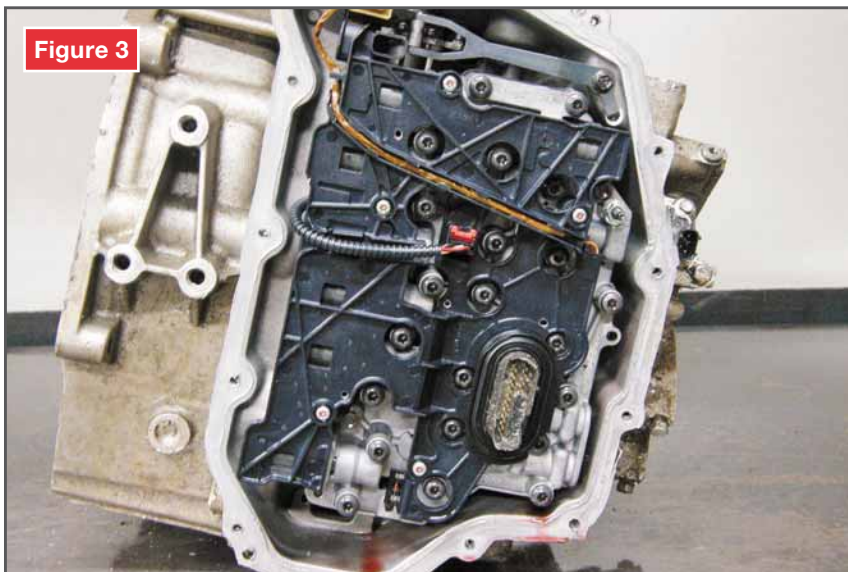
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Figure 3



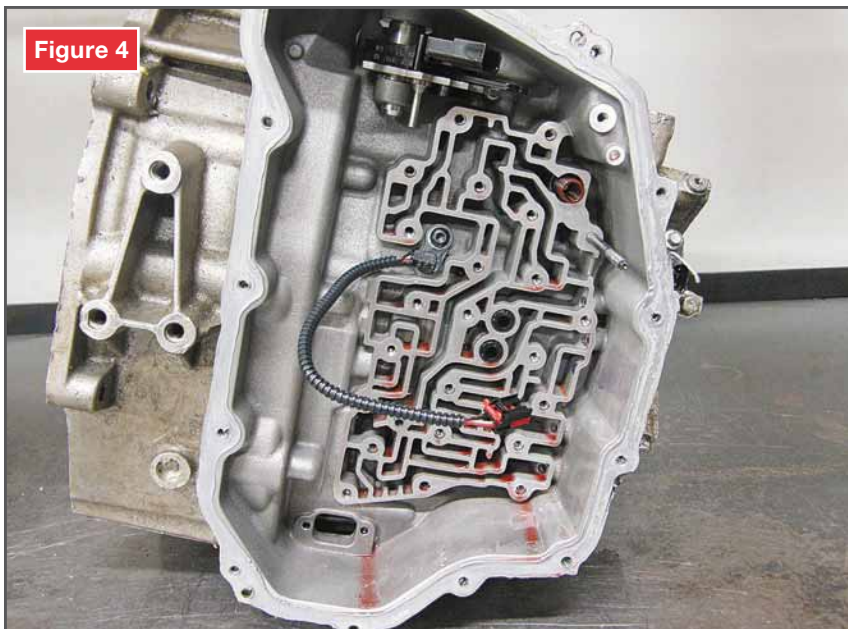
will develop harsh shifts followed by a default into fifth gear with code P0720 and/or P0722 set for OSS issues.

If the fluid is not burnt, the internal lead frame (Figure 3) or OSS (Figure 4) will need to be replaced. This lead frame has a Julian date on it with the first two digits indicating the year while the second three digits indicate the day of the year. Lead frames not to be used are 09184, 09185, 09186, 09229, 09230, 09234, 09235, 09236 and 09237. If the lead frame used has one of these numbers, it will need to be replaced with part No. 9L8Z-7G276-A. If it does not have these numbers, the OSS sensor will need to be replaced with part No. 9L8Z-7H103-A.

Another issue with these vehicles including the Milan fixable via reprogramming occurs after the customer used the Grade Assist option. While in Drive, there is a transmission control switch (location model dependant) that activates grade assist and cancels overdrive. This operation provides additional engine braking and extends lower gears operation for both uphill climbs and downhill grades.

There is apparently a problem using this option causing these DTC's to set: P072F, P073A, P073B OR P07A8, P07A9, P07AA, P0731 and P0732. Performing the reprogramming procedure per Ford's TSB 10-12-12 will remedy the complaint. *TL*

Figure 4



TECHNOLOGY

THE NUTS AND BOLTS
OF AUTOMOTIVE REPAIR

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THE TAKE AWAY

CODE DIAGNOSIS IS MUCH EASIER IF YOU TAKE THE TIME UPFRONT TO LEARN WHY THE ECM TURNED THE LIGHT ON.


 ↘ DRIVABILITY

Growing

Your Diagnostic Skills

This is the vacuum transducer and is used to control vacuum flow to the EGR valve. Notice there are three vacuum lines attached and one electrical solenoid.

EVERY TECH HAS TO START AT THE BEGINNING. HERE ARE TIPS TO HELP YOU MAKE THE TRANSITION FROM GENERAL REPAIR TO DRIVABILITY SPECIALIST.

BY **PETE MEIER** | TECHNICAL EDITOR

We all had to start somewhere. No one was born a drivability expert, though some are gifted with a natural talent for reasoning through even the most difficult of diagnostic challenges. I, for one, was not so gifted and had to work at developing my diagnostic techniques.

Don't be Afraid

In days gone by, carburetors dumped a poorly atomized air/fuel mix into a common chamber in the intake. From there, the hungry cylinders drew in the mixture through the intake valve (each cyl-

inder had only one) into the combustion chamber. A mechanical switch called "points" was used to interrupt the flow of current to the single ignition coil, and from there the secondary voltage was routed to each cylinder by a distributor rotor that was mechanically driven. The spark ignited the compressed mixture, and it exited through the exhaust valve. A single camshaft opened and closed all of the valves. Not a lot to it, but these early designs had one unique and common factor: They didn't need a computer to run.

But they weren't that good at utilizing the energy released during combustion

either. Today's engines are much more efficient, producing more power on less fuel than ever before. Computer controlled systems allow precise control of factors that impact efficiency. And often it's the word "computer" that scares techs away from drivability issues.

Don't be one of them. No matter how involved or complicated the technology might seem to be, it's still an internal combustion engine (ICE) that needs compression, ignition and fuel in just the right amounts and at just the right time to perform properly. Sure, there might be more complex ways of con-



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trolling it all, but with a little thought, a good service information (SI) source, and a bit of continuing education, you can learn to adapt with the change.

A Foundation To Build On

Before you can tackle a drivability problem, you first must have a solid core understanding of how an engine works. A computer is at the heart of the engine management system. If the computer controls only engine related functions, it's called an Engine Control Module (ECM); if it also controls transmission functions it's called a Powertrain Control Module (PCM). You might see these terms interchanged, especially in generic uses like this story you're reading.

The computer is not as smart as you might think it is. It has to be told what we want it to do and what is going on around it. These are the input sensors. Once it has the information, it can act only within the confines of its programming. If an input is confusing to the computer, the computer won't know what to do and might even start shutting things down in a panic.

The computer is so paranoid that it even monitors the outputs it commands to see if they did what they were told to do. Should the computer "see" something it doesn't like, it can't fix it itself. Instead, it turns on the Malfunction Indicator Lamp (MIL) so you can fix it.

Most cars on the road are fuel-injected. In these systems, the computer

opens and closes the injectors for a precisely calculated amount of time in order to deliver the exact quantity of fuel needed for the air drawn into the engine. Did you know that there

are two ways that calculation can be made? Diagnosing drivability complaints are approached differently depending on whether it is a speed density system or mass airflow one, and this kind of knowledge is exactly the kind you need to be successful in your diagnostic endeavors.

What about the ignition system? They all still use a spark plug, but can you identify what type of ignition system you're dealing with without looking it up? Do you understand how it functions? More foundational knowledge you need to know.

Think of it this way. Remember that game where you had two seemingly identical pictures in front of you? The object of the game is to find what is different in the second picture from the first, and the more you knew about that first picture the easier it was to find the differences, right?

Same thing. The more you understand how these systems work and interact, the easier it is to see when one isn't acting the way it should.

An Example Of The Process

In addition to a solid knowledge base of the engine and its operating systems, you need a solid process to keep you on track during your troubleshooting. Whether you're dealing with a Check

Engine light that is on or just a symptom with no codes, using the same basic process and making it a habit will keep you focused on the task at hand — finding the root cause of the problem.

Follow along with me as we tackle an older Chrysler with a simple "MIL is on" customer complaint. The same process applies to any diagnostic issue you will face. As you're reading the rest of this story, consider what steps you would have taken and why. And if you read something about a system or function that you don't understand, take the time to look it up for yourself in your SI system and seek the training you obviously need to improve your diagnostic skills.

Verifying the complaint on the Chrysler is the easy part. The MIL is obviously on and stays on long after the bulb check function has been completed. Connecting with a generic scan tool retrieves a code P0401 that, according to the SI, stands for "EGR (Exhaust Gas Recirculation) system failure". That definition is not quite enough, though, to begin our troubleshooting.

Remember, we are after the root cause of the failure and before I can find out what it is, I need to know why the ECM is logging the code. I do that by reading up on the code's enabling conditions and setting requirements (more typically referred to in the SI as "criteria"). There are two advantages to taking the time to study this information. First, it will help me gain a more thorough understanding of how the system works and why the ECM turned the MIL on and second, it will help me test in a way that mimics the ECM tests so I can be sure the MIL will stay off once the repair is made.

In the case of the Chrysler, the ECM will test the function of the EGR system when the engine temperature is above 180°F and the outside air temperature is above 40°F. In addition, the engine must be in closed loop (fuel control) and under a steady load with the throttle open. If the conditions are met, the ECM will momentarily close the EGR valve and look for a change of state in the oxygen sensor signal. If it sees no change or too much change, it will assume there is a problem and record the failed test.

Do you understand what EGR is and the basics of how these systems work? After reading this description, how would you proceed with your diagnosis?



(Left) This third line is also attached to the EGR valve, and feeds exhaust backpressure to the transducer. (Right) One way to tell if an EGR valve is open when it shouldn't be on some applications is to monitor the temperature of the feed tube during a cold engine start. If it heats quickly, odds are good that hot exhaust gasses are passing through it.

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The Picture Gets Some Detail

Not every OEM monitors their systems in the same way. By reading up on how Chrysler monitors this particular variant, I know now that the problem is related to the amount of EGR flow when the EGR system is supposed to be on; that is, during a steady state cruise. That could mean a failure of the EGR valve or a restriction to flow somewhere in the plumbing. Time to take a closer look at the hard parts that make up the system.

The 2.5-liter V6 in this Sebring uses a vacuum-operated EGR valve that attaches to the cylinder head on the front bank. An internal passage feeds



EGR passages typically clog right where the hot exhaust gasses meet the cooler intake air. A borescope can be used to see if there are deposits that need to be removed.



While there isn't excessive blockage of the port, there is plenty of build up in the intake itself. What would you recommend?



These deposits weren't the cause of this particular failure, but now would be a good time to clean it out to prevent another P0401 from happening in the foreseeable future.

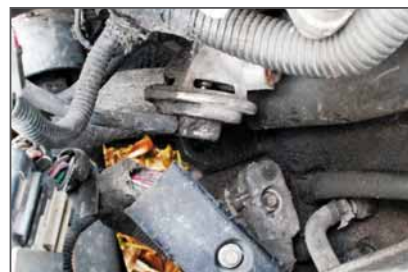
exhaust gasses to the valve, so excessive carbon build-up here might be a potential cause. The vacuum source has to be controlled some how to prevent the EGR valve from staying open all the time, so a closer look upstream uncovers a weird looking device that has three lines and two electrical wires attached to it.

This is the vacuum transducer. One line is the vacuum source from the engine's intake manifold and is connected to an electrical solenoid that opens and closes the vacuum path to the EGR valve's vacuum port. The solenoid must be turned OFF to open that path. A third vacuum line, though, runs from the base of the transducer to the base of the EGR valve. What does that do, and can that be a potential cause of the failure? Time to do a bit more reading.

Sometimes you won't have a full description of all the nuances of the system you are working on. Diagnostic flow charts can help fill in the gaps if you take the time to read them from that perspective. Reading over the troubleshooting steps for the Sebring added a bit more clarity as to how everything works. The third line is exhaust backpressure, feeding from the valve to the transducer. It operates a bleed valve internal to the transducer, and when there is no backpressure the bleed valve is open.

In order for EGR to flow when it should, then, there must be sufficient backpressure to the transducer to close the bleed valve and the ECM must turn the solenoid off. Vacuum is then free to move to the EGR valve itself, where it raises the stem off of its seat, allowing the burned remains to flow through a connecting pipe to the intake manifold at a point just past the throttle body assembly. Partial backpressure will limit the vacuum that reaches the valve and reduce the EGR feed to the intake.

This more complete understanding, however, only adds to the list of possible causes, doesn't it? The code can't tell if it's a matter of too much or too little flow, only that the flow of EGR is not what it should be. Our list of potential suspects includes damaged vacuum lines, a failed transducer, a failed EGR valve, and clogged passages at the very least.



The EGR valve is visible and half-coated with oil, as are the vacuum lines. Would a bad vacuum line cause this P0401?



The new valve came with a new transducer. Had we just "thrown parts" at this car, would we be sure that would actually fix the problem? Test, don't guess.

Another important step that often is overlooked is a search for Technical Service Bulletins (TSBs) that might apply to the problem. There is a bulletin related to the EGR system for this car, but it has to do with an EGR valve that sticks partially open. This causes intermittent misfires, a rough idle, even a hard start condition; depending on how much the valve is open.

There are additional online resources available that I routinely check as well. Sources like iATN and Identifix often can help point you in a diagnostic direction. Just don't fall prey to that easy practice of using these resources to find that "silver bullet" you need to fix the car. Always test to verify that the problems outlined and identified in these resources is the same as the one you're facing before you blindly apply the repair.

What Is Most Likely?

Diagnosing a drivability issue involves the whole car, and not just the system that logged the code. Now that we understand the system and what caused the code to set, it's time to do a little visual check of the car itself. It doesn't take long to see that there are several oil leaks and the lines attached to the transducer and EGR valve are in rough shape. The car also

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has some miles on it, so the possibility of a clogged EGR passage is going to move closer to the top of the probable list. There has been a lot of work, unrelated, done to the car over the past several months so odds are the car had a rough life before its present owner took over.

Based on what we know so far, wouldn't it be a logical first step to see if the EGR valve works? How would you do that and how would you know?

The valve is visible from under the hood, but not visible enough to see the pintle move with all the oil that is on it. Remember the TSB we found? It said that an EGR valve that was open at idle would cause the idle to be rough, maybe even stall the engine. That makes sense, doesn't it? The already burned gasses aren't going to burn again and the air charge at idle isn't that much so adding this dirty gas is going to make it harder for the engine to run.

Let's hook up a hand vacuum pump to the EGR's vacuum port with the engine idling and at normal operating temperature. Applying vacuum, I immediately noticed two things: one, the idle didn't change and two, the vacuum wouldn't hold. What does this test result tell you?

The lack of idle change could mean that the valve wasn't opening or that the passage leading from the valve to the intake manifold was clogged. The immediate vacuum loss, however, was the final piece of the puzzle. Inside the valve is a diaphragm that attaches to the valve's pintle. Vacuum applied above this diaphragm creates a pressure differential that causes the diaphragm to deflect towards the vacuum source, raising the pintle off of its seat. The immediate loss of vacuum is a pretty good sign that the diaphragm is damaged and not sealing, allowing the vacuum applied to bleed off to outside air. It's all we need to pull the trigger on the EGR valve as the cause of this P0401 code.

Time To Fix It

Not the car, you. If you found this too easy a problem to solve then you're not the guy I want to talk to. If you read this story, and found yourself asking, "What is he talking about?" anywhere along the line, I want to encourage you to pursue those answers. Spend time reading the "Theory and Operation" sections of your SI system, attend that next training session in your area, join us for our free web-based training, take advantage of the more than 100 videos we alone have produced and shared online in the AutoPro Workshop. The knowledge you need to move from general service to drivability specialist is out there. It's just waiting for you to take it. **TM**

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

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TECHNOLOGY

UNDERHOOD



PUMPS, JACKETS, AND HEAT EXCHANGERS

When you have the transmission out, you might as well yank the flywheel to have a look at the expansion plugs and rear main seal. This Caravan needed both.

THE QUALITY OF THE CHEMICALS USED HERE VARIES, BUT THE TREATMENT DOES NOT.

BY RICHARD MCCUISTIAN | CONTRIBUTING EDITOR

What we do in this business is keep America rolling by maintaining transportation resources, and our job is to repair or to prevent concerns. Without automobile technicians, everything that travels on the world's highways eventually would grind or rattle to a halt. Vehicles provide so much that we take for granted, including personal freedom. Imagine yourself without an operable set of wheels to get my point.

When it comes to maintaining those rides, a wise vehicle owner will recognize the axiom that a dime's worth of prevention is worth a hundred dollars worth of cure, and nowhere is that more pertinent than in the water jackets and heat exchangers of a car's powerplant. While most customers think regularly about their oil, coolant condition typically is forgotten until the temperature gauge swings too far

to the high side or rusty stuff begins to paint underhood parts and find its way to the pavement.

The challenge of educating customers is more demanding every year. Many owners are fairly savvy, but there are others I've encountered who don't even know what model year their vehicle is, let alone whether it has a four cylinder or a V6. They usually can tell me it's a Chevy, a Nissan or a Dodge, and that it's a pickup or a sedan, but very little beyond that.

The point is that if these folks don't know their vehicle any better than what I've just described, they aren't likely to understand the importance of cooling system maintenance until they've experienced steamy side-of-the-road trouble that leads to a large repair bill. Some of them simply wait until their car is exhibiting symptoms before having anything done, and that leads to disaster.



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The cooling system on my 2007 F150 calls for a 17.6-quart mix of the gold stuff and distilled water to be replaced at 100,000 miles. With the coolant flush machine my department owns, it was quite easy to shove new coolant in, displacing the old. That works if the system is clean, but without adding a flushing chemical, the machine doesn't do a good job on a system that's clouded with rust. On those, I shove a lot of water through before displacing that with coolant mix. On my own truck, replacing the coolant at 100,000 miles almost seemed wasteful, because the coolant I shoved out looked just as good as the coolant I was shoving in, but I did it anyway.

The clock had reached the change point and the coolant was original, so in obedience to Ford, I replaced it even though it looked fine. It keeps the cool-

Photos: Richard McCuistian

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ing system healthy. And it bears mention that a good machine is the right way to handle coolant exchanges, because the waste stuff should never be spilled on the ground. We keep our waste coolant in a big bumblebee tank a company pumps out when it's full.

Breaking Down

So why do some engines have nasty, rusty coolant at the prescribed coolant change interval and others look pristine? It's pretty simple, actually. Coolant gets tired and breaks down over time, but there are other factors, and at least one of them is plain old atmospheric oxygen. A good, tight cooling system can't ingest oxygen molecules every time the coolant expands and contracts and typically will be cleaner than a system with a bad pressure cap or some other atmospheric breach. If the cap has a dangling valve or bad rubber, I always replace it.

Then there's the electrolysis bomb, which comes from poor grounding, out-of-balance PH in the system, etc. You can detect electrolysis by measuring the voltage in the cooling system with a simple voltmeter. A few millivolts isn't a big deal, but when the numbers climb to more than a volt or two, things can get pretty dicey in there, and some vehicles seem more prone to it than others. Interestingly, there are radiator caps available with anodes like the ones used to protect aluminum boats against sea water electrolysis. The principle is that the anode sacrifices itself to protect the innards of the cooling system and prevents the engine's cooling jacket innards from melting away.

Coolant types abound, and because there are many articles talking about the different types, the only thing I'm going to say here is that some of them tend to break down sooner than others, and that when mixing water and coolant for top-off or replacement, the conscientious tech will use distilled water rather than tap water. In some cases, coolant mixed with tap water will become cloudy and contaminated sitting right there in the jug on your garage shelf. That being said, almost nobody I've ever personally known about uses anything except tap water.

If a system is awash with big rust flakes, the water pump seal is subject

to be shredded, so be careful to notice any staining if you can get a flashlight beam and an eyeball on the weep hole. The Front End Accessory Drive (belt and pulley system) is part of the cooling system too, so whenever you remove



Sometimes a simple peek under the radiator cap will be grounds for a flush job.

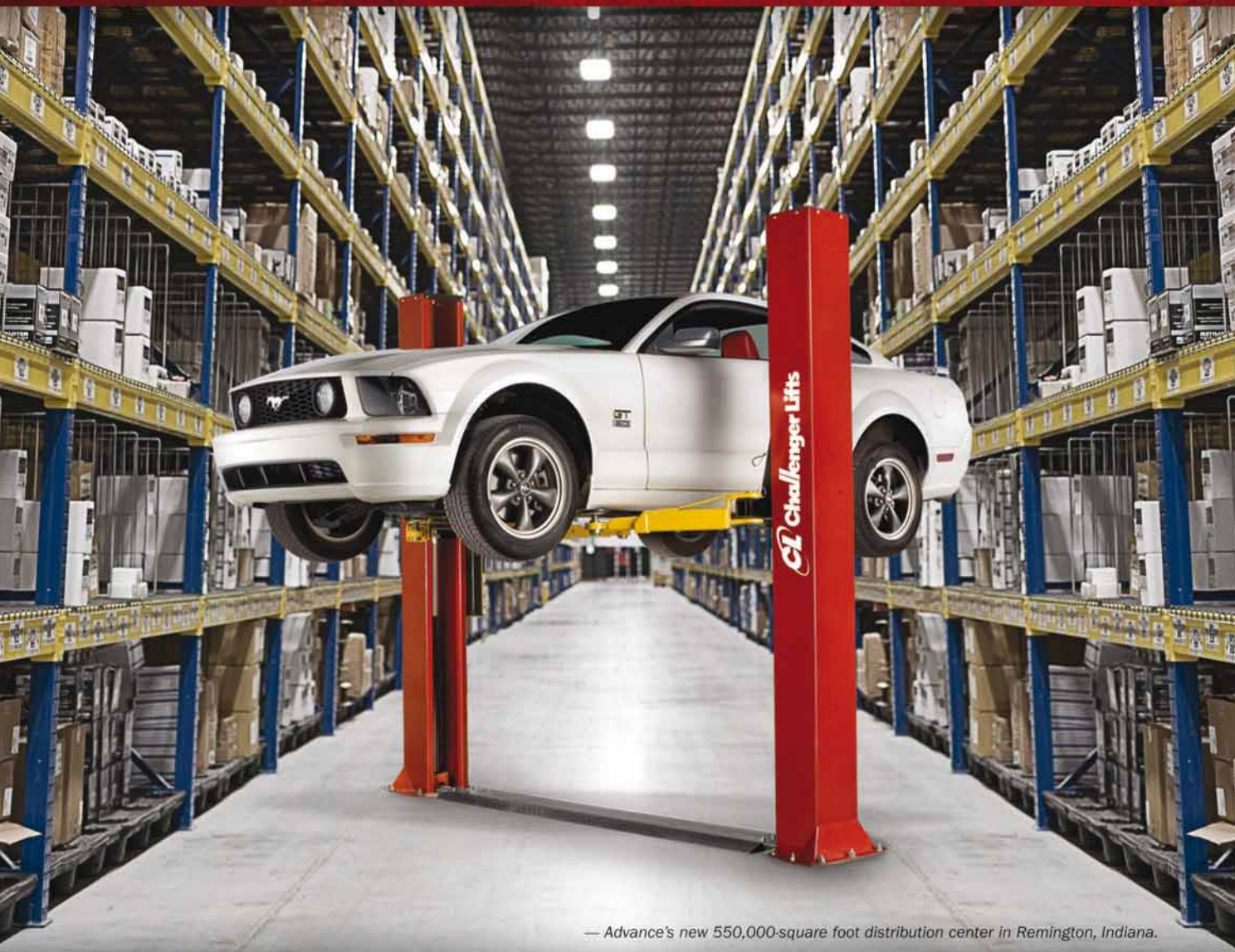


This is about as bad as it gets. This Toyota Camry drove up to the service bay having burst this particular hose only a few hundred yards up the road. The person driving the car decided on the fly to wheel in when the hose popped and steam erupted from the edges of the hood.



Telltale problems include a wet and rusty area, a stain on a spark plug wire, a swollen hose threatening to burst and a rotten coolant elbow, which usually leaks famously.

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the belt for any reason, feel the pump if you can (some pumps may be out of reach at this point since they're inside the timing cover and driven by the timing belt or chain) for loose or noisy bearings, not only on the water pump, but on the tensioner and idler pulleys.

Under the Hood

I've known of frozen and destroyed engine blocks on diesel tractors, and when the coolant melted and drained out the cracks, it was pretty and green. It's best to use a refractometer when checking the coolant; they don't lie, and they don't cost that much if you know where to buy them. Tooltopia.com is a good source.

Visuals are a big deal when it comes to cooling systems. The first visual would be a look at the gauge when the engine is as warm as it's going to get, that is, unless overheating is the issue. If it is, look around the engine compartment for rust or coolant stains, which can red-flag a leak. A cold running engine is not a healthy one, and that should be addressed quickly. Poor cabin heat can either mean the engine is low on coolant (and it won't always overheat in that case) or it can mean the engine

is indeed running too cold, which will usually toss a P0125 or a P0128 – the PCM likes for the engine to run in a particular temperature window.

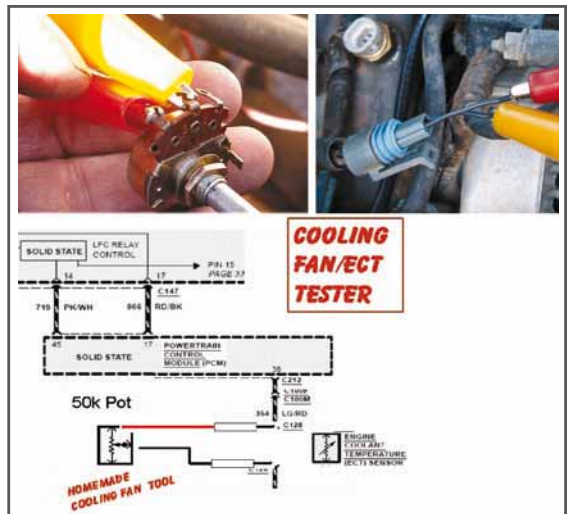
A cold running engine is practically without exception a thermostat issue, and on most cars thermostats are easy to replace. In many cases (certainly not all), you can replace the thermostat without draining the cooling system if it's near the top of the engine, but keep coolant off the belts to avert the squeal. In other cases the thermostat may be feeding the lower radiator hose, so do your homework before you yank the wrong housing.

Some of those gaskets are hard to come by on short notice and they just about always rip when the housing is removed. Also realize that if you replace the thermostat and the engine still wants to run cold (and I've been there), you might have to get two or three thermostats to get one that will work as designed. It would seem that the spring on some thermostats gets weak over time, because most of them look just fine when removed, even if the thermostat is the problem.

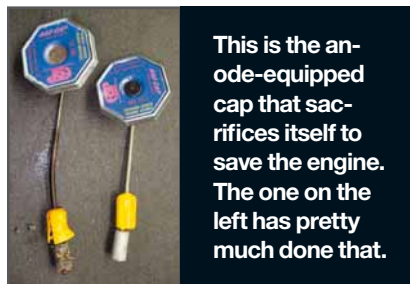
Service and Testing

Thermostats can be heated in a can of clear water with a temperature probe measuring the opening point, and while a stuck thermostat can be pegged that way, that method isn't always accurate on a thermostat that causes an engine to run too cold. I saw a Jeep Cherokee that was running about 120°, removed the thermostat, heated it in a pan and got the water to 200° before it opened. I put a new thermostat in that one and the coolant temp rose about 80°. I have no idea why it passed the coffee can test but failed in service. Thermostats are cheap anyway.

On a similar note, I was finishing up a routine vehicle inspection on a Ford Crown Victoria a few weeks ago and had the EASE Diagnostics Wireless Vehicle Interface connected to get some numbers on what the temp was



This tester is very cheap to build. You can connect it in place of a temperature sensor and dial in a reading that will cause the PCM to energize the cooling fan. Be aware, however, that some systems won't operate the fan unless the engine is running.



This is the anode-equipped cap that sacrifices itself to save the engine. The one on the left has pretty much done that.



Sometimes the thermostat comes apart like this one did, but usually the spring loses some of its tension and starts opening at a lower temperature.

(it looked to be running a bit cold on the gauge), and I saw a disappointing 160°F. Shutting the engine off, it took me about five minutes to throw a thermostat in that one (I had one in stock for a Victoria), and started the engine again. This time the big yellow numbers on my computer screen climbed from 160° to a comfy 210°. Problem solved in record time, but you couldn't look at the thermostat and tell there was anything wrong with it.

Next, a glance at the coolant bottle (whether it's a surge tank or a pressure capsule) is in order to see if the coolant is on the full mark. Then squeeze of the top radiator hose is in order to see if there is pressure on the cooling system and remove the cap. I kind of like looking directly into the radiator, but on cooling systems that have a pressure bottle only, peering into that chamber is all you've got. If that plastic reservoir is heavily stained on the inside and you can't see the level, I flush the cooling system and replace it (usually about \$50).

Hoses seem to last longer these days than they ever did in the 1970s, but if oil has been leaking on a rubber hose for very long, it already has been compromised and shouldn't be ignored. Sometimes a hose will have rotted from the inside out right near a metal connection point, but you can

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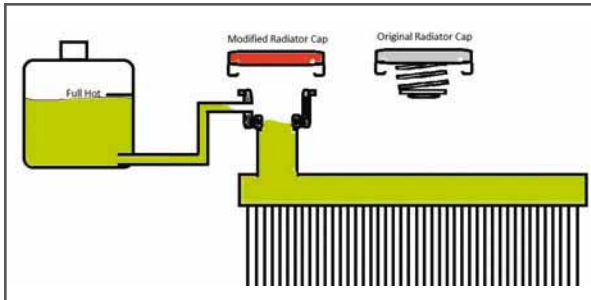
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This is a graphic explaining my home-made coolant burp tool. It's cheap, easy to make and safe to use, but only suitable for vehicles with a cap on the radiator and a light duty surge tank like this.

feel that while pinching the hose if you have knowing fingers. When replacing a hose, its good practice to clean the calcium crud off the neck where the hose will be clamped, else that bumpy stuff might cause a leak.

Then there are those plastic tees and elbows that either connect heater hoses or bend from the intake down into the water pump or timing cover, and those can fail without warning. They don't cost much, and they should always be replaced if either connecting part is serviced. Plastic/aluminum radiators should be replaced at about 150,000 miles for the same reason.

There also are the funky spring clamps on radiator and heater hoses. I like the way they keep things looking factory, but if one is in a tough place to access, or really old, I'll usually replace them with regular worm type clamps. I've seen metal fatigue cause spring clamps to break without warning but with obvious consequences.

The Fill

One of the most consistent lessons I have to hammer home to my new students is that filling a cooling sys-

tem isn't like pouring water in a bottle or a bucket. If there are bleeders, you should do research to find out where they are, and manufacturer filling instructions should be followed to the letter using the right kind of coolant. I tend to fire up a scan tool or my wireless interface so as to watch the coolant numbers in real time during the warm-up, and you can tell

when the thermostat opens because the coolant temperature will take a shallow dive when it finally happens. Proper follow-up during a fill takes 20 to 30 minutes.

I like to hear the electric fan kick off and on four times if it has one (some cars don't energize it until nearly 230°, so do your homework on that, too). Turn on the heater and keep watch for warm air there, but make sure you don't choose a setting that brings the A/C online or the condenser fan will run all the time and mask potential problems. The fan should cut on and off; if it stays engaged and doesn't shut off and the engine temperature continues to rise, there are problems. If the heater was working before but it's not now, the system either is airbound or the water pump isn't working right, particularly if the heater hoses are cooler than they should be.

Getting all of the air out of some systems can be a challenge. I have an Air Lift® vacuum filler tool for those more stubborn cooling systems and another homemade tool I use on systems with a radiator cap and surge bottle that works very well. It's a cap with the



Every so often one like this will come from the parts store, and I always reject it and send it back for a replacement. Some thermostat factory reps say caps with this dangly valve are designed this way to relieve system pressure, but if that's the case I have two questions. First, why doesn't every cap with the same part number have a dangly valve? Second, why have I never seen a dangly valve on an OEM cap?

spring and lower seal removed. It seals around the top of the radiator neck but allows coolant to come and go from the surge bottle unchecked.

With the radiator as full as I can get it and the surge bottle tanked up to the Full mark, I fire up the engine, and my modified cap allows the cooling system to shove any air it's burping into the plastic surge tank and then drink any coolant it needs from there as well. You have to keep coolant in the tank all the time and make sure the thermostat is wide open before you remove the cap to verify the radiator coolant level, and install a new cap.

There are three obvious benefits to this method. First, the tool is practically free. Second, the system isn't puking coolant all over the floor while you're finishing the fill process with the engine running. Third, there's a safety benefit in that there is no pressure on the system when you finally decide to remove the modified cap and replace it with the new one. **ZZ**

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Comparing the ECT reading to the IAT reading after an overnight cold soak is a good way to find an out-of-range sensor. The one that matches ambient temperature is the one that's telling the truth.



Richard McCuistian is an ASE-certified Master Auto Technician and was a professional mechanic for more than 25 years. Richard is now an auto mechanics instructor at LBW Community College/MacArthur Campus in Opp, Ala.

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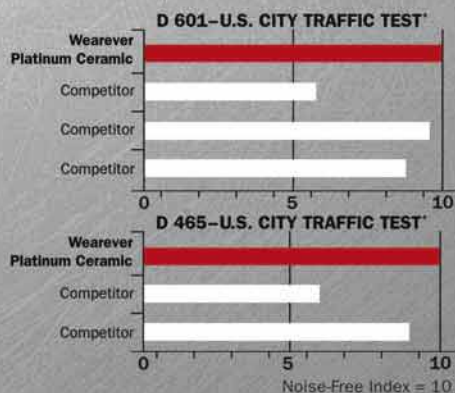


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Another frontier

As opposed to an IR thermometer, a TIC gives a view of the entire thermal context of a component and its surroundings.

THERMAL IMAGING TECHNOLOGY COULD ADD A NEW DIMENSION TO AUTOMOTIVE DIAGNOSTICS.

BY TONY MARTIN | CONTRIBUTING EDITOR

Every once in awhile, a diagnostic technique that is well established in other sectors of industry will take hold in the automotive world. Case in point: The digital storage oscilloscope (DSO) had been around for many years before being pressed into service as an automotive diagnostic tool.

And what a difference it made.

While a digital multimeter (DMM) could do basic measurement of an electrical signal, it could not touch the insight that a DSO provides. Now, many technicians use a DSO as their first line of defense when performing electrical diagnostics.

We might be on the cusp of a similar revolution in automotive temperature measurement. For years, technicians have been using contact probes and infrared (IR) thermometers to help them diag-

nose drivability and HVAC issues. Like the DMM, these tools provide basic information but don't give a comprehensive view of the environment. What if we could see an entire temperature context, similar to the way that a DSO expands our understanding of an electrical signal?

The thermal imaging camera (TIC) can do exactly that. TICs have been in use in industrial applications for many years, but were hampered initially by high cost and a steep learning curve for the operator. However, times have changed and there are now user-friendly units available for not much more than what you would spend on a scan tool.

It is quite possible that your shop could put this technology to work, potentially lowering your diagnostic times and increasing your technician productivity.



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Applications

Many industries already are benefiting from thermal imaging technology. An excellent example is industrial maintenance in 24/7 operations such as oil refineries and chemical plants. In the industrial world, downtime of any kind can be extremely expensive, so an emphasis is placed on predictive maintenance. This means catching failures before they happen and scheduling repairs in such a way that production isn't interrupted.

Thermal imaging is highly suited for industrial applications because it doesn't require direct contact with the objects being inspected. More often than not, a machine either can't be shut down or is difficult to reach. While the plant is in operation, technicians use thermal imaging cameras to take pictures of the various

Photo: Tony Martin



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machines and electrical distribution hardware. These images then are analyzed carefully, looking for signs of an imminent failure. Typically, “hot spots” are signs of trouble, such as a circuit breaker in an electrical panel that has developed some resistance and now is running at a higher temperature than normal. This would show up clearly in a thermal image, where the faulty breaker would be portrayed in a different (warmer) color from the surrounding components.

Thermal imaging technology is making its way into the world of automotive safety systems. Higher-end vehicles are coming equipped with night-vision capabilities that are based on thermal imaging technology. A supplemental display on the instrument panel shows an infrared image of the driver’s view of the road ahead, making poorly illuminated pedestrians and animals more visible.

For the most part, the manufacturers of thermal imaging cameras have focused their energy on heavy industry and building maintenance applications. However, there are markets such as automotive diagnostics that are essentially untapped but have become more viable now that TICs are much less expensive.

Read more
using an infrared gun
to tell when a thermostat
opens & the ECT
sensor’s accuracy
[MotorAge.com/
temptroubleshoot](http://MotorAge.com/temptroubleshoot)

How it Works

Infrared light is electromagnetic radiation that is invisible to the naked eye, lying on the spectrum between visible light and radio waves. All objects emit infrared radiation, which is proportional to the temperature on the object’s surface. Infrared (IR) thermometers and TICs both use IR detectors to measure the infrared energy being emitted from an object.

An IR thermometer determines the average temperature of a small area and displays the results on a digital readout. In contrast, a TIC will capture an image and paint it with a palette, assigning colors to the various temperatures it detects. The processed image is then shown on the instrument’s display, giving the technician a view of the thermal context of the area being inspected. As you can imagine, the level of information provided by a TIC can make it much easier to identify trouble spots or anomalies.

An advantage that a TIC has over an IR thermometer is that the TIC is able to record whatever shows on the display on an internal memory card.

These images then can be uploaded to a personal computer for use in reports, emails to customers, etc.

Another difference between a TIC and an IR thermometer is that many TICs have a lens with a manual focus adjustment. The performance of the pixels in the camera’s IR detector is highly dependent on correct focus, which directs the infrared energy on to the pixels. Higher-end TICs might have infinite focus imaging as an ease-of-use feature. Regardless, the technician should be aware that the camera’s infrared detector is not invincible. To prevent permanent damage to your TIC, never point it at the sun or at arc welding processes.

Camera Features

Thermal imaging cameras start at around \$1,000 and work their way up. The main difference between the least expensive units and ones that cost several thousand dollars is resolution. Similar to the megapixel rating of a digital camera, a higher resolution produces better images at greater distances. Also, more expensive units typically have a higher thermal sensitivity, which is the ability to recognize small differences in temperature.

Advanced models may also have a built-in digital camera that can

EMISSIVITY AND THERMAL IMAGING

The ability of an object to emit infrared energy is known as emissivity. Emissivity of an object depends on its surface finish and the materials it is made from. Generally speaking, reflective metallic surfaces emit infrared poorly, where rough or oxidized metallic surfaces do much better. This has a direct impact on thermal imaging, because the temperature accuracy of the camera is dependent on the object’s emissivity value. An object with a low emissivity value can fool the camera into estimating its temperature much lower than it actually is.

Emissivity of a material is rated on a scale from 0 to 1. A surface that is painted flat black would have excellent emissivity and is rated close to 1. Polished copper, on the other hand, is rated at 0.03, indicating that it has very low emissivity. Good thermal imaging

cameras can be adjusted to compensate for low emissivity, which increases the accuracy of its temperature measurement on that object.

The emissivity issue needs to be kept in perspective. According to Lou Bellock, director of Product Management for General Tools & Instruments, “The best guide for considering emissivity is a user’s common sense. If a person understands the concept that flat black, non-reflective surfaces are best for accuracy and that bright, reflective metallic surfaces are worst for accuracy; that’s probably 80 percent of the battle.”

In cases where greater accuracy is required, the technician can use either black tape to cover a small area of a low-emissivity object or paint a section with flat black paint.



Thermal imaging cameras have been used extensively in building and industrial maintenance applications. Automotive diagnostics may be the next frontier for this technology.

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take regular pictures simultaneously with the thermal image. Having both images available for viewing can help immensely with identifying the specific objects in the thermal image.

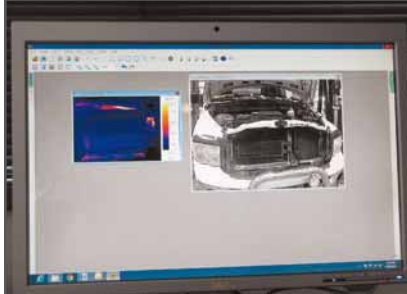
The camera manufacturer most likely will supply reporting software with the TIC. This will make it easier to review



A thermal imaging camera can be purchased for as little as \$1,000. More expensive models will have better resolution and temperature accuracy, as well as features such as built-in digital cameras and voice annotation.



Thermal imaging cameras use memory cards such as these, which can be removed for uploading images to a personal computer.



TICs often have reporting software included in the kit. This can help organize your images and integrate them into reports.

the images that you've captured and prepare reports on your findings. In the automotive world, this could turn into an excellent supplement to your repair order and final billing to your customer. Imagine how professional this could look to your customers, especially if you are justifying extra diagnostic time.

You should be able to get a TIC that will do most of what you need it to do for less than \$3,000. If you have more money to spend, there are numerous other features available that can increase performance and add functionality to your TIC. Shop carefully, however, because many of these high-end options offer limited increases in overall performance for automotive applications.

Automotive Diagnostics

One of the decisions you must make when you first set up your TIC for automotive diagnostics is what palette will you use to illustrate your thermal images? A thermal imager typically will give the user a choice of a number of palettes, which are the range of colors used to represent the temperatures in the camera view.

Regarding the question on which palette is most effective for automotive diagnostics, Lou Bellock of General Tools & Instruments states, "This is purely personal preference. Application independent, I prefer to see hot items light (white or red) and cold items dark (blue or purple). Therefore, my preference is Feather, which is basically simple rainbow colors." This is an area where you will want to experiment to determine what works for you. In some situations, you may even decide that a gray (monochrome) display is best.

The actual temperature of an object will most often be less important than how it compares to a known good component operating under similar conditions. For years, we have heard from oscilloscope users that you have to know what a good waveform looks like before you can identify a bad one. It is no different with thermal imaging; the more "camera time" you spend on vehicles that are operating correctly, the easier it will be for you to pinpoint malfunctions on a problem vehicle.

An example of where the comparison strategy might work is in the case of a noisy axle bearing. In some vehicles, it

is a lot of work to replace an axle bearing, and the bearings themselves can be expensive. It also can be a challenge to know for sure which side is causing the problem. In this situation, try taking the vehicle for a robust test drive, then use a TIC to compare the temperatures of the bearing housings. If one side is hotter than the other, you've likely found your bad bearing. And don't forget to record your images for inclusion in your customer report.

You might be able to locate a misfiring cylinder by checking temperatures across an exhaust manifold while the engine is running. On a diesel, start the engine cold and watch carefully for cooler sections of the manifold as the engine warms up. Catalytic converter operation also can be confirmed, provided you are able to view the catalyst housing itself and not the heat shield. If the housing is still shiny (not corroded), try spraying a 3-inch wide stripe of flat black high-temperature paint over the length of the converter to increase the temperature accuracy of the TIC.

HVAC diagnosis could get easier if the technician has a thermal imager at their disposal. Think about a restricted refrigerant line, and how much easier it would be to identify one if you could view the temperatures along the entire length of the line. This same dynamic

THERMAL IMAGING TIPS & TRICKS

There are some important rules of thumb to keep in mind when using a thermal imaging camera.

1. Focus carefully. As mentioned earlier, the IR detector in the camera will provide inaccurate information with an out-of-focus image.
2. Always try to take measurements at right angles (90°) to the object. This might be a tall order in certain situations, but at least make the attempt.
3. Get as close to the object as possible. This puts more pixels of the IR detector into service on the object you are viewing, which provides a better view of the temperature variations across the object.
4. Centering the object in the display also enhances thermal accuracy.



Flat black high-temperature paint can be applied to components to improve temperature accuracy of a thermal imaging camera.

measuring voltage drops. This still is the most reliable way to go about this, but what about looking for temperature increases at the connections using a thermal imaging camera?

While this strategy won't work with low-current circuits, it could work very well on heavier loads such as blower motors, seat heating elements, and rear window defrosters. This would include an inspection of the vehicle fuse boxes and power distribution center, where poor contacts in a relay could cause a temperature increase of the relay housing. Actual temperature would be far less important than just knowing that the specific connection is much warmer than the ones around it.

about how to utilize this technique, so this could be a great opportunity to do some pioneering.

If you happen to purchase a TIC and start using it for automotive diagnostics, consider sharing what you've learned via iATN or similar forums. Sharing of ideas can help us all get better at what we do and will also encourage further innovation. In the end, you and your customers will benefit as we all strive to improve the professional image of the automotive repair industry. *TZ*

would apply to a condenser, or anywhere else in the A/C system where a pressure drop is taking place.

Electrical resistance generates heat. Knowing this, how could a TIC be used to identify poor connections in electrical circuits? For many years, technicians have looked for unwanted resistance in live electrical circuits by

Carry On, Then!

For the most part, the book has yet to be written on the use of thermal imaging cameras for automotive diagnostics. Thermal imaging has great potential, not only for helping techs become better diagnosticians, but also for enhancing their professional image. There is much to be learned



TONY MARTIN
CONTRIBUTING
EDITOR

Tony Martin is an associate professor of Automotive Technology at the University of Alaska Southeast in Juneau, Alaska. He holds Canadian Interprovincial status as a Heavy-Duty Equipment Mechanic. He also holds 18 ASE certifications, including CMAT, CMTT, L1 and L2.

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COOPERATION MAKES IT HAPPEN

THE WAY SYSTEMS WORK TOGETHER MAKES OUR JOBS EASIER OR HARDER.

BY JERRY "G" TRUGLIA | CONTRIBUTING EDITOR

In this month's column, we take a look at suspension dos and don'ts, offer tips on running stubborn monitors and share a lesson learned by one of our TST members.

Uncooperative Monitors

As a professional, you understand that the last step in any repair is to verify the success of that repair. Diagnosing and repairing a Check Engine Light complaint also might involve rerunning all the system monitors to make sure a secondary problem, temporarily covered up by the first, isn't hiding in the wings waiting to bite you on your backside. You dutifully follow the OEM procedures for running a total drive cycle, but when you return to the shop, you find that some of the computer monitors have not completed their testing. Here are a few things to check to help you get those stubborn monitors to complete.

First, are any new Diagnostic Trouble Codes (DTCs) stored or pending Freeze Frame? If so, they might be suspending testing on other systems. That is what you wanted to find out, right? Repair as needed and perform another complete drive cycle.

Second, are all the conditions needed to run the incomplete monitors met? That includes commonly overlooked things like the amount of fuel in the



Nothing beats using the right tool for the job.

tank, battery/system voltage levels, the ambient air temperature and engine operating temperature. On some models, you might need to ensure that the crankshaft relearn has been successfully completed and that the required cold soak time has been met. All of the information telling you what conditions are needed can be found in your service information system.

When beginning your generic drive cycle test drive, make sure that the engine has not been started for eight hours, followed by an engine that is warmed up to normal operating temperature before driving. Get in at least 10 continuous minutes of highway speed driving and 20 minutes of stop-and-go city driving, with at least four idle stops that are two minutes each. Be sure that you don't turn off the key at any time or you will have to start over again. Once completed, make sure you turn of the

engine and wait two minutes before turning the key back on to check the monitor status.

There are tools on the market that connect to the Diagnostic Link Connector (DLC) and provide a visual indication that the monitors have completed that also might prove helpful. Some monitors, like the EVAP monitor, might be able to be completed with the car sitting in the bay using an appropriate scan tool.

Firing kV Diagnosis

TST member Alex Portillo was dealing with a misfire on a Toyota Rav4 and used a new tool to check the ignition output of the Coil On Plug (COP) ignition system non-intrusively. The General Technologies TA500 tester uses a probe tip, so if you can reach the coil you can check it.

He found one coil that was firing at a lower voltage than the others. Now the

Photos: Pete Meier; Alex Portillo

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Peened edges or retaining clips aren't designed to make up for sloppy fits.

question becomes, "Why?" The tool measured a peak firing voltage of 6.9 kilovolts (6,900 volts) and a burn time across the plug gap of 2.30 milliseconds on the low cylinder. The other cylinders recorded firing voltages more in the range of 11.7 kilovolts (11,700 volts) and shorter burn times of 1.8 milliseconds.

If we were looking at this information on a scope, the firing line on the weak cylinder would be lower but the burn line would be longer than all the others.



Measuring firing demand and burn time can tell you about more than just the health of the ignition system.



Head gasket leaks can be slow, or occur only after the engine has reached operating temperature. Don't rely on visual signs alone.

It helps to think of the entire pattern as a length of rope. A good coil will produce a certain amount of energy, and if the firing demand is higher than it should be there is less left over to sustain the spark. The same is true in reverse. If the firing demand, for some reason, is lower than there is more energy left to maintain the burn time.

At first, Portillo suspected a weak coil. Had that been true, odds are the burn time recorded would have been the same or even less than the companion cylinders. What else impacts firing time?

The spark plug gap, the fuel molecules in the gap, and the amount of pressure the gap is working in.

A rich mixture might cause the readings Portillo saw, as would a cylinder with low compression. He decided to test the compression next and did, indeed, find that the cylinder was low. A wet compression test (one where a small amount of oil is added to the cylinder before testing) increased the pressure and pointed to a problem with ring seal. A follow-up test with an exhaust gas analyzer led to the discovery of a small leak in the cylinder head gasket, allowing just enough coolant in to wash the cylinders down and lower compression but not enough to provide a visual clue in the engine oil.

Good diagnostic tools are wonderful to have at hand when looking for any drivability problem, but they aren't worth a dime if the user doesn't understand what they are trying to say. When you invest in a new tool, be sure to use it on several "known good" cars so when the time comes, you'll know what "known bad" looks like.

Suspension No-no


Ever watch in disbelief as a tech bangs away at a ball joint with a huge mini-sledge hammer? I guess I could understand somewhat if he's taking the ball joint out, but installing it that way?

Here's the scene. The new ball joint is being held in place on top of a floor jack with only minimal pressure keeping it aligned with the hole in the lower control arm. Then the tech applies additional pressure using the floor jack, waiting for the lower control arm to start to compress against the spring. With the ball joint pressurized, the tech then wails on the lower control arm to force the new ball joint in place.

Many ball joints are press-fit into their mating control arms and driving them in even a bit out of alignment can reduce the interference tolerance they need to stay put. Some are located with a circlip retaining ring, and others require you to peen the edges after installation. But do you think that is enough to keep them in place when that interference fit is lost?

Rather than install ball joints cave-man-style, invest in the tooling to do the job correctly. Nearly every tool truck offers ball joint service tools and they all make the job of removing and installing a lot easier. And if you run across one that has lost that interference fit, be sure to replace the control arm at the same time to insure a professional repair.

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G. Jerry Truglia, president of Technicians Service Training, has been in the auto repair business for a long time as a tech, shop owner and nationally recognized trainer/author. He founded TST to bring affordable training to his fellow techs and shop owners.

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OVERLOOKING THE OBVIOUS

THE PARTS THAT KEEP THE RUBBER ON THE ROAD SHOULD NOT BE TREATED CASUALLY.

BY **ALBIN MOORE** | CONTRIBUTING EDITOR

A vehicle's suspension has a very important job, yet many times it's overlooked. Most of the work that comes to my shop is drivability work, and this makes the problem of missing steering/suspension work even worse, because I tend to get lazy and want to concentrate only on the drivability side of the business.

When I stop and think about different systems on a vehicle, though, I realize that the brake system is the most important (because the brakes

are the only way of getting the thing to stop), with the steering and suspension system running a very close second. Problems in these systems can cause a vehicle to become very unsafe to operate on the public roads.

Thinking about a vehicle steering/suspension system, we must start where the tires contact the road. If this tire-to-road contact is not correct, then the ride quality suffers and the vehicle is hard to control. The tires are a very important part in the suspension system, needed to absorb road shock and soften the vehicle ride.

Just as important are the parts used to keep the tires located in place while allowing them to move and steer the vehicle. Ball joints, tie-rod ends, shock absorbers, struts, springs and a few other things work together not only to soften the ride but also to keep the front and rear suspension tracking straight and true under the car. Don't forget about the rear of the car. It also is a very important part of the steering/suspension system, because the rear wheels must run straight and true or the vehicle will not handle properly and fuel economy will suffer.

While we are talking about suspension, we should not forget about the importance of the shock absorbers.

Their job is to not only smooth the bounce from the vehicle and make the ride comfortable for the occupants, but they also have a very important role in keeping the tires in proper contact with the road surface. Shock absorbers that are not doing their job will let the tires bounce from the road surface. When this happens, the tires will wear rapidly, and the vehicle can become very difficult to control, especially at higher road speeds and on crooked roads with rough pavement.

Every time a vehicle is in for any sort of service, a quick suspension check should be performed. The inspection starts as the technician is walking through the parking lot on his or her way to bring the vehicle to the bay. From a distance, it is easy to see worn tires and front wheels that do not stand straight. Many times, squeaks can be heard while the car is rocked as you



FRONT CLUNK

2006 GMC K1500 SIERRA

Vehicle Year/Make/Model

5.3 LITER

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Mileage

CLUNK IN THE FRONT SUSPENSION WHEN TURNING TO THE LEFT

Vehicle complaint



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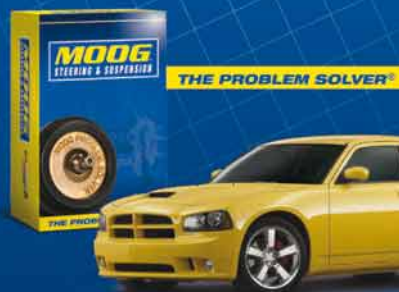
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open the door and sit down in the driver's seat. Listen for squeaks as you turn the steering wheel. Vehicles that are driven in salt brine will get salt water in both the ball joints and tie rod ends. This forms rust in places that eyes cannot see, and rusty ball joints or tie rod ends can emit some strange noises as they are being flexed.

Before you move the vehicle, turn the steering wheel from the left lock to the right lock and back a few times. Many times binding steering or weak power steering pumps can be found this way if the steering wheel is gently turned while the engine is at an idle. A quick test drive over some uneven pavement is also a great way to see if the shock absorbers are doing their job.

Before the vehicle is lifted on the hoist, have someone gently rock the steering wheel side to side while you watch the tie rod ends and idlers for any unwanted movement. Once the vehicle is on the hoist it is easy to do a thorough visual inspection. From under the vehicle, it is easy to see if any of the shock absorbers are dented, leaking or lose. How about the boots around the ball joints and tie rod ends, are any of those cracked or broken? How about the sway bar mounts and connecting links? Worn bushings and loose or missing parts can cause rattles and poor handling.

When lubricating suspension joints, always wipe the dirt and grease from the grease fitting. You do lubricate the fittings, don't you? If this grit and grease is left on the grease fitting, dirt will be forced into the suspension joint, which will reduce the useful life of the joint. This debris can also clog the grease fitting, making it nearly impossible to lube the joint at all.

Tire inspections also are a great way to detect suspension and alignment problems. By running your hands over the tires, a technician can feel for things like tire cupping, feather edges on the tire tread, along with lumps and hot spots on the tires. All of these things are indicators of either tire problems or alignment problems that are hiding where we can't see them with our eyes.

Become the Tire Whisperer

Reading the tire wear with your hands will tell the technician a lot about the vehicle alignment. As long as the tires are running down the road straight



As road salt intrudes a suspension part, the grease is displaced with the salt brine. This causes the parts to rust from the inside. Watching for the brown rust around the ball joint boots is an easy way to spot trouble.



Sway bar bushings and connector links are a great place for rattles to occur. Use a pry-bar to move the sway bar up and down and look for any movement in the bushings. Watch closely for worn bushings in the connector links.



Caked grease on grease fittings is a great way to shorten the life of the suspension component. Always remove the dirt and dried grease from the grease fittings to keep the dirt out of the component being lubricated

and the tire load is evenly distributed across the tire, the tire tread will feel smooth to the touch. If the tire is being pushed sideways down the road (misaligned toe angle), the tire tread will have a feather edge along either the inside or the outside edges of each of the tire treads. Feeling the inside and outside tread ribs might locate feather edges that run crosswise of the tire. Most times this wear pattern will be caused by a camber angle that is incorrectly adjusted. In this case, the tire-rotating axis is not parallel with



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NOTE BROKEN SWAY BAR LINK



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Buick Allure 08-05; Century 05-97; LaCrosse 08-05; Regal 04-97; Rendezvous 07-02; Terraza 06-05; Chevrolet Impala 11-00; Monte Carlo 07-00; Uplander 06-05; Venture 05-97; Oldsmobile Intrigue 02-98; Silhouette 04-97; Pontiac Aztek 05-01; Grand Prix 03-97	K700527
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Chevrolet Express 1500 02-96; Express 2500 02-96; Express 3500 02-96; Chrysler Neon 02-00; Dodge Neon 05-00; SX 2.0 05-03; Ford Crown Victoria 11-92; Mustang 04-94; GMC G3500 96; Savana 1500 02-96; Savana 2500 02-96; Savana 3500 02-96; Lincoln Town Car 11	K700537
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Ford Explorer 05-02; Lincoln Aviator 05-03; Mercury Mountaineer 05-02	K700540
Ford Taurus 07-86; Lincoln Continental 91-84; Mark VII 92-84; Mercury Sable 05-86	K700541
Dodge Ram 1500 01-94; Ram 2500 02-94; Ram 3500 02-94; Ford Explorer 10-95; Explorer Sport Trac 10-01; Ranger 11-98; Mazda B2300 08-01; B2500 01-98; B3000 07-98; B4000 08-98; Mercury Mountaineer 10-97	K700542

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Front tire mismatch. All four tires are the same brand and the same model, but the right front was a different sub model. The tread pattern on the two front tires are close, but different. There is a complaint of a slight pull to the right. Examining both front tires found the inner tread of each tire is wearing faster than the center of the tire. There also is a slight feather edge running across the inner tread band of each tire giving the indication of a camber problem.



Testing the ball joint movement using a dial indicator. On this vehicle, the suspension is supported with a jack stand, the dial indicator fastened so the ball joint can be pried up and down while monitoring the slack in the ball joint. Each of the lower ball joints had wear of .020 inch more than the maximum wear limit listed in service information.

the road, and the inside of the tire is being pushed down the road while the center of the tire is rolling nice and smooth.

This always calls for more system analysis. Depending on the type of suspension, the cause could be sagging springs, worn ball joints, something being bent in the suspension system or all of the above. Most of these kinds of problems can be easily found without the need of an alignment machine.

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Adjusting the alignment with worn parts does not fix the real problem; it will only cover up the existing problem.

Dealing With a Clunk

This nice looking 2006 GMC crew cab truck has a complaint of a light clunk in the front suspension when turning corners to the left. On the test drive, we noticed a slight pull to the right, felt the shock absorbers were doing a good job of preventing vehicle sway and smoothing out the bumps in the road and heard a very slight clunk noise when making a left turn while hitting a slight bump in the pavement. Back in the shop, a fellow tech rocked the steering wheel left and right while I watched for any sideways movement in the tie rod ends but none was found. We raised the vehicle on a hoist and inspected the front and rear suspensions. We found no problems with the front sway bar system, and all brake calipers are fastened properly.

An inspection of the shock absorbers did not show anything loose or leaking. We inspected the front tires and found a slight feather edge on the inner tire tread ring. This wear pattern points to a camber problem, which worn lower ball joints can cause. The front tires have a different tread pattern, and although both tires are the same manufacturer and make, the model of tire is different.

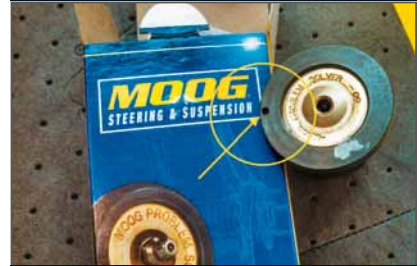
Shaking the front wheels found no noticeable movement in the tie rod ends or the idler arms but more inspection is needed, since just shaking the front wheels will not find ball joints that are worn beyond their wear limit. We'll need to unload them first before we can measure their play and see if they are getting to an unsafe condition.

To do that on this vehicle design (verified by looking up the inspection procedure in our service information system), a floor jack was placed under each lower control arm and a dial indicator was used to measure the wear on the lower ball joints. By comparing this measurement with the ball joint specifications found in service information, I found that both lower ball joints were worn more than .020-inch over the wear limit.

Compiling the test data brought me to the conclusion that the excessive wear in the lower ball joints is the reason for both the "clunk" when turning and the feather edging on the inside of the front tires. The mismatch of the two front



This shows us pressing a lower ball joint into the lower control arm.



Always pay attention to the installation instruction supplied with the part. The little hole in the rim of the ball joint is very important.

tires is the reason for the slight pull to the right when driving. This light truck will need to have the upper and lower ball joints replaced in the front suspension. Once the repair is made, we'll have the alignment checked and brought into spec if needed.

The truck had a set of new ball joints installed on both sides of the front suspension. When installing new parts, be sure and read the instruction papers that are supplied with them. In this case, the hole in the rim of the top ball joint needs to be put in the correct place. While the tires were off, the tires were rotated front to back, all tires properly inflated and then the alignment adjusted. On the after the repair road test, the slight pull to the right was gone, the "clunk" when turning was gone and the vehicle once again drives straight and true. **TM**



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.

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CARDONE Power Steering Pumps have a new metal pulley pre-installed. There are 25 new SKUs of late-model Ford applications and 130-plus SKUs of domestic and import coverage. According to the manufacturer, the power steering pumps feature metal pulleys that reportedly save labor time, because there is no need to transfer the old pulley to the replacement pump. Other features include avoiding warranties (no chance of reusing a damaged or bent pulley); avoiding common installation errors (no damage to internal components due to excess pressure applied during installation); and saving money (one complete unit is less expensive than buying a separate pump and pulley). CARDONE also offers an option for the popular 2000-2004 Dodge Durango/Dakota (Part No. 21-4045R, pictured) that not only includes the pump with pre-installed pulley, but also the reservoir. These units are ready to install out of the box.



www.cardone.com

CARDONE Industries

GEAR OIL

Permatex offers its specialized Permatex Gear Oil RTV Gasket Maker for use as a gasket maker or sealant on transfer cases, differentials and manual transmissions. This gasket maker is specifically formulated to withstand the effects of advanced synthetic and petroleum gear oils, which are known to destroy standard RTV silicones, the manufacturer says. Permatex Gear Oil RTV Gasket Maker effectively resists the effects of friction modifiers found in newer gear oils and will prevent leaks and ensure proper performance in harsh drivetrain environments. The sealant has been developed to OE manufacturers' specifications and is proven to meet demanding OEM sealing standards. It can be used as a differential case sealant or as a drain plug gasket.



www.permatex.com

Permatex

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The TJ-1, 2 and 3 transmission bearing pullers are the newest addition to the Posi Lock line, featuring the patented steel Safety Cage. These pullers are specially machined to clamp in snapping grooves as narrow as .070-inch for easy removal of transmission bearings. Posi Lock offers three puller sizes to suit jobs large and small. The TJ-1 puller is a two jaw model with a 9.25-inch reach and a spread range of 2.75-inch to 14.75-inch. The TJ-2 is a three jaw model with a 5.25-inch reach and a spread range of 1-inch to 6.75-inch. The TJ-3 is a three jaw model with a 4-inch reach and a spread range of 0.5-inch to 5.5-inch.



www.posilock.com

Posi Lock Puller

SYNTHETIC AUTOMATIC TRANSMISSION FLUID

Shell Lubricants has introduced Shell Spirax S6 ATF A295 synthetic automatic transmission fluid. The new lubricant is approved against Allison's TES-295 specification for extended warranty and extended drain intervals. Shell Spirax S6 ATF A295 can be relied on to last up to 300,000 miles under normal conditions or 150,000 miles under severe conditions without risk to the transmission components or warranty.



www.rotella.com

Shell

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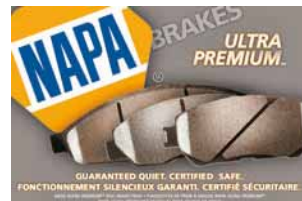
Standard® TPMS sensors are engineered to match OE fit, form and function, plus they can be ID cloned to the sensor they replace using a TechSmart cloning tool. Each clone-able sensor has a unique sensor ID, the right protocol and matching body style. Technicians can bypass complex factory relearn processes, saving time and money.



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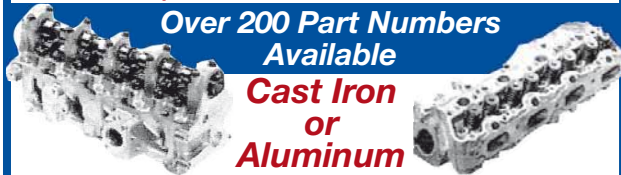
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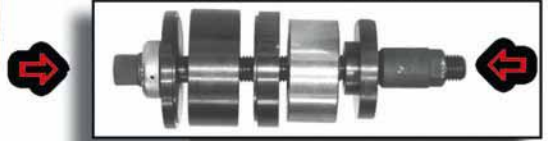


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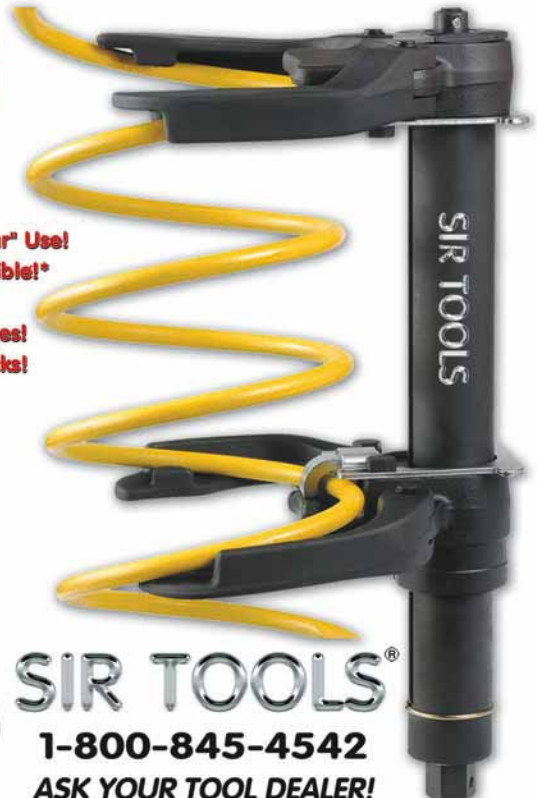
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BY **PETE MEIER**
Technical Editor

The car in your bay isn't talking and is providing you with few clues as to what ails it. The schematics laid out on your workbench might as well be the undecipherable ramblings of a toddler for all the sense they make to you. The flow chart you're using says something about measuring 5.0 volts on pin A of the sensor connector, but you're not sure why it should be 5.0 volts and not the 12.5 volts you measured at the battery.

You remember something that the instructor said at the electrical training class you attended a few months back about something called voltage drop. Would that explain why you're reading the 5.0 volts on your meter?

You go back to the car and hook up for the next test the trouble tree is instructing you to do. You don't know why you're taking this test, and it isn't the easiest connector in the world to get to. Maybe you can skip this one and move on to the next? For that matter, why don't we just skip to the bottom and "replace with a known good component" to see what happens?

Your frustration is building. You've been at this for most of the day and still don't see the light at the end of the tunnel.

Then you look across the shop at Bob, who thinks he's just the greatest tech who ever lived. He loves doing electrical work, says it's clean work and



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requires very little heavy lifting. And, as much as you hate to admit it, he's pretty good at it. You're betting he'd have this car fixed by now if he had pulled the ticket before you.

There are three areas you need to fully comprehend before you'll be as comfortable tackling electrical problems as Bob seems to be. First, you need to understand some basic electrical theory. Second, you need to understand how to read an electrical schematic. And third, you need to understand the voltage drop testing technique.

In this issue of our monthly how-to video series The Trainer, we'll focus on strengthening your electrical fundamentals foundation so you'll have a solid base to build on. We guarantee

that if you study the basics enough to make them automatic in your thinking, you might even be better than Bob when tackling electrical gremlins in the future. *TL*

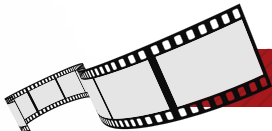
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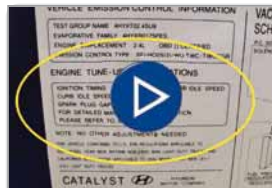
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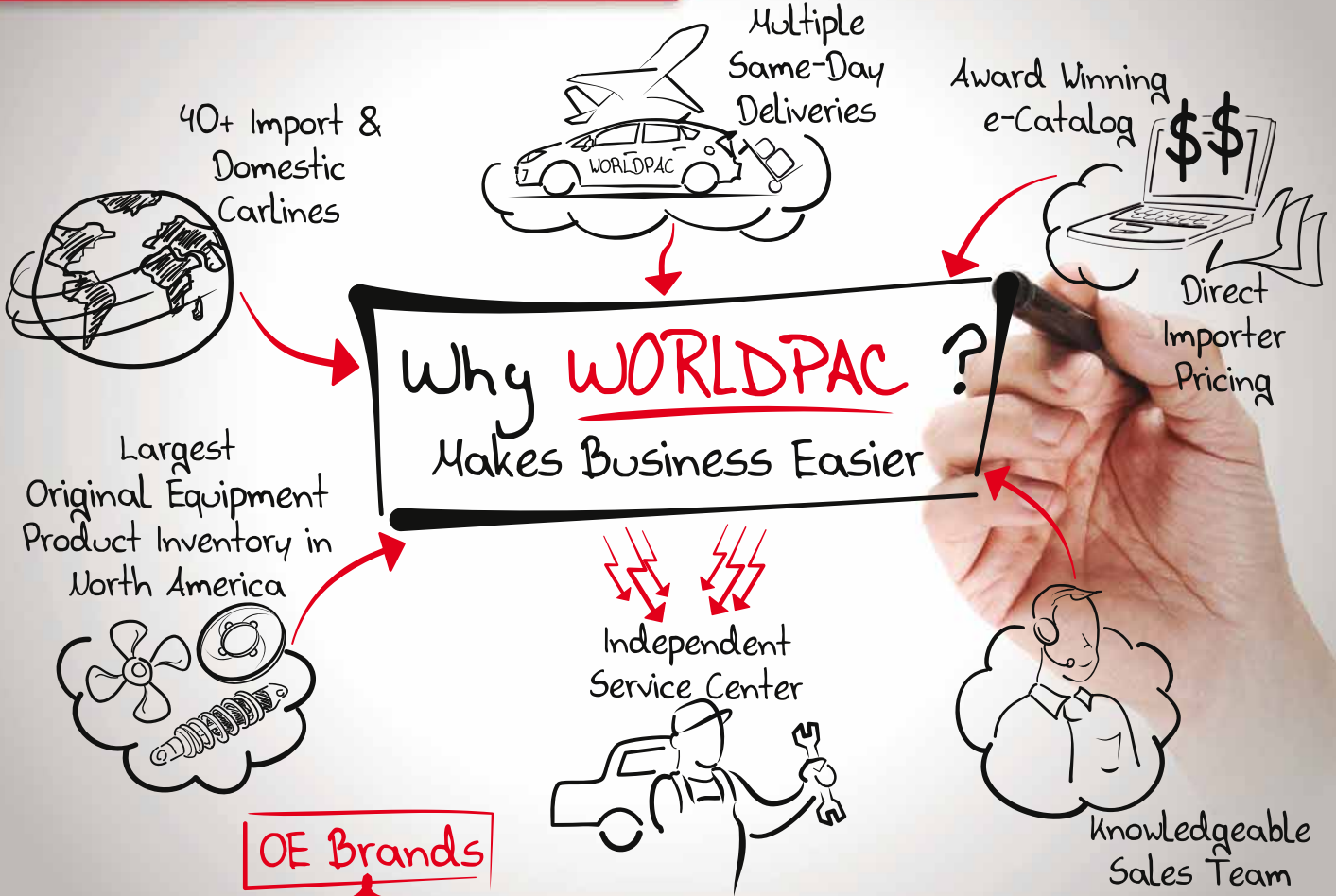


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