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AUTOPRO WORKSHOP

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Talk shop anytime AUTOPRO WORKSHOP

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Upcoming Webinars & Archives
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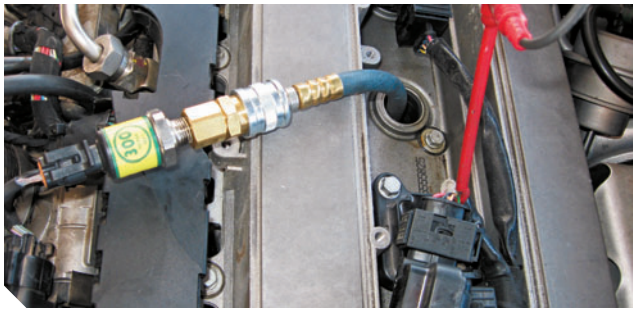

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SALES STAFF

Midwest/Western/Northern California
Chuck Steinke, Regional Sales Manager
Tel: (630) 369-0752
Fax: (630) 369-3755
csteinke@advanstar.com

Eastern/Southern States
Paul A. Ropski, Regional Sales Manager
Tel: (312) 566-9885
Fax: (312) 566-9884
propski@advanstar.com

Ohio/Michigan/Southern California
Lisa Mend, Regional Sales Manager
Tel: (773) 866-1514
Fax: (773) 866-1314
lmend@advanstar.com

U.K., Denmark, Norway, Sweden, Finland
Alastair Swift, ASA Media
4 Jersey Lane
St. Albans, Herts AL4 9AB UK
Tel: +44 (0) 1727-765542
Fax: +44 (0) 1727-752408
alastair@asa-media.com

Germany, Austria, Switzerland, Netherlands
Friedrich K. Anacker,
IMP InterMedia Partners GmbH
In der Fleute 46
D-42389 Wuppertal, Germany
Tel: 011 49 202 27169 0
Fax: 011 49 202 27169 20
fanacker@intermediapartners.de

Inside Sales/Classified Sales/Recruitment
Keith Havemann, Sales Representative
Tel: (310) 857-7634
Fax: (310) 943-1465
khavemann@advanstar.com

List Rental Sales
Carissa Simmerman
csimmerman@advanstar.com
(440) 891-2655

Permissions/International Licensing
Maureen Cannon
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»» MOTORAGE.COM/AMI20

ROTARY LIFT DEBUTS BLOG
Rotary Lift has added a blog to its recently redesigned website to be updated weekly with product and industry news.
»» MOTORAGE.COM/ROTARYLIFTBLOG

ACDELCO LAUNCHES TECHCONNECT SITE
The new website features more content and improved navigation and search functionality.
»» MOTORAGE.COM/TECHCONNECT

AN AFTERMARKET WARNING
Former MEMA CEO says he is concerned there are too many stores, too many distribution points and too much inventory in the system.
»» AFTERMARKETBUSINESS.COM/WARN

MILITARY PARTS PARTNERSHIP
TARDEC is partnered with many of industry's top automotive and research/development corporations and institutions.
»» AFTERMARKETBUSINESS.COM/FRONT

TOBYHANNA ARMY DEPOT APPLIES REAL-WORLD COLLISION REPAIR
The Pennsylvania depot stays on top of today's trends just like its civilian counterparts.
»» ABRN.COM/REALWORLDREPAIR

A SALUTE FROM THE MSOS
It seems appropriate that "MSO" is just a letter off "USO."
»» ABRN.COM/MSOSALUTE

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NATIONAL TRAINING EVENT

Automechanika Chicago set for 2015

CHICAGO — The mayor of Chicago and executives from Advanstar Communications and Messe Frankfurt introduced Automechanika Chicago, a new trade show that will focus on shop-level training for technicians and product discovery. The biannual show will debut at McCormick Place April 24 to 26, 2015, the parties said in a May 1 press conference in the Windy City.

The show will be the 14th Automechanika event around the globe, but the first in the U.S. Chicago was chosen because it is centrally located and easily accessible for drive-in attendees and air travel.

Chicago Mayor Rahm Emanuel said, "By choosing Chicago for Automechanika next year, a great international convention comes to a great international city. Three years ago we started the hard effort of repairing the relationship and the image of McCormick Place. We used to have conflicts between labor and management. We resolved all those issues. We now work together as a team and go out and secure business for Chicago. This is a classic example of a win/win situation you can have when labor and management work together on behlaf of the city of Chicago."

Chris DeMoulin, executive vice president of Advanstar automotive group, said this is the second show Advanstar has scheduled at McCormick Place.

Photo: Adam Alexander

BREAKING NEWS

WEBSITES

AUTOSHOP SOLUTIONS EARNS GOOGLE PARTNER STATUS

Autoshop Solutions, a website design and Internet marketing agency for the automotive industry, has been awarded Google Partner Status. Since 2006, Autoshop Solutions has held a Google Adwords Certification and various other levels of certifications offered by Google. Becoming a Google Partner recognizes the marketing agency as a top performer.

Google Partner status was awarded to Autoshop Solutions as a result of rigorous training by the Autoshop Solutions marketing team in the areas of Google Adwords Management and Google Analytics. In order to qualify, Autoshop Solutions was also evaluated in terms of experience and increased client account performance.

[Autoshop] CONTINUES / PAGE 9
Discussion is on-going in MotorAge.com forums

Before the fans go in

Before the drivers go in

Before the championships go in

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"The Chicago team won our business seven months ago when we announced we would move our Powersports Dealer Expo from Indianapolis to Chicago. When our research showed that one out of evey four repair and collision shops in America are within 500 miles of Chicago, that made this an easy choice." He also praised Chicago's union leaders for making McCormick Place "an easier, more user-friendly place to have a show."

Michael Johannes, vice president of Messe Frankfurt and brand manager of Automechanika, said, "I am delighted to welcome Automechanika Chicago in our portfolio and I am sure that we have found the right partner in Advanstar and the right location in Chicago. Our global network, which is active in more than 150 countries, will be working very hard to make the first Automechanika Chicago a huge success next year.

"We are in constant dialogue with our customers from manufacturing, distribution, retail and the entire automotive supply chain to ensure that we meet their requirements and organize shows in markets that they want. That's how we know that our customers are waiting for an Automechanika in the U.S. The brand Automechanika serves over 16,000 exhibitors worldwide and over 500,000 trade visitors – that is our asset and that is what we take care of every day."

Automechanika Chicago will showcase the newest tools, equipment and products in the market and will be the largest U.S. trade show dedicated to high-end technical training and management classes for automotive technicians and shop owners. The event will leverage the world's most-trusted show brand – Automechanika – with Advanstar's leading automotive publications for the service repair and collision repair segments, *Motor Age* and *ABRN*.

DeMoulin said, "Automechanika Chicago will be designed specifically for shop owners and technicians as we seek to make it the largest training event ever produced in the U.S. marketplace. Attendees will find a show floor packed with the latest products and innovations for independent shop owners and technicians and get top-notch classroom and hands-on training."

Johannes said the show's shop-friendly environment "will allow visitors, from technicians to shop owners, to really get a feel for the new product offerings through the various demonstrations, management seminars and technical training sessions. With the number of diverse product categories exhibiting at this one event, attendees can experience the latest advancements in a very efficient manner."

The U.S. automotive aftermarket has maintained steady growth of more than 3.4 percent annually, fueled by an aging vehicle population where the average vehice age is 11.4 years. These trends along with an explosion of new technology means technicians must keep pace. Automechanika Chicago will be the venue for shop-level training and new product discovery in North America.

To learn more about Automechanika Chicago, visit www.AutomechanikaChicago.com.

Headquartered in California with offices across the United States and abroad, Advanstar Communications has a portfolio of more than 50 trade shows, 30 publications, and 200 electronic products and websites, including auto industry brands Aftermarket Business World, ABRN, Motor Age and SearchAutoParts.com.

The Automechanika brand continues to experience record exhibitor and visitor numbers. This year's Automechanika Frankfurt show Sept. 16-20 had 90 percent of its floor space booked at press time. In 2012, more than 4,500 exhibitors attended the show in Frankfurt as well as 148,000 visitors from 176 countries.

Messe Frankfurt is one of the world's leading trade show organizers. In 2013, Messe Frankfurt organized 114 trade fairs, of which more than half took place outside Germany.

[Autoshop]

CONTINUED FROM PAGE 6

"Our company is committed to staying on the cutting edge of internet marketing technology" states Danny Sanchez, CEO Autoshop Solutions. "Becoming a Google Partner is just one more way we achieve that goal. As a Google Partner, we have higher level access to a team at Google, so we can get questions answered and problems solved more quickly to better serve our clients."

In addition to increased access to the Google Team, another benefit of being a Google Partner is actively engaging in beta tests to help Google's engineers design the ever-changing Adwords format. This partnership also gives Autoshop Solutions insights specific to the automotive industry via case studies and other resources concerning marketing trends and best practice advice.

New group of World Class Techs named

Of the more than 812,000 automotive technicians working in the United States, 22 outstanding individuals have qualified for the prestigious 2014 World Class Technician Award. The Auto Care Association and National Institute for Automotive Service Excellence (ASE) work together to recognize these professional technicians who have tested and obtained ASE certification in 22 specialty areas during the 2013 ASE test.

The 2014 World Class Technicians are:

Nicholas C. Atherton, Council Bluffs, Ind.
Jared M. Avent, Lincoln, Calif.
George E. Ayers, II, Mount Laurel, N.J.
Freddie L. Castillo, Grapevine, Texas
Mark W. Couvrette, Sacramento, Calif.
Arnold E. Demann, Martin, Mich.
James B. Fields, Winchester, Va.
John S. Furtek, Mount Laurel, N.J.
Franklin W. Harris, Nashville, Tenn.
John R. Hubbard, Mount Laurel, N.J.
Alberto L. Lopez, Lancaster, Calif.
Andrew S. Meyer, West Chester, Ohio
Joe R. Mitchell, Grapevine, Texas
Troy A. Nolan, Houston, Texas
Robert J. Palczewski, Bloomingdale, Ill.
Gary L. Perttula, Sun City West, Ariz.
Kenneth J. Placzek, Westmont, Ill.
Kristopher L. Stevens, Haltom City, Texas
James W. Trusley, Jr., Dallas, Ga.
Chad E. Wade, Iowa City, Iowa
Michael Whalen, Dixon, Calif.
Matthew Z. Younger, Irving, Texas

"Recipients of the World Class Technician Award are truly the best of the best," says Kathleen Schmatz, president and CEO, Auto Care Association. "Passing 22 ASE tests is a monumental achievement requiring exceptional knowledge and skills."

"This recognition partnership between the Auto Care Association and ASE represents one of the most significant achievement awards available to our ASE-certified professionals," says Tim Zilke, president and CEO, ASE.

Since the World Class Technician recognition was established 28 years ago, only 1,885 technicians have been honored. Recipients receive a special certificate, a logo medallion and embroidered shoulder insignia. Their name is inscribed in an honor book located in the Automotive Hall of Fame.

COMMUNITY

EXPERT OPINION, INPUT FROM THE FIELD, FORUM COMMENTS, & SOCIAL MEDIA

ASE GUIDES

QUESTION OF THE MONTH

SPONSORED BY Federated Auto Parts

☑SURVEY: You won't find a question like this one on any ASE test (yet), but we wanted to pique your interest.
In-cylinder pressure testing is done with a pressure transducer and digital storage oscilloscope, and can be performed as both a cranking test and as a running test. All of the following faults can be diagnosed by observing a running in-cylinder pressure test EXCEPT:

A. jumped timing belt
B. overly rich fuel mixture
C. retarded ignition timing
D. inoperative variable valve timing

Answer the question at MotorAge.com/jun14survey and enter our monthly contest from Federated Auto Parts.

FROM THE BLOG SPHERE

Five important questions

These questions — and honest responses —will make sure you do what you need to grow your business.

BY **TIM ROSS, WORKSHOP MEMBER**

It's time to take a good look at your shop and answer these five questions.

1. Are you diagnosing car repairs over the phone? This approach allows your customers to shop around to see what competitors charge to fix the issue (likely a repair or service he or she might not even need). Instead, focus on getting the customer to bring his or her car in for a free inspection/written estimate by one of your ASE-certified technicians.

2. Is your sales staff prepared to handle the typical customer objections? Training your sales staff by rehearsing and role-playing responses to typical objections so they become seamless in conversation is essential.

3. Do you pause when you give a price to a customer, or do you use an "assumed close"? Always give a price and follow up without hesitation by adding, "We can get this service done for you today. Is this still the best number to reach you?" When you pause, you give customers a chance to think about it and reject the service. This is not to say that some customers will say "No" regardless of your system, but if you are targeting the correct households with your marketing, you will get the "Yes" you want frequently. And that will give you some negotiating room for the customers who initially say "No."

MotorAge.com BEST OF THE BLOGS

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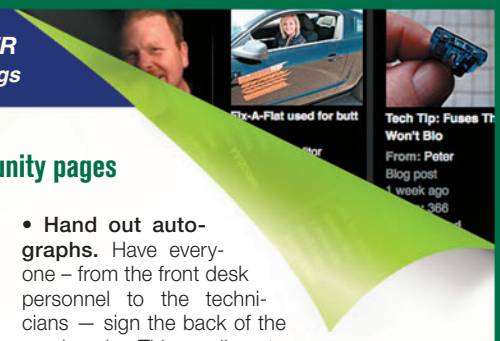

BEST OF THE BLOGS are articles written by bloggers on *Motor Age's* community pages

Rock star strategies

By Todd Westerlund

Like many of you, I am always searching for ways to differentiate my business from the competition. I recently found some interesting ideas in Mack Collier's book *Think Like a Rock Star*. At first glance, there doesn't seem to be much overlap between the automotive repair business and the world of rock and roll. But there's actually a lot to be learned from successful long-running bands. For example:

• **Set the stage.** We all know that show business, to a certain degree, is about style. I'm not saying your shop needs to look like the backdrop of an Iron Maiden concert, but keep in mind that the appearance of your storefront and lobby area will give customers a preview of what to expect. Show off your achievements and certification, but on the other hand, don't plaster your front desk with coupons and promotions. Nobody wants to walk into a concert only to be bombarded by vendors selling T-shirts and souvenir cups.

• **Have a designated frontman.** The Rolling Stones have Mick Jagger. U2 has Bono. The lead singer is essentially the face of any successful band — setting the tone, working the crowd and turning on the charm to cultivate new fans. Your shop needs someone to play a similar role. Whether it's the shop owner or a general manager, whoever takes on that task should be front and center daily, thanking customers for their business.

• **Give everyone a backstage pass.** Educate customers about what happens behind the scenes. Introduce them to the technicians who work on their cars so they feel like they're part of the process.

• **Hand out autographs.** Have everyone – from the front desk personnel to the technicians — sign the back of the repair order. This small gesture shows customers that everyone at your shop takes ownership of their work.

• **Build your identity**. Who says rock stars are the only ones who can have posters? Make a "poster" of your team and post it for all your "fans" to see. Travel in packs to lunch, coffee runs, supply pick-ups, so the surrounding community associates you with the shop. Show your personality by hosting a "pimp my ride" or charity challenge against another shop.

• **Make your customers fans.** Get to know everyone who comes in your shop. Take photos of your customers and feature them throughout the shop. Reward your fans with special offers for their loyalty.

FEATURED WEBCAST
Aug. 21
@ 8:00 PM
Ignition Testing
Learn the ins and outs of ignition system diagnosis in this *Motor Age*/TST webinar, sponsored by Champion.

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MOTOR AGE PARENT COMPANY DEBUTS
AUTOMECHANIKA CHICAGO
Taking place April 24-26, 2015

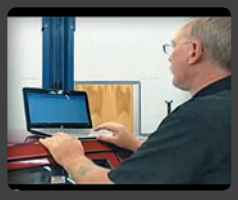
PAGE 136
THE TRAINER VIDEO
PETE MEIER
Taking a sniff

4. How many oil changes walk in and out of your shop with no additional PMI service sold? You have to hold your service managers accountable to sell service.

5. Are your staff members printing out the following for every customer? Vehicle maintenance schedule, completed PMI sheet, written estimate for all work found on PMI, service bulletins, customer history (if applicable) and repair order.

MotorAge TOP VIDEOS

MOST WATCHED VIDEO



Diagnosing EVAP systems

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Leadership choices

David Wheatley of Humanenergy recently presented "Leadership is About Choice" to the annual meeting of the Spring Manufacturers Institute (SMI)

MotorAge.com/leadership

How to read an automotive block wiring diagram

A wiring schematic and/or wiring diagram is more than just the electrical road map. It's instrumental in helping you understand how the circuit works — and vital to organizing your diagnostic strategy.

MotorAge.com/wiring

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Noteworthy

comments from *MotorAge*'s online communities

The best of what you're saying on Facebook.com/MotorAgeMagazine, Twitter (@Motor_Age and @PeteMeier) and the AutoProNetwork

@UrMechanic TWEETS:
Chocolate covered bonbons or scoops of Nutella & latest edition of anything @Motor_Age / @hotrod magazine #wrenchbliss

@dsm4g63mcneil TWEETS (in response to our tweet "How we address changes in #automotive #diagnostics is influenced by our attitude towards change http://bit.ly/1i6RAmg #OERepairs #OEM"):
@Motor_Age I embrace technology and I love to diagnose!

Andre K Pitts (in response to a Facebook photo of Wally Meridian at #STX2014):
If you don't learn it with Wally you probably won't learn it at all.

Shannon Brian Pieczymski (in response to our Facebook question "Are we producing enough new techs to replace those who are leaving the workforce?"):
Flat rate is killing the business and pay does not adjust for the skills of many years in the field.

CraigsCarCare (in response to Jon Ellsworth's blog post, "Do you sell value?")
Jon, you just hit a home run in my book! That is one of the most basic (shortest) but true statements I have seen written in a while. As a consumer I will spend more for the relevant value as opposed to just buying cheap. Thanks, Craig.

sunrise (in response to Richard McCuistian's "12 rules" blog post)
Excellent technician rules to live by

join the community—join the discussion MotorAge.com/Community

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2014 WEBCAST SCHEDULE

JULY 10
Documentation Best Practices for Key-to-Key and Digital Photography
Presented by I-CAR.

AUG. 21 @ 8 P.M. ET
Ignition System Testing
Presented by *Motor Age* Technical Editor Peter Meier and G. Truglia of TST, and sponsored by Federal Mogul.

SEPTEMBER
Understanding Hydraulics
Presented in partnership with ATSG.

NOV. 20 @ 8 P.M. ET
Mastering Voltage Drop Testing
Presented by *Motor Age* Technical Editor Peter Meier and G. Truglia of TST

STREAMING PROGRAMS

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NOV. 12-15
Automechanika Argentina 2014
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MANAGEMENT

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UNLESS YOUR LITERAL INTENTION IS TO BE TAKEN OUT HORIZONTALLY, PASSING FROM THIS WORLD WHILE AT WORK IN YOUR SHOP WITH A RATCHET CLUTCHED IN YOUR HAND, THE SOONER YOU BEGIN PLANNING FOR WHATEVER COMES NEXT, THE BETTER.

BY **BRIAN CANNING** | CONTRIBUTING EDITOR

IT IS a fact that most shops in the U.S. are not as profitable as they need to be, with net operating profit numbers in the low single digits — or about a quarter or more of where they need to be to assure the viability of the business.

Too many shop owners have hired or inherited the wrong type of service manager or technicians. Rather than doing what is right for the business, they put up with these poor performers, hopeful they will come around over time.

In the same way, rather than assuring a great service experience for our customers and thereby developing a strong customer base over the years, far

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"IF THEY ARE NOT CONTRIBUTING TO THE SUCCESS OF YOUR SHOP, THEY ARE A LIABILITY. DO YOURSELF A FAVOR AND FIND THE RIGHT PEOPLE TO PLAN YOUR RETIREMENT AROUND."

BRIAN CANNING [CONTRIBUTOR]

too many owners go to market striving to be the cheapest guy in town — and discover far too late that it is hard to be profitable when there is no profit. It is just as hard or harder to retire.

Instead of suffering that 11th-hour shock, my strong suggestion would be to start running your business with an end (like retirement) in mind. Whether you would sell it outright or develop a succession plan that transferred ownership of your shop to your service manager or other party through a buy-out mechanism, work out those details and get that plan in place as soon as is possible.

First Things First

Even before that, however, I would have you work very hard to hire the right people. I can promise that you will not want to turn your business over to a lazy slacker, with your retirement dependent upon the business being profitable. The very same would apply to your techs and other staff. If they are not up to snuff, then they are a threat to that end date — and you do not have the luxury of waiting for them to come around.

Remember, if they are not contributing to the success of your shop, they are a liability. Do yourself a favor and find the right people to plan your retirement around.

Another important step would be in giving your people incentives toward performance. No matter whether you are selling the business or are planning a long-term buy-out, performance at the counter and in the bays will pay the bills and finance your retirement. Pay for that performance.

A final, but very important step in all of this is getting with your accountant or financial advisor and putting that plan on paper ASAP. Peace of mind has value, and having a great and well thought out plan is worth the time and effort.

It would seem like common sense, but in taking on a financial advisor, it is extraordinarily important not only to find someone who is ethical and competent, but also is somebody you are comfortable with and can talk to. It's not quite a spouse, but choosing your financial advisor can and should be a serious exercise.

He or she is not an hourly employee paid by you to shut up and do what you say. On the contrary, this is an expert whose job it is to advise you on your financial status and make recommendations that will take your existing operation and make it better. We are not talking about a bookkeeper, whose job it is to balance your books at the end of the day, the end of the week and the end of the month. We are talking about a financial professional who can give you in-depth and far-reaching advice on everything from profit models to cash flow, corporate law and succession planning. His or her job is not to accept your bad habits and misbehaviors, but to take them into account in developing a plan to achieve your financial goals.

I know this is something new for many of you, but having a financial advisor almost insists that you have financial goals and a long-term financial plan to deliver on those goals. That you might actually end up with money in the bank and be able to retire someday are genuine risks to my efforts here, but that would seem to be the price of admission.

We of the automotive repair and tire worlds can take great pride in our ability to take on extraordinarily complex

repair and service challenges en route to taking care of our customers on a regular basis. We also can take pride in our commitment to excellence and in our tenacity in overcoming huge challenges such as technician shortages and government regulation. That the average shop and shop owner in the U.S. in generating less than 6 percent net operating profit (NOP) would make it very clear that despite the many things we do well, financial planning is not one of them. Just as our customers look to us for our expertise, we need to look to an expert to help us get our financial house in some kind of order. We need to have a financial plan.

I could not tell you who would be the best financial advisor for you, because you and your business are unique, with your own strengths and weaknesses and your own goals. I would caution you against hiring somebody just because you liked him or her, but also warn you against hiring based on the diploma and resume alone. This professional certainly will need to have a track record, but he or she also needs to be somebody you can be comfortable with and willing to engage. This is a very intimate, important and far-reaching relationship you are trying to establish; it's nothing like hiring that B-tech you have been looking for.

In finding that perfect match, I would tell you to take your time and hire tough. Remember that if the advisor is successful, you are successful. If he or she is not successful — well, you know where that is leading.

If you do not have a financial goal, you are adrift on a stormy sea without a compass. If you have a goal, you need a plan toward accomplishment or you are just dreaming.

It is not about what your labor margin should be or what you should charge on parts. It is about quality of life, making your business into an asset and being able to retire sometime before your 83rd birthday. It really is about cash being king and having a plan.

Someday, many years from now, you will decide you have had enough and you will think seriously about retirement. Beginning to plan for that day now will allow you to approach that day with confidence. Failing to plan will have that day out there as a big question mark.

What your retirement will look like is entirely dependent on how you run your business today and on how well you plan for those tomorrows. My strong suggestion is you start that process now.

It's eight o'clock: Do you know where your service manager is? Maybe you had better find out!

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.

Email Brian at brimarc@hotmail.com

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YOU DIDN'T SET ANY GOALS THIS YEAR, DID YOU?

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BY **CHRIS "CHUBBY" FREDERICK** | CONTRIBUTOR

I HAVE often wondered why some years I achieve my goals and some years I don't. Sometimes I blame it on the goals being too lofty, or someone or something got in my way. I was listening to one of our senior coaches, Geoff Berman, explain it to a client and it helped me, so I wanted to share what Geoff had to say.

It is amazing how quickly time goes by — and the older I get, the faster time seems to go. What a year 2013 was! As you look back on the year, whatever you see, I can make this statement with absolute certainty: There were things that happened in your life you can be proud of, and there are things you wish were different.

As a 10-year coach at ATI, I have noticed that as important as goal setting is, for most clients it simply doesn't work. So the last few years I have instructed my clients to stop making New Year's resolutions and stop setting goals. At first, most of them thought I was insane at this request (that is certainly a possibility); but after I explained why, it became clear what I was asking them to do. For some, this was way outside their comfort zone and it took some coaxing. For others, it immediately made sense. For those who participated fully, they found it to be more effective than traditional goal-setting exercises.

Why It Doesn't Work

To understand what I want you to do, first you need to understand why typical goal setting just doesn't work. If you did set goals this year, take note of how many you missed, as you read why they typically are ineffective. As you reflect on the results, let it resonate why this process failed you. Here are five reasons why you don't accomplish your goals:

1. You were not specific. For example, maybe you have not taken a vacation in 10 years and you want to take a vacation in the coming year. So you set a goal to take a vacation this year. That is very generic. Be more specific: *I'm going to Cancun from Sept. 19 through Sept. 25 with my spouse and three kids.* This goal allows you to do many things. First, now you can figure out what it will cost and start saving for it. If you book it

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[1]2013 Employer Health Benefits Survey, The Henry J. Kaiser Family Foundation, August 20, 2013, http://kff.org/report-section/2013-summary-of-findings/ Accessed 11/19/2013. [2]Aflac Company Statistics, October 2013, One day processing turnaround based on business days after required documents are received. Online claims available for Accident, Sickness, Cancer & Wellness claims. [3]Eastbridge Consulting Group. U.S. Worksite/Voluntary Sales Report. Carrier Results for 2012. Avon, CT: April 2013. **Coverage is underwritten by American Family Life Assurance Company of Columbus. In New York, coverage is underwritten by American Family Life Assurance Company of New York.** Worldwide Headquarters | 1932 Wynnton Road | Columbus, GA 31999

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WHAT IS A GOOD WAY TO BE ABLE TO REFER TO YOUR GOALS DURING THE YEAR? CREATE A GOAL POSTER AND HANG IT WHERE YOU SEE IT EVERY DAY SO YOUR RETICULAR ACTIVATING SYSTEM KEEPS IT IN FRONT OF YOUR BRAIN.

CHRIS "CHUBBY" FREDERICK [ATI CEO]

now, you likely will get it for less and be more accountable to its actually happening. Plus, you will have plenty of time to prepare your business to be successful during the week you are gone. To just say you're going to take a vacation is simply not enough detail to help this goal become a reality. The more specific you are, the more likely it is to happen.

2. You didn't date the goal. Keeping with the vacation goal example, you will notice when the original "take a vacation" goal was made more specific, part of that process included dates. This is very important when goal setting. If you do not set a date, you are giving yourself an excuse to miss it. There is nothing driving you, and at the end of the year when you did not accomplish that goal, you either transfer it to the next year's goals again or scrap it altogether. There is a reason why your offers expire when you advertise. The same concept is true here. Give yourself a sense of urgency, and it is more likely to become a reality.

3. You didn't refer to it constantly. How many times have you written down goals for the year only to put them aside, never to be seen again? Maybe you did refer to them when you started setting goals for the next year to see what was not accomplished, but they have been out of sight for most of the year. Without a constant reminder of what you want and when it is to be done, it is unlikely the goal will come to fruition. Post your goals somewhere where you see them weekly, or even daily. Maybe it could be the screen saver on your laptop.

4. You made a wish list, not a goal list. Let's be honest: If you look at goals you have made in the past, they are really not goals at all. Some, if not all of them, are just wishes — things you have written down that you are hoping for. If that is what you put on your goal poster, then you have failed before you even started. While things like "increase car count by 25 a week," "buy that childhood dream car," "become a millionaire" or even "go on vacation" might seem attainable eventually, they are likely not going to happen this year, and they are much less likely if they do not follow the rules. If you confuse your goals with your wishes, eventually you will give up on those wishes.

5. You didn't share your goals. As a coach, I can be a great resource to my clients in accomplishing what they want if that information is shared with me. Even if you don't, there are many people in your lives who will help you if you let them. Your spouse, friends and staff all should be aware of your goals. When you put it out there in the universe, the level of accountability rises. You should not be ashamed of your goals or feel they need to be kept private. Get them out there for all to see, and you will find yourself there before you know it.

A Much Better Way

I want you to take yourself to the end of the year. Once there, ask yourself what you accomplished. Instead of saying what you want, I want you to tell yourself what you've done. How does it feel to have accomplished that goal? I bet it feels good. Now I want you to describe that feeling when writing what you accomplished. Be as detailed as you can, as if you are writing a novel and you're trying to draw the reader in. If I read that goal, I want to feel how you felt when you wrote it. For example:

Not good, a wish: Clean and paint the shop.

Much better, your accomplishment: In June, I completed my cleanup project. I updated my shop for even better curb appeal. I cleaned out all the clutter and painted the lifts and shelving. It really looks great, and my customers feel a great sense of professionalism.

When I read that goal, I can actually visualize customers walking up to the service advisor and saying, "I really like what you've done with the place. It looks great!"

If you can get to that point with your goals, you can't help but accomplish them. If you want to succeed more often at achieving your dreams and goals, download the goal accomplishment cheat sheet for a limited time at www.ationlinetraining.com/2014-06.

CHRIS "CHUBBY" FREDERICK
CONTRIBUTOR

Chris "Chubby" Frederick is the CEO and founder of the Automotive Training Institute. ATI's 108 associates train and coach more than 1,150 shop owners every week across North America to drive profits and dreams home to their families. Our associates love helping shop owners who are having the same struggle as many of them have had, and who are looking for the same answers — and in some cases looking for a lifeline. This month's article was written with the help of Senior Coach Geoff Berman, a 10-year veteran at ATI.

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CREATING A WAVE OF REVENUE

WHEN YOU UNDERSTAND YOUR DOOR/LABOR RATES, YOUR PRODUCTIVITY INCREASES, TOO.

BY **BOB GREENWOOD** | CONTRIBUTING EDITOR

MANY shop owners are convinced they can't raise their rate because it would price them out of their marketplace. Many shop owners believe they only need more car count.

I disagree.

It is important to understand that the labor rates of the shop should not be used as a marketing tool. The labor rate reflects the shop's competency. We no longer are in the breakdown and repair business; we are in the knowledge business. If you are incompetent, then make sure you have the lowest door rates in the marketplace. If you are competent, then make sure you have the right door rate in your marketplace.

Today's business is challenging. We must diagnose the problem accurately, then explain it completely to the consumer in layperson's terms — and at the same time secure their trust. The consumer is not stupid, but is likely to be uninformed. We, as an industry, have done a great job of keeping them in the dark.

Doing the Math

What is the effect on your business if you raise your labor rate $5 per hour

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"THE INDEPENDENT SHOP IS NOT IN THE COMMODITY BUSINESS; THAT BELONGS TO THE MANUFACTURER, WD AND JOBBER BUSINESS."

BOB GREENWOOD [CONTRIBUTOR]

on maintenance work? Here are some assumptions:

- Your site efficiency number is 64.1 percent, meaning a technician who is available 40 hours per week, a total of five days per week, is being billed out 25.64 hours per week. (You cannot calculate this accurately if you don't first calculate your site efficiency number; but once you have that number, you will start to know the facts about your business.)
- There are the equivalent of six technicians in the shop: Licensed techs are one tech, and apprentices are equivalent to a half-tech, so five licensed and two apprentices equal six techs for calculation purposes.
- Technicians work 50 weeks a year.

How much additional gross profit/net profit would be created by increasing the door rate $5? Do the math:

25.64 hours per week X $5 increase = $128.50 per week

$128.50 X 6 technicians = $769.20 per week

$769.20 X 50 weeks per year = $38,460 GP/NP per year to the business.

This not only is gross profit, but also net profit, because it did not cost you any more to raise the door rate.

Adding Onto the Math

The next step is to understand the productivity issue that is available in this sector of the autocare industry.

Using the same facts as above and charging a labor rate at $85 per hour in the maintenance department, what would be the results to the business if management got focused to get one more hour billed per technician per day over what they currently average? Do the math:

$85 per hour X 6 technicians = $510 per day

$510 X 5 days per week = $2,550 per week

$2,550 X 50 weeks per year = $127,500 GP/NP per year.

Between these two moves being incorporated into the business, and with management executing with discipline, the business generates $38,460 + $127,500 = $165,960 additional GP/NP dollars per year.

Let's say you are not that good and you only achieve half these results. You still have changed your life!

It is not about car count, it is about billed hours per R/O. A professional shop owner understands the shop doesn't need to be busy, it needs to be steady.

Insert your own numbers and see what you have been leaving on the table because of the distraction of "noise" the industry has been providing to you over the years. The independent shop is not in the commodity business; that belongs to the manufacturer, WD and jobber business. The independent shop is in the knowledge business, which requires a completely different strategy and explanation of what a shop is and how it must measure itself and function today. The select few, at every level in the industry, who get this understanding clearly reap the rewards. They have not only a beautiful business, but enjoy a great career.

The rest buy themselves a terrible job because they don't want to learn about who and what we really are today.

Let me know what you discovered about your business doing these exercises. I would love to hear from you. You can send an email to *greenwood@aaec.ca*. MA

BOB GREENWOOD
CONTRIBUTOR

Bob Greenwood, AAM, is president and CEO of Automotive Aftermarket E-Learning Centre Ltd. (AAEC), a company focused on providing business management resources and development for the independent sector of the automotive aftermarket industry utilizing the Internet environment. Bob has more than 36 years of business management experience within the independent aftermarket industry, consulting independent retail shops on all facets of their business operations. Bob is one of 150 worldwide AMI approved instructors.

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SHOP PROFILE

A snapshot of one of the industry's leading shops

MARK'S AUTO SERVICE / ROCKFORD, ILL.

Second Wind

Navigating through the rough portion of the 2000s brought this shop new life in the new decade.

BY **ROBERT BRAVENDER** | CONTRIBUTING EDITOR

Two simultaneous events once threatened to close Mark's Auto Service: the financial crisis of 2008 and the passing of Mark Buttita's father.

"That really took the wind out of my sails," he recalls. The Rockford, Ill., shop he had opened 65 years ago was his father's legacy. "But then my wife and I bought the (property) from the estate. We brought my son in, joined a 20 Group, hired a business coach and things really started to take off."

Founded as a radiator repair shop, Buttita joined the operation in 1977 and promptly petitioned his dad about becoming a full repair shop, which it did after his father retired in the 1980s. As the shop changed so did the name, fully and figuratively becoming "Mark's." But his father still loomed large with his design foresight.

"My dad was sharp," Buttita boasts. "When he built the shop before this one, it was written up in two magazines as state-of-the-art. Then my dad and I built (the current facility) as our dream shop 30 years ago and we're just now growing into it. One of his signature things was to put all the lines over the shop — air, electrical, water — so there wasn't a lot on the floor. And he was pretty particular about the floor itself; he floated a red powder into the concrete so it wasn't painted and didn't chip off."

Despite being near the Chicago metropolitan area, Rockford was deeply impacted by the economic downturns of 2008. "We had shops going out of business left and right," comments Buttita. "But where a lot of places had rent to pay, we owned the building so there wasn't a whole lot of debt. (However) our numbers got crushed; we were down to two guys in the shop, two guys in the office and I was one of those guys."

Fortunately one of the other guys was technician Terry Smith, who had started with the company about the same time as Buttita. "He was able to run the shop, which allowed me to go search out what I needed to do to save the business."

Thus Mark began looking into consulting firms, one which came highly recommended at $50,000 a year. "But I asked if (their method) doesn't work, what then? They said just keep sending in the checks; 'You're in a contract, you're going to pay us $50,000 whether you use it or not.' I didn't get the warm fuzzies from that."

Eventually Buttita found a 20 Group association headed by Gary Gunn of Automotive Service Leaders. "All the guys were great. They had all started out where I was and they were all doing over million dollars a year now. And no contracts; you're not happy, you leave, no problem. I was like, are you kidding me? That's fantastic! Where do I sign?"

With Gunn as his business coach, Buttita learned about becoming a "yes" company. Mark's Auto Service now sends out about 10,000 cards a month for oil changes under $20, but Buttita had to get the shop ready first. "You have to have your policies, procedures and staff in place, because when these things hit you're going to get busy, and you have to be able to say yes," he explains. "You don't send a customer down the road, you don't say, 'No, we can't get to it right now.'

Photos: Mark's Auto Service

AT A GLANCE

Mark's Auto Service
Shop name

Mark Buttita
Owner

Rockford, Ill.
Location

1
Number of locations

65
Years in business

$250-$300
Average repair order

$1.1 million
Annual gross revenue

ASA, AAA, CARQUEST
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"And then boom — you do a good PMI, you do the inspections, you do speed of service to get everyone in and out right away. Our RO is $250 to $300, so it's not that high, but our volume is. We believe car count is king," Buttita continues. "We call it an 'oil change chain:' oil change, oil change, oil change; then hopefully they'll do a brake job or whatever. And it works. In the last couple of years, our business has been going up and up. Last year we hit a million one and we had never gone over $600,000 before. This year we're on track to go over that."

Buttita estimates that in the last year or two, they've about doubled the staff and put in $100,000 worth of gear: seven more lifts and new alignment and tire changing equipment. "In March of 2010 we did 99 cars for $30,000; in 2012 that jumped up to 163 cars for $53,000; 2014, up to 315 cars for $74,000; last month we finished 503 at $150,000. And we're looking at buying even more equipment and putting more guys on, including another service writer. We also went to all flat rate technicians; I had two techs recently book 80 hours each. This place is just blowing out. I recently signed a contract to expand my parking lot because I'm running out of space. It's a good problem to have," he laughs.

"We've invested a lot of money in diagnostics, a lot of money in training, and we're going to have to keep doing that," Buttita observes. "It looks like we might have to spend $100,000 on equipment and training every year. But we give away the first 15 minutes of diagnostics for free just to get them in the door. We offer free towing with the repair. We offer free shuttle service, free pickup and delivery, free alignment inspection just to get them in the door. But the customers learn to like you, trust you. You recommend a lot of work, and while you might not see it right away, pretty soon it all comes back."

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The Mazda RC4A-3L

WHILE IT'S NOT AS COMMON AS OTHER MAKES, KNOWING THIS TRANSMISSION WILL PUT YOU AHEAD OF THE REST.

BY **WAYNE COLONNA** | POWERTRAIN PRO PUBLISHER

FROM 2004 to 2006, the Mazda RX8 used a 4-speed, fully electronic transmission from JATCO called the JR405E. Mazda calls it the RC4A-EL transmission. Approximately 48,000 of these cars using this transmission were sold in the U.S. Around the world, it has had a bit longer of a life. In fact it was used in the Chevrolet Colorado from 2004 to 2011. Here in the U.S., the 4L60E transmission was used. I don't know how many of these 48,000 are still on the road today, but every once in a while we get a call on this transmission. And the rare times this transmission shows up on your door step, it's good to have some information so you can diagnose and repair the vehicle.

A good place to start is with a simple component application chart as seen in Figure 1. The location of the clutch assemblies inside the transmission are provided in Figure 2. The application chart also provides solenoid and pressure switch activity which we will go over further in this article. But for now, a quick look at the application chart in Figure 1 shows how the Low clutch is on for 1st, 2nd, and 3rd gear and releases in 4th. When a shift into 2nd takes place, the 2-4 brake is applied. This makes the 1-2 shift transition non-synchronous in that no timing is involved in releasing one clutch and applying another.

But the 2-3 and 3-4 shifts are another story; they are synchronous. The 2-4 brake releases while the High clutch is applied for a shift into 3rd. The Low clutch releases while the 2-4 brake applies for a 3-4 shift. This is essential to observe, as there are significant additions to diagnosing harsh synchronous shifts as opposed to a non-synchronous shift.

Characteristically, with a non-synchronous shift, you would need to consider pressure control, accumulator control, cushion plates, clutch clearances or band travel, orifice controlling check balls and fluid to friction compatibility. The same could be said for synchronous shifts with the addition of computer calculated adaptations for clutch release and apply timing control and temperature. Depending on the type transmission involved, this also might include counter balance pistons.

COMPONENT APPLICATION AND SHIFT SOLENOID CHART

Gear	Low Clutch	High Clutch	Reverse Clutch	2-4 Brake	L&R Brake	Low Sprag Clutch	PWM Sol "A"	PWM Sol "B"	PWM Sol "C"	PWM Sol "F"	TCC Sol	PS "B"	PS "C"	PS "F"	Gear Ratio
Park								X	X	X					
Reverse			On		On			X	X					X	2.272
Neutral								X	X	X					
"D"-1st	On					Hold		X	X	X					2.785
"D"-2nd	On			On					X	X		X			1.545
"D"-3rd	On	On						X		X	X*		X		1.000
"D"-4th		On		On			X			X	X*	X	X		0.694
"M"-1st	On				On*			X	X						2.785

X = Operating, Solenoids are On.
X* = Torque Converter Clutch may be on depending on vehicle speed and throttle opening.
M = When in Manual shift mode.

Figure 1

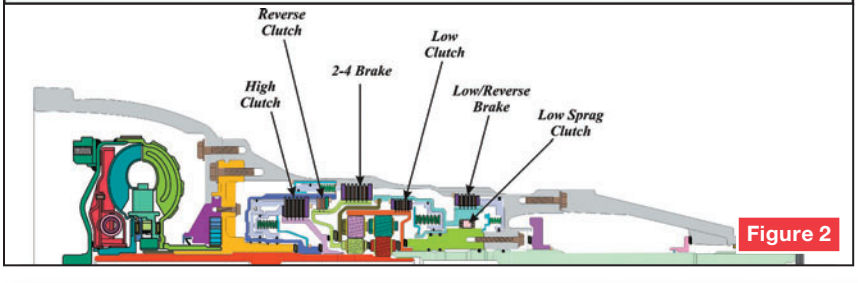

Figure 2

Photos: Wayne Colonna

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

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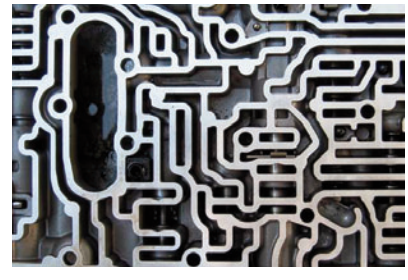

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The RC4A-EL utilizes this strategy with the Low (Figure 3) and High (Figure 4) clutch assembly. They refer to this as a centrifugal balance system. It replaces the conventional piston check ball. Centrifugal head oil pressure generated during clutch drum rotation is used to prevent clutch drag-engagement and to stabilize piston pressure during full rotation.

To take this a little deeper, you would need to determine what solenoids and regulating valves are involved in the specific shift transition giving troubles. This also includes bushings and sealing rings that are in play. When it comes to the RC4A-EL, there are pressure switches involved, particularly the 2-4 clutch pressure switch and the High clutch pressure switch (Figure 5). Without exhausting all the variables, there still remains quite a laundry list of items to consider when fighting harsh or slipping shifts; especially synchronous shifts.

Before we take a closer look at some of the solenoid controls in this transmission, I would like to mention a little about adaptation control. With different manufacturers come different computer strategies with which to determine clutch adaption. You can, however, usually count on a number of inputs to be common ground among them all. The first being engine load. This is a big input. It's good to remember that as time goes by, engine input data can become skewed for a wide variety of reasons. This ultimately will affect shift feel. Engine and/or transmission fluid temperature, speed sensors and a healthy electrical system are other critical inputs that influence clutch adaptation.

With that said, the first area in the hydraulic operation of this transmission to look at is the pressure control solenoid (Figure 6). This is a normally applied solenoid that measures between 12.3 to 16.3 ohms. It is fed with pilot valve pressure (solenoid regulating pressure), which the solenoid uses to raise and lower line pressures. The interesting aspect about this solenoid is that it is an On/Off type solenoid. When it is off, it directs pilot pressure to the spring side of the pressure regulator valve placing it at maximum pressure. When it is on, it blocks pilot pressure to the pressure regulator valve placing it at the minimum pressure position. The range is 46-65 psi low to 164-193 high in the Drive range. It is the Normally Applied clutch pressure control solenoids (Figure 7) that duty cycles at 50 Hz (20 ms cycle) to indirectly control clutch apply and release pressure. They have a specification range of 2.7 to 4.4 ohms.

Shift solenoid A controls the Low clutch pressure via an amplifier valve. This was the first time I saw a valve called by this name. I suppose the Low clutch could be called the low clutch Speaker. Well, thank goodness I do not get paid for my jokes. Continuing on, shift solenoid B controls the 2-4 Brake while shift solenoid C controls the High clutch through their respective amplifier valve. Shift solenoid F controls the Low and Reverse clutch via a L/R switch valve.

Another interesting shift control strategy unique to this transmission is the 2-4 clutch and high clutch each has both a pressure switch in their hydraulic circuits and accumulator pistons. Pressure switch signals and accumulator pistons for these two clutch assemblies assist in controlling smooth synchronous shifting. These pressure switches are rated to close between 57 and 71 psi.

To bench test these switches, simply place the positive meter lead on the

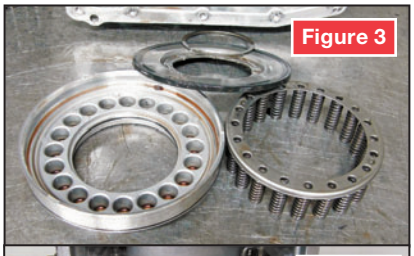
Figure 3

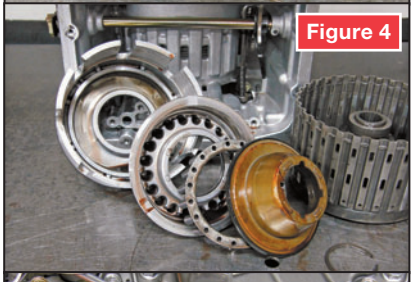
Figure 4

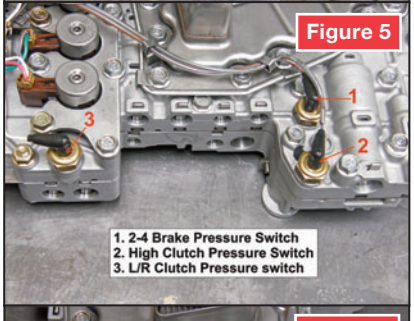

Figure 5

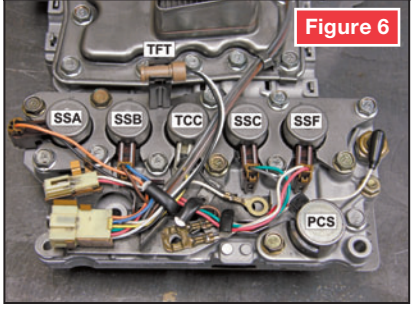

Figure 6

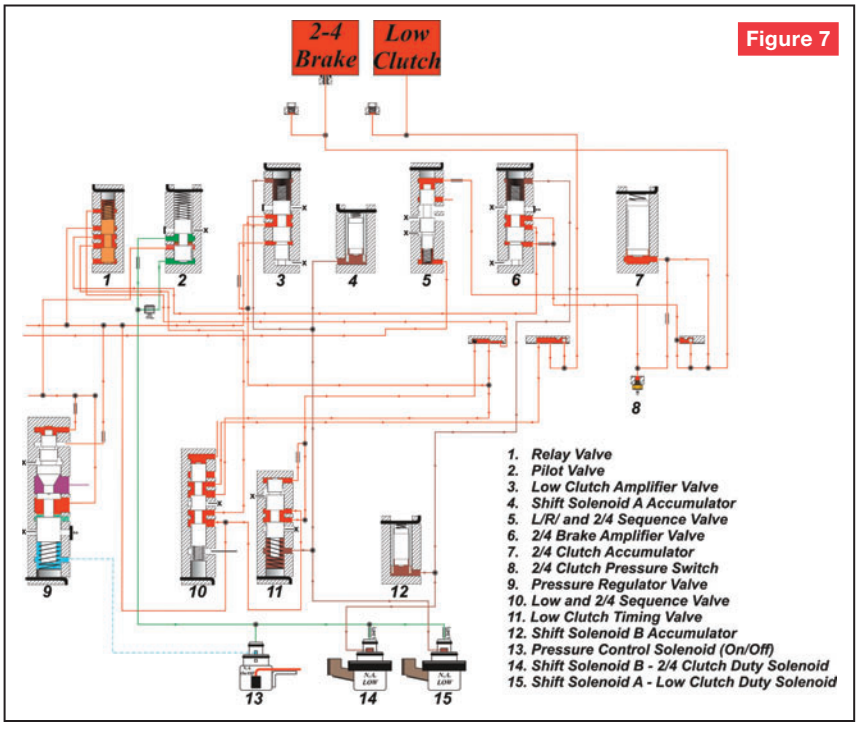

Figure 7

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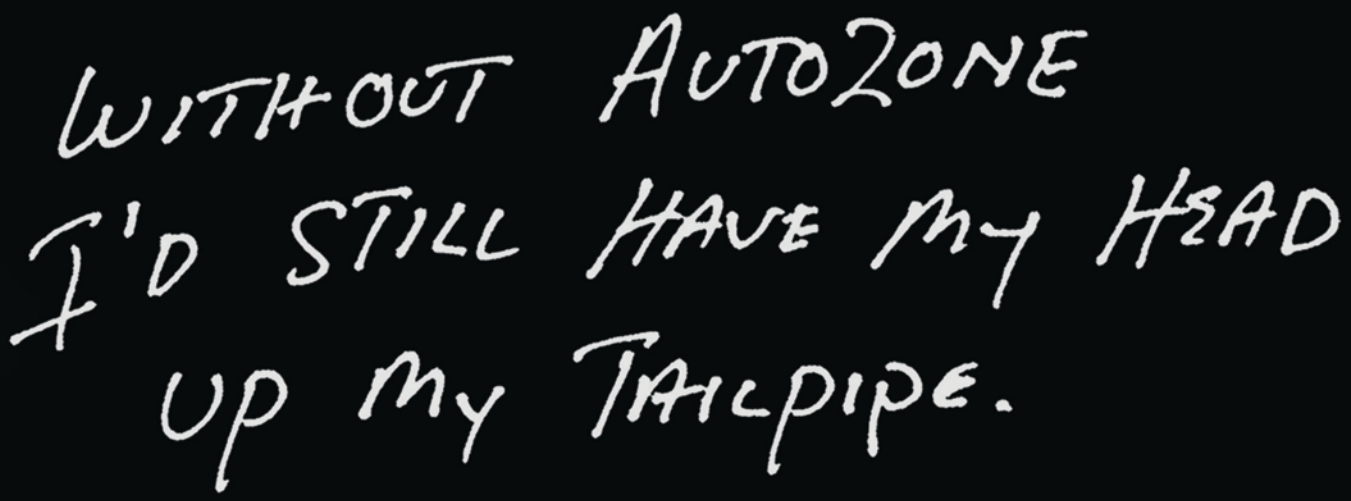

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single terminal located at the top of the switch. Place the negative lead to the base of the switch where the threads are located. The meter should read open. When 57 to 71 psi of air is supplied to the switch, continuity should be observed. The 2-4 pressure switch provides information to the computer for finer control of the 1- 2 and 3-4 shifts.

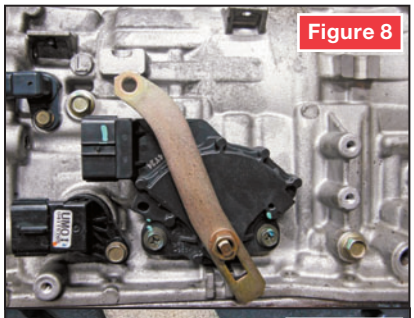
Figure 8

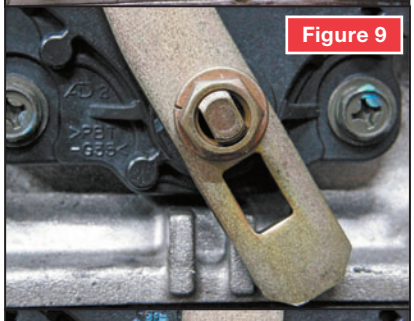
Figure 9

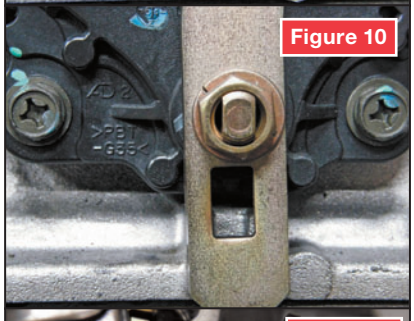
Figure 10

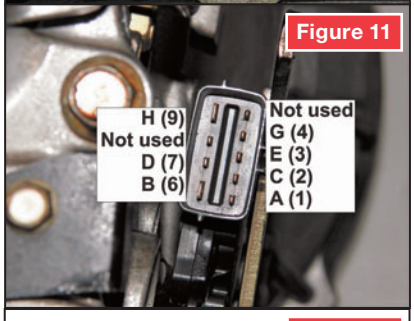

Figure 11

Figure 12

ATF temperature F° (°C)	Resistance (kilohm)
-4 (-20)	15.87-17.54
32 (0)	5.727-6.320
68 (20)	2.375-2.625
104 (40)	1.102-1.218
140 (60)	0.561-0.620
176 (80)	0.308-0.341
212 (100)	0.181-0.200
248 (120)	0.112-0.123
266 (130)	0.089-0.099

The High Clutch Pressure Switch for the 2-3 and the Low/Reverse for a garage shift into Reverse. Each of these pressure switches receives a 12 volt signal. When the switch closes it pull the voltage down to below 1 volt.

In addition to that, each of the duty cycle solenoids has its own accumulator pistons as well. The idea here is to provide a smoother stroking of their respective valves, which provides smoother clutch apply and release pressure (see SSA and SSB as an example in Figure 7).

The parameter in the scan tool for these duty cycle solenoids will be presented in percentage. As mentioned previously, these duty cycle clutch solenoids (shift solenoids) are Normally Applied solenoids. A zero percent duty cycle will indicate full apply, while a 99 percent duty cycle will indicate full release. The Lock-Up duty solenoid works in the opposite manner. This is a Normally Vented solenoid which would mean that a zero percent duty cycle will indicate a fully released converter clutch, while 99 percent will indicate a fully applied solenoid. The Pressure Control Solenoid and Pressure switches will be displayed as On or Off.

The turbine shaft speed sensor (TSS) and output shaft speed sensors (OSS) are both Hall Effect type. These sensors are supplied with 12 volts and a ground. The sensor will then provide a zero to 5 volt pulse back to the computer. It is recommended that when checking this signal using a scope, to set it at 5V division and 250 microseconds.

The scan tool will show this input in rpm. This is especially helpful should gear ratio needs to be calculated. This transmission has a 2.785 for 1st, 1.545 for 2nd, 1:1 for 3rd and 0.69 for 4th. A screen capture of the speed sensors can be used to verify a slipping or holding clutch. Dividing the OSS rpm into the TSS rpm will provide the recorded ratio. A TSS, for example, with an rpm of 1,785 divided by an OSS rpm of 642 will equal 2.780. A gear PID and a Gear ratio PID is also provided in the data monitor list as well. This is a great way to inspect the health of the converter clutch. When fully applied, TSS should equal engine speed.

There are a variety of PID's available for the transmission range sensor (Figure 8). They are:

1. The Park/Neutral position switch (CPP/NP) displaying P/N, R, D or M range.

2. Transmission Range (TR) displaying R, N and D.

3. D range Switch (TRD) displaying D On/Off.

4. R position switch (TRR) displaying R On/Off. A PID for the Manual (M) range will also be displayed as On/Off.

5. M range switch (MNL SW) displaying M range On/Off

6. Up Switch (UP SW) displaying Up-shift On/Off.

The range sensor itself is easy enough to check electrically. Ignition power is supplied to the C(2) terminal. When in Park, this voltage is supplied to the A(1) terminal. In Reverse, it's present on the E(3), in Neutral the D(7) and Drive the G(4) terminal. When aligning this sensor, align the square notch in the TRS lever with the square notch in the case (Figures 9 and 10). This is the Neutral position. Adjust the TRS sensor to read Neutral: continuity between C(2) and D(7) then tighten the switch to case (Figure 11).

Two PIDs are offered for the transmission fluid temperature sensor, one in degrees Fahrenheit or Celsius (TFT), the other in signal voltage (TFTV). The signal wire supplies the sensor with 5 volts. As the sensor resistance decrease when temperature increases, this 5-volt signal will drop. Factory specifications place the voltage to be 1.55 at 68° F. A temperature to sensor resistance chart is provided in Figure 12.

When this transmission was first released, the manufacturer claimed that the RC4A-EL type was newly developed as an automatic transmission with state-of-the-art technology. For improved shift quality, it used direct electronic shift control via the duty-cycle shift solenoids briefly covered in this article. It also cited the use of a feedback control system, a centrifugal balance clutch chamber system (Low and High Clutch also mentioned in this article) and a late-type clutch pack replacing the 2-4 brake band.

It is amazing how in just a few years this state-of-the-art technology has become near common place. And with the passing of time, some of these added features will begin to fail compromising the quality of the shift. Having now a little insight and information with this rare transmission, it will not be a stranger to you when it arrives in your shop.


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DRIVABILITY

Figure 1

A WINDOW TO THE SOUL

Here, the spark plug of the cylinder under test has been removed and a pressure transducer installed in its place.

HOW TO USE IN-CYLINDER PRESSURE ANALYSIS TO SOLVE DRIVABILITY PROBLEMS.

BY **BERNIE THOMPSON** | CONTRIBUTING EDITOR

The impossible is upon us — the ability to see into the internal combustion engine while it is running. Could this really be true? Can this really happen? Modern technology is ever-expanding, helping us with every facet of our daily lives from our homes to our phones to our vehicles. Advancements in technology are just downright amazing!

With such advancements in technology, it is an exciting time to be a technician. The modern vehicle has more computer power than the space shuttle with the appearance of a sophisticated aerodynamic road machine.

Just like the rapid advancement in the modern vehicle, rapid advancements have been made recently in automotive tools. These tools can make a huge difference in your shop's ability to quickly and accurately diagnose problems in these modern vehicle systems.

JUST SCAN IT

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Pressure Transducers

Now, back to that modern tool that allows you to see into the internal combustion engine: the pressure transducer. A pressure transducer is a device that measures a physical quantity of pressure (negative or positive) and converts it to an electrical output that is proportional to the applied pressure. To check the in-cylinder pressure,

Photos: Bernie Thompson

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the spark plug is removed and a compression testing hose with a pressure transducer is attached to the hose and inserted into the cylinder head as seen in Figure 1.

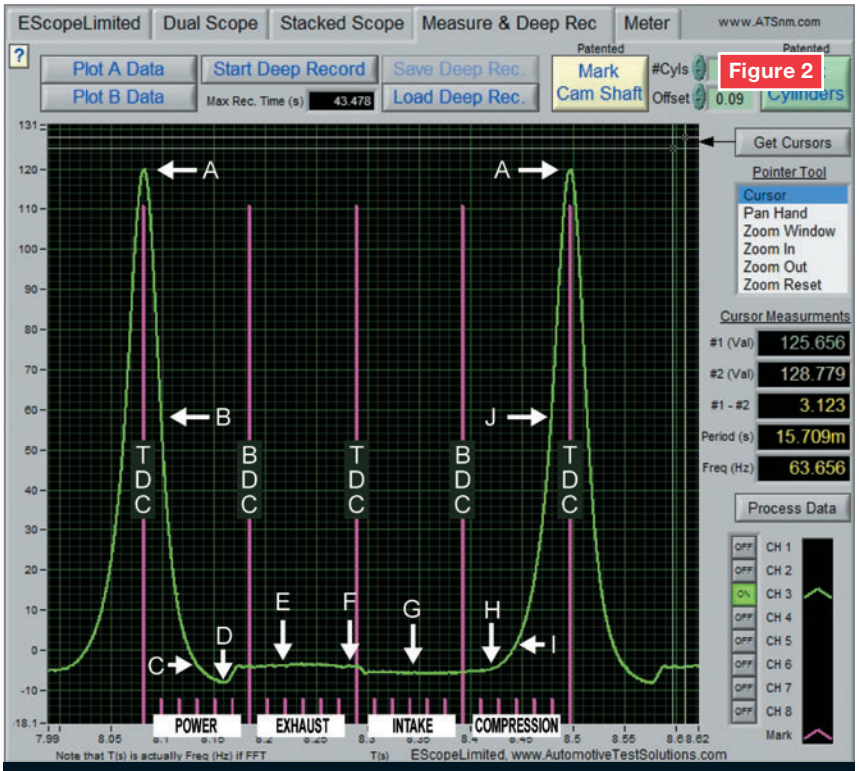
Because the internal combustion engine pumps air volume into and out of a cylinder, pressure changes will occur that will be proportional to the air volume being pumped. By using pressure transducers to monitor this volume-to-pressure change, one can "see" into the internal combustion engine.

To monitor the voltage output from these pressure transducers, use an oscilloscope. The oscilloscope will trace the pressure transducer's voltage output over time. This will allow one to see the inner workings of the engine, such as the intake and exhaust valves opening and closing.

When diagnosing using pressure transducers, there are three different distinct in-cylinder waveforms that will need to be analyzed: cranking, idle and snap throttle. Additionally, each of these in-cylinder pressure waveforms comes with different intake vacuum waveforms and different exhaust pressure waveforms that will also need to be analyzed.

Read Bernie Thompson's introduction to in-cylinder pressure testing at MotorAge.com/incylinder

Next, let's analyze a cranking in-cylinder pressure waveform as shown in Figure 2. The cranking pressure waveform is designated by the green trace, while the engine strokes are designated by the pink vertical lines. These pink vertical lines are broken down in two-degree marks — the large vertical lines are 180 crankshaft degrees while the small vertical lines are 30 crankshaft degrees. The pink mark on the left of the screen marked Top Dead Center (TDC) shows the point where the piston came as close to the cylinder head as mechanically possible. This occurs on the compression stroke where both the intake and



The green trace is recording the pressure changes during a no-start/cranking compression test. The pink vertical lines are crankshaft position references.

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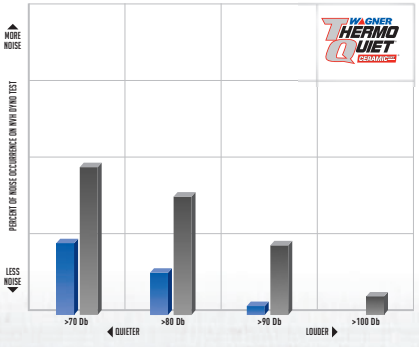

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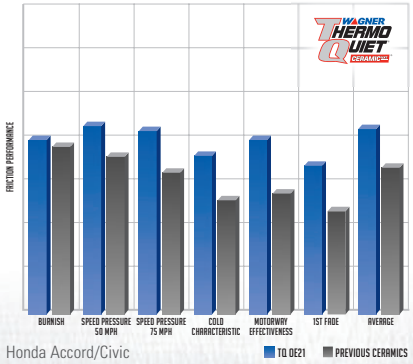
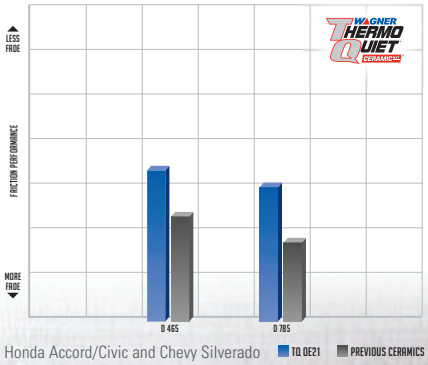


Honda Accord/Civic

REDUCED FADE



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exhaust valve are closed.

The peak pressure can be checked by the scale seen on the left side of the screen, which currently indicates that the peak pressure is 120 psi. You will need 7 to 10 seconds of cranking data obtained with the throttle in the closed position. It will be important to check the peak pressure on all the cylinders during the crank. These pressure peaks should be less than 1 psi from each other.

Make sure that the engine is not trying to start, thus changing the cranking rpm. If the rpm is changing, the peak pressure will also be changing. You need a steady crank rpm so the peak pressure will not change.

If a large leak is present in one of the cylinders, the rpm cannot be stable; additionally, this leak usually can be heard as the starter spins the engine faster during the low-pressure cylinder event and then slows down on the next high-pressure cylinder event. If a steady crank rpm is obtained and the peak pressure is changing cycle to cycle, then the cylinder volume is changing. This usually is caused by a leak within the cylinder.

After the TDC compression event at Point A, the piston, after being stopped momentarily, will start to be pulled away from the cylinder head by the connecting rod, which is connected to the rotating crankshaft. This will increase the volume within the cylinder, thereby decreasing the cylinder pressure. This normally would be the power stroke, but remember, there is not a spark plug present in the cylinder to start the point of ignition. (On cylinders with dual spark plugs, the second spark plug must be disabled.) Because this stroke does not have a point of ignition, this will be referred to as the decompression stoke.

As the piston moves further away from the cylinder head, the pressure within the cylinder follows the volume change and continues to decrease. Point B is the point at half-mast, which is the point halfway between Points A and D. This Point B on the decompression ramp, as well as Point J on the compression ramp, should be within 20 crankshaft degrees of the TDC mark.

If these half-mast points fall greater than 20 crankshaft degrees of the TDC mark, then the cylinder most likely is leaking. When this happens, the compression tower looks like it is leaning. These leaning towers can be caused by cylinder leakage from valve sealing issues, piston sealing issues, head gasket sealing issues or camshaft timing problems.

Points C and D

As the cylinder pressure decreases further, Point C is reached. Point C is at 90 crankshaft degrees after TDC compression. As the decompression of the cylinder continues, Point D is reached. Point D is the point of exhaust valve opening, and should occur between 30 and 60 crankshaft degrees Before Bottom Dead Center (BBDC) exhaust.

The exhaust valve pocket at Point D should be formed with a definition point that is clear, concise and repeats over and over. This shows the exhaust valve seal is intact. Right after Point D, the waveform starts to rise up until the exhaust plateau is reached.

It is interesting to note that the piston is still moving down when the pressure waveform is rising right after Point D. This is caused by the vacuum created during the intake stroke and seal within the cylinder when the intake valve closed. When the exhaust valve opens, the higher atmospheric pressure in the exhaust system rushes into the cylinder to fill the low-pressure area contained in the cylinder. This allows the pressure to rise, even though the piston still is moving down, creating more volume, which in turn should create a lower pressure.

The point at D is how you can see whether the exhaust camshaft timing is off during engine crank. This point can be up to one tooth off, and you might not be able to identify the exhaust camshaft timing is off; however, you will be able to identify if it is two teeth off. This is very helpful, because most engines still will start with the camshaft timing being one tooth off.

If the engine will start, it is better to check the idle compression waveform for camshaft timing, which will identify a one-tooth camshaft timing error. During the idle compression waveform, the exhaust plateau ramps will be used to check camshaft timing. It is important to understand these exhaust plateau ramps will not be used to check camshaft timing for a cranking waveform.

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Points E, F, G and H

Point D will rise into the exhaust plateau, which is at atmospheric pressure and is shown as the average pressure at Point E. At Point F, the intake valve opens, allowing the air to flow into the cylinder. As the piston moves away from the cylinder head, the cylinder volume is increased, creating a lower cylinder pressure.

This pressure drop should occur at the TDC intake mark and should fall rapidly to the lower intake pressure, shown as an average at Point G, and is a lower pressure than the atmospheric pressure shown at Point F. This pressure differential between E and F is at engine crank, and is low compared to engine idle. At engine crank, the pressure difference is 1 to 2 psi, and at engine idle this pressure is 8 to 11 psi. The faster the engine is turning, the more energy is available to pull against the close throttle. This is why the exhaust plateau is larger at engine idle and smaller at engine crank.

Additionally, the pressure differential at Points D and G should be within 2 psi of each other. If the pressure at Point D is lower than 2 psi from Point G, there has been volume loss — you should suspect a leak within the cylinder.

During the compression stoke, the in-cylinder pressure is increased, which allows a larger volume to escape past a leak point. As the cylinder decompresses, the decrease in air volume within the cylinder will show greater vacuum at Point D than the intake pull pressure at Point G. This allows the exhaust pocket at Point D to have more vacuum than the intake vacuum pull had at Point G.

At Point H, the intake valve closes, as can be seen by the rapid rise in pressure after Point H. This pressure rise should occur between 40 and 60 crankshaft degrees After Bottom Dead Center (ABDC) compression. This point is where the intake camshaft timing will be checked.

It is interesting to note that as the piston is rising, reducing the volume in the cylinder, the pressure within the cylinder remains the same — it does not increase, as one might expect. This is because the intake valve is still open during the piston's upward movement, thus exposing the cylinder pressure to the pressure from the intake manifold. The intake manifold, having volume area, will store other cylinders' intake pulls, which act like an accumulator storing a lower pressure. This lower pressure will stabilize the in-cylinder pressure from rising until the intake valve is closed, which makes this an ideal point to check the intake camshaft timing.

Points I and J

The piston continues its upward movement, lowering the volume and thus increasing the in-cylinder pressure. The pressure will increase and come to Point I, which is at 90 crankshaft degrees. As the pressure increases, it will come to Point J, which is the point of half-mast on the compression tower.

The piston will continue its upward travel to the point where the smallest volume and highest pressure in the cylinder is reached, which is TDC. It will help to understand that the majority of the in-cylinder pressure is made in the last 30 degrees of crankshaft rotation, and very little piston travel occurs at this point. If any of the cylinder volume leaks out of the cylinder, it will have a great impact on the overall pressure at TDC within the cylinder.

To fully understand the in-cylinder pressure waveform, we will need to look at the intake and exhaust waveform that is produced during engine crank as well, as seen in Figure 3. The green waveform is the same compression waveform that we have analyzed thus far. It's helpful to overlay the intake waveform (blue trace) and the exhaust waveform (yellow trace) over the compression waveform (green trace). When analyzing the in-cylinder pressure waveform, this overlay will help show where the cylinder leak is located.

Intake Waveform

Let's start by analyzing the intake waveform (blue trace), which is read in inches of mercury. The cylinder that is producing the in-cylinder pressure waveform will have the intake pull located right after the TDC 360 crankshaft degree mark. The intake pull indicated by the blue trace hump marked No. 1 is produced from the in-cylinder pressure waveform (green trace).

It will be important to check this point on each of the cylinder pulls. This point where the intake pressure is falling and then rising is the point

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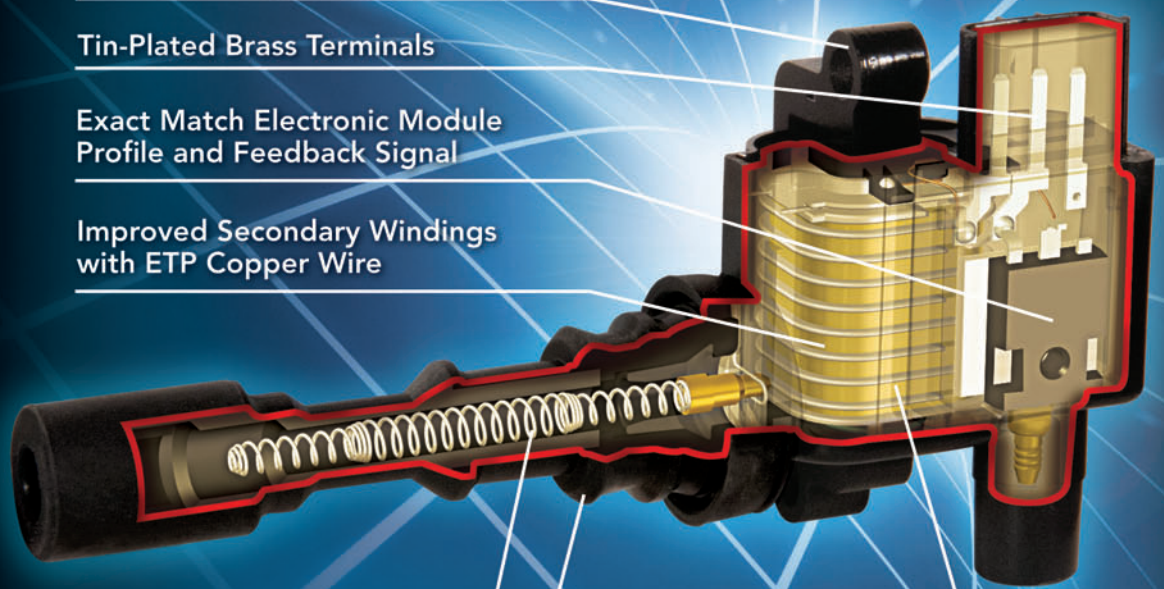

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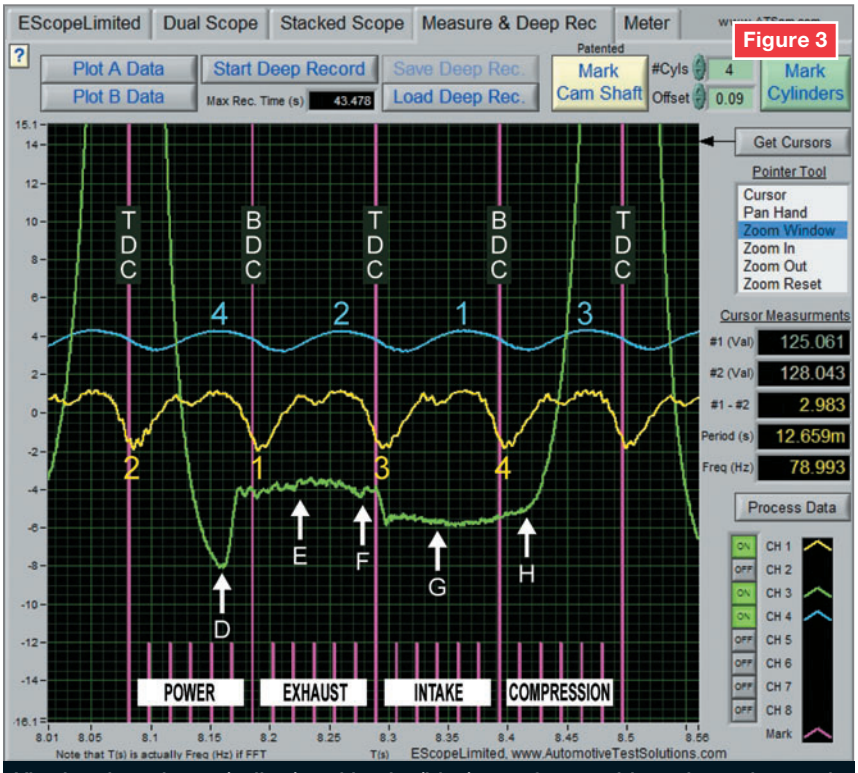

Viewing the exhaust (yellow) and intake (blue) waveforms adds to the understanding of what the cranking pressure waveform is trying to tell you.

where the vacuum pull is transferring from one cylinder to the next. These transfer points should all be very even, as well as the overall pressure increase located next to the cylinder number. If they are not even, a cylinder leak is the likely cause. To locate the cylinder vacuum pull, first locate the pull from the cylinder that is producing the in-cylinder pressure waveform as described above, then apply the firing order for the engine on which you are working. As can be seen on the blue trace, each of the cylinder vacuum pulls is marked by the firing order, indicating the cylinder that created it.

Exhaust Pressure Waveform

Now we will analyze the exhaust pressure waveform (yellow trace), which is read in inches of water column. The cylinder that is producing the in-cylinder pressure waveform will have the exhaust push located right before the TDC intake 360 crankshaft degree mark.

As we have covered previously, Point D is where the exhaust valve opened — and this exhaust valve

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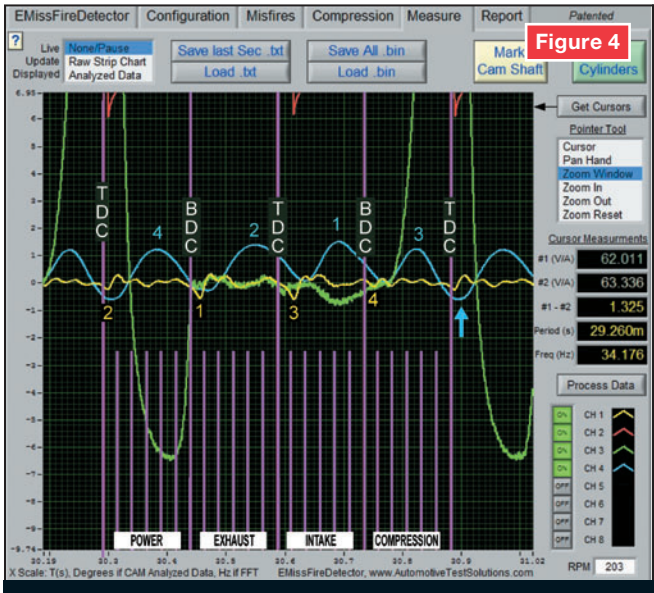

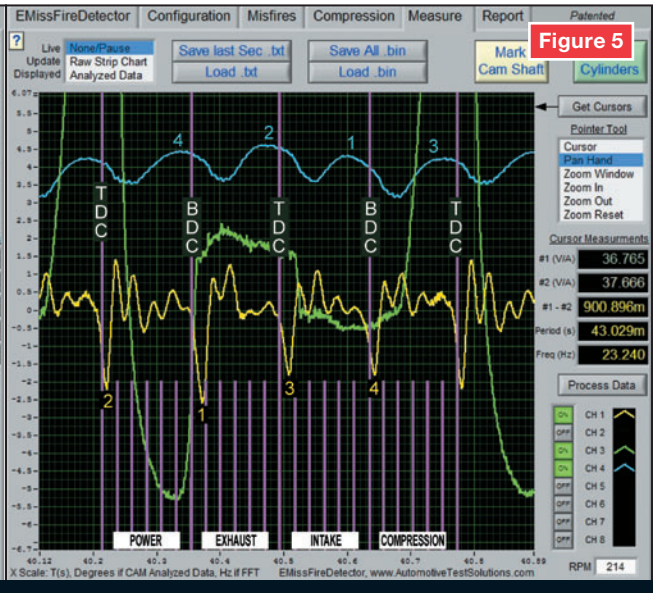

(Figure 4) Look closely at the intake (blue) waveform in this known bad cylinder, revealing an intake valve sealing issue as the cause of the low compression. (Figure 5) In this known bad capture, the intake (blue) trace points to either an exhaust valve sealing issue or ring sealing issue. A follow-up running pressure test will confirm which is the cause.

opening will affect the exhaust manifold pressure. The yellow trace where No. 1 is located is where the exhaust valve opening allowed the vacuum contained within the cylinder to pull the exhaust manifold pressure into the cylinder, thus creating a low-pressure area in the exhaust. This low pressure, indicated by the No. 1 mark, is the transfer area — or the point that one cylinder exhaust is transferring to the next cylinder's exhaust. These exhaust transfer points should be even from one cylinder to the next cylinder.

Just after the BBDC exhaust mark, the piston starts to move upward. This creates a pressure push, which in turn increases pressure in the exhaust manifold. As the piston moves upward, this pressure will increase until it reaches a level just above atmospheric pressure. This pressure level will have slight ripples, which is normal. At the point the exhaust valve is closing and the next cylinder exhaust valve is opening, the pressure drops into the next exhaust pressure transfer point.

Cases in Point

In the problem cylinder seen in Figure 4, the green trace is the in-cylinder pressure waveform; the blue trace is the intake waveform; and the yellow trace is the exhaust waveform. When analyzing the in-cylinder waveform, several things stand out — including the leaning compression towers and the deep exhaust pocket. These items clearly show the cylinder is leaking.

Now look at the intake waveform in blue. The cylinder intake pull marked No. 1 is from the cylinder we are currently testing. The intake pull marked No. 3, as we can see, is narrow and the transfer point at the TDC mark has moved to a positive pressure. This is caused from an intake valve sealing problem.

As the piston moves upward on the compression stroke, the air volume in the cylinder is pushed into the intake manifold past the leaking intake valve. This creates the narrow intake pull on No. 3 and then the positive pressure in the intake manifold.

In the problem cylinder seen in Figure 5, the green trace is the in-cylinder pressure waveform; the blue trace is the intake waveform; and the yellow trace is the exhaust waveform. When analyzing the in-cylinder waveform, several things stand out — including the leaning compression towers and the deep exhaust pocket. These items clearly show the cylinder is leaking.

Now look at the intake waveform in blue. The cylinder intake pull marked No. 1 is from the cylinder we are currently testing. Notice that the intake pulls from Nos. 1 and 3 are slightly lower; additionally, the transfer point after No. 1 is lower. If the exhaust valve is leaking when the intake valve opens, some of the air is pulled from the intake manifold and some of the air is pulled from the exhaust manifold past the leaking valve. This lowers the intake manifold pressure until the intake valve closes.

To ensure this is not a piston sealing issue, the engine will be run and the exhaust pockets will be checked. If the exhaust pockets are changing cycle to cycle, the exhaust valve likely is the problem. If the exhaust pockets are good, the piston seal is the problem. The crankcase pressure can also be tested to see whether pressure is building in the crankcase when the compression stroke is made, indicating the piston is not sealing.

Not that long ago, we didn't have cell phones, but now the cell phone serves a purpose and helps us in our daily lives. Similarly, once you start to use pressure transducers in your service bays, you will wonder how you ever got along without these high-tech marvels.

BERNIE THOMPSON
CONTRIBUTING EDITOR

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

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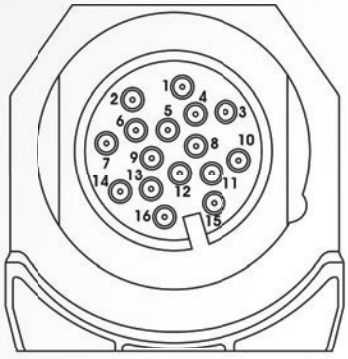

Figure 2

PINS	COMPONENT	OHM VALUE
3&7	TCC SOLENOID	Approx. 5.5 Ohms
5&6	TRANSMISSION FLUID TEMPERATURE	30k @ 68°-drops with temp increase
8&7	SHIFT SOLENOID E CONTROL "SSE"	Approx. 10.5 Ohms
9&7	SHIFT SOLENOID A CONTROL "SSA"	Approx. 5.5 Ohms
10&7	SHIFT SOLENOID D CONTROL "SSD"	Approx. 5.5 Ohms
13&7	SHIFT SOLENOID C CONTROL "SSC"	Approx. 5.5 Ohms
14&7	SHIFT SOLENOID B CONTROL "SSB"	Approx. 5.5 Ohms
16&7	PRESSURE CONTROL SOLENOID A "PCA"	Approx. 5.5 Ohms

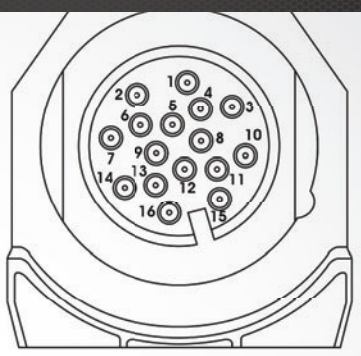

Figure 1

PIN #	DESCRIPTION AND FUNCTION
1	TURBINE SHAFT SPEED SENSOR (TSS)
2	NOT USED
3	TCC SOLENOID CONTROL (GROUND)
4	TRANSMISSION RANGE SENSOR (TR)
5	SIGNAL RETURN (TFT-GROUND)
6	TRANSMISSION FLUID TEMPERATURE (TFT) POWER SUPPLY
7	IGNITION VOLTAGE (POWER SUPPLY FOR SOLENOIDS)
8	SHIFT SOLENOID E CONTROL "SSE" (GROUND)
9	SHIFT SOLENOID A CONTROL "SSA" (GROUND)
10	SHIFT SOLENOID D CONTROL "SSD" (GROUND)
11	TRANSMISSION RANGE SENSOR (TR) GROUND
12	BATTERY VOLTAGE (TSS AND OSS)
13	SHIFT SOLENOID C CONTROL "SSC" (GROUND)
14	SHIFT SOLENOID B CONTROL "SSB" (GROUND)
15	OUTPUT SHAFT SPEED SENSOR (OSS)
16	PRESSURE CONTROL SOLENOID A "PCA" (GROUND)

TCM RELOCATION

WHEN MANUFACTURERS STARTED SAVING SOME MONEY BY PLACING TRANSMISSION CONTROL MODULES (TCMS) INSIDE THE TRANSMISSION, DIAGNOSING SOLENOID-RELATED ISSUES 'EXTERNALLY' WAS LIMITED TO WHATEVER YOUR SCAN TOOL COULD TELL YOU.

BY **WAYNE COLONNA** | POWERTRAIN PRO PUBLISHER

Sometimes you hear of a freely traveled road or bridge suddenly becoming toll access only. The promise is that once they raise enough money for a certain project, the toll will go away. I have yet to see that promise fulfilled.

When I see a transmission control module (TCM) inside the transmission, I think to myself, it sure would be nice if they would relocate it externally. But I don't hold my breath.

But to my surprise, I could have held my breath with this new feature with Ford, as the automaker relocated it. Beginning at the start of production for the 2010 model year on Ford trucks with the 6.2L engine, the Transmission Control Module/Mechatronic unit was removed from the top of the valve body and is now combined with the Engine Control Module in the newly revised Powertrain Control Module. This change then carried on to 2011 model cars and trucks equipped with 3.7, 5.0 and 6.2 L engines. However, 4.6 and 5.4L vehicles still have an internal TCM.

Figure 1 provides terminal identification for the new pass through transmission connector, which can be used for external diagnostics. Figure 2 provides solenoid resistance checks.

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ELECTRICAL

TROUBLESHOOTING PARASITIC ELECTRICAL DRAINS

This tech is testing voltage drop across a fuse.

LIKE ANY OTHER PROBLEM, FOLLOWING A SOLID PROCESS WILL ENSURE YOUR SUCCESS.

BY **ALBIN MOORE** | CONTRIBUTING EDITOR

How many times has a vehicle come to your bay with a new battery, new starter, new generator — and the vehicle owner complaining of the battery going dead if the vehicle is not driven every day or so? From time to time I read about problems like this, and see them in my shop quite often. Most times the vehicles have had many new parts installed, wiring harnesses cut apart and modules unhooked, all in an attempt to find where those elusive electrons are going.

The key to the diagnostic process is to get the problem to come to you instead of you chasing the problem. I would imagine that most of you folks own a cell phone and have lost it a time or two. When it comes time to find it, what path do you take? Do you start looking for it, turning the room upside down and searching, or do you grab another phone, call your cell phone number and then follow the sound of the ringing phone to its hiding place? So it goes with any diagnostic process; learn how the system works, do the appropriate testing, and use the testing results to find where and what the problem is.

The Challenge Has Changed

Parasitic draw problems have changed a lot over the years. Back before electronic control modules were used on vehicles, there was nothing to draw current from the battery once the headlights, accessories and ignition switch were turned off.

Fast-forward to today, and the places on a vehicle that can cause battery drain are endless. Today's vehicles have many electronic modules that draw current at all times, with some modules that can draw current for several hours even after the ignition switch has been turned off. With the advancement of electronics and the seemingly endless electrical systems,

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parasitic draw problems are getting to be more common all the time.

Back in the day, using a bulb or test light to complete the ground circuit of a battery was a great way to do the testing for a parasitic draw problem. If the bulb glowed, there was some current flow; when the bulb no longer glowed, the problem was fixed. This tried and proven test is no longer of value, since there is always some current flowing from the battery, powering internal "clocks" and the Keep Alive Memory (KAM) of the Engine and Transmission Control Modules (ECM and TCM).

So far, I have not yet seen a test light with a calibrated bulb (or a tech with a calibrated eye) that could tell the difference between a 2 milliamp (mA) draw and a 4 MA draw. Relying on this outdated method will only lead to frustration and continued comebacks from misdiagnosis.

Low-Tech Solution

While the potential causes of parasitic drain have become more complex, the tooling for detecting them does not need to be very high tech. It can be as simple as using a digital volt ohm meter (DVOM), a set of test leads, a high-current battery cable switch and a wiring diagram.

Watch a Trainer video on 3 ways to troubleshoot battery drain at MotorAge.com/batterydrain

For some parasitic draw problems, having a recording amp meter can be very useful, especially in the case of a module that will wake up in the middle of the night and drain the energy from the battery. As a professional technician, you already should own a quality DVOM, and many high-end scan tools are equipped with graphing meters and/or digital storage oscilloscopes (DSOs).

Before You Start the Hunt

Before any testing for parasitic draw problems is performed, the battery should be tested to verify it is in good condition and that the charging system is working properly. Once these are verified to be in good working order, then move on to the parasitic draw problem.

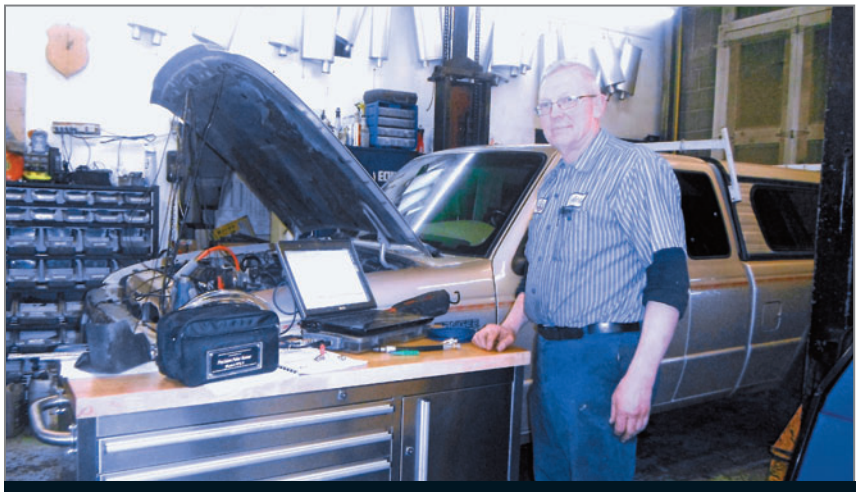
Go to your service information and find out how much current draw the vehicle manufacturer allows. For most vehicles with a single battery, this current draw will be somewhere between 2 mA (0.02 amps) to 4 mA (0.04 amps). Once you know how much current is allowed, you will have a target for which to shoot.

Start the diagnostic process by putting a high current switch on the negative battery terminal and hooking the negative battery cable up tight. It is always a good practice to take the vehicle on a short test drive, and then operate all the accessories on the vehicles. This is done to bring the vehicle as close to its real-world working conditions as possible. The battery disconnect switch has been installed in the battery circuit so an amp meter can be hooked into the circuit without having to open the circuit and destroy all the evidence you were able to capture on the test drive.

Why not use a low-amp current probe around a battery cable, you ask? This will work in some cases, but if a low-amp probe is left on for an extended period of time, most current probes will drift a little. Then when you look and observe a reading of, lets say, 2.5 mA and the actual current flow is 3.5 mA, the information is not correct. This can mean the difference between fixing the problem the first time and having an angry customer stuck somewhere with a dead battery.

This is the reason why I prefer running the current through a meter, whether it be a graphing or digital device. These kinds of test meters always report with great accuracy.

With the meter hooked up and all doors closed, let the vehicle set until all the modules go to sleep. Depending on the vehicle, this might take 20 minutes or it might take six hours. If the vehicle is disturbed during this period, you get to start the process over again. In a case like this, you are at the mercy of



Albin doing what he does best — watching a scanner or labscope.

This 2007 Suburban had multiple electrical problems.

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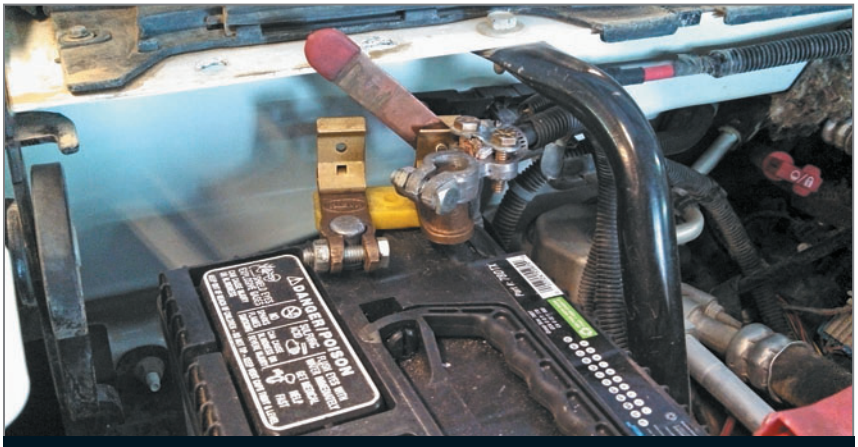
the vehicle, and it doesn't do any good to try and hurry the process.

If you must access the cabin, disable the driver's door switch ahead of time so the door can be open without turning on lights or letting a module know the door is being opened.

Tracking it Down

Once all modules have gone to sleep, it is time to start finding where the current is flowing. I suggest printing out a picture of each fuse panel so you can easily identify the fuses. This also gives you a place to make notes as you work your way through the diagnostic process.



Here is a high-amp switch installed on the negative battery terminal. This switch is used so the vehicle can be started and driven. The meter test leads are then hooked to both sides of the switch, then the switch is open. That allows the current to flow through the recording meter, and allows the meter to be hooked up without disrupting the power to the vehicle.

Testing volt drop across the 25-amp rear wiper fuse on the Suburban.

Here are the results of the volt drop test across the 25-amp rear wiper fuse. The volt meter shows 0.3 mA of volt drop. This fuse is flowing 0.6 amps of current.

Before you grab a pair of pliers and start pulling fuses, though, consider what happens when you pull the fuse to the Powertrain Control Module (PCM) or the Body Control Module (BCM). Pulling the fuse will cut the current flow to those modules — and if you are lucky, you might find where the current draw is. But if you aren't, when the fuse is inserted back into its cavity, you just woke up those modules and now you need to take a break while those modules go back to sleep.

A less-intrusive way to find the current flow is performing a voltage drop test across each fuse with your DVOM set to the milliamp voltage scale. I have found this procedure to be both accurate and quick.

Start by setting the DVOM to the lowest voltage setting the meter allows. You also should be using a pointed probe on each meter lead. If you take a look at the meter display, the DVOM will show voltage when the leads are not hooked to anything. Once the leads are hooked to each terminal of the fuse, the meter reading should show zero volts.

If there is any current flow through the fuse, a voltage will be reported on the meter screen. Why? The fuse is a thermal device that is designed to fail when the rated load is exceeded. It has a resistance, and this resistance varies with fuse design and current rating. As with any resistance in an electrical circuit, when current is flowing, a drop in voltage will be present — and measurable.

As with any diagnostic process, the technician should start with a system of gathering information and as the process proceeds, the information gathered will keep narrowing the problem down until the problem has been pinpointed. In this case, use the DVOM to test the voltage drop across each fuse and note this voltage on your fuse chart.

Once all fuses have been tested, use the fuse charts to identify the circuit each fuse feed. Identify the circuits that do not power up modules, and start removing those fuses one at a time, while watching the reading on your recording amp meter. The reason for using this approach is so none of the electronic modules are disturbed.

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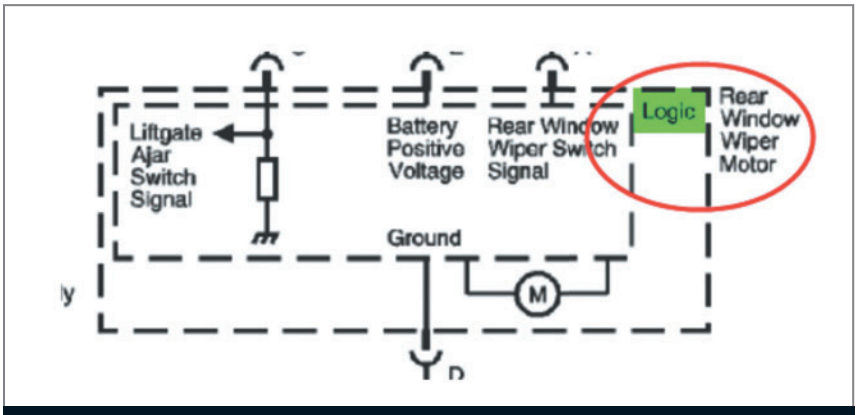
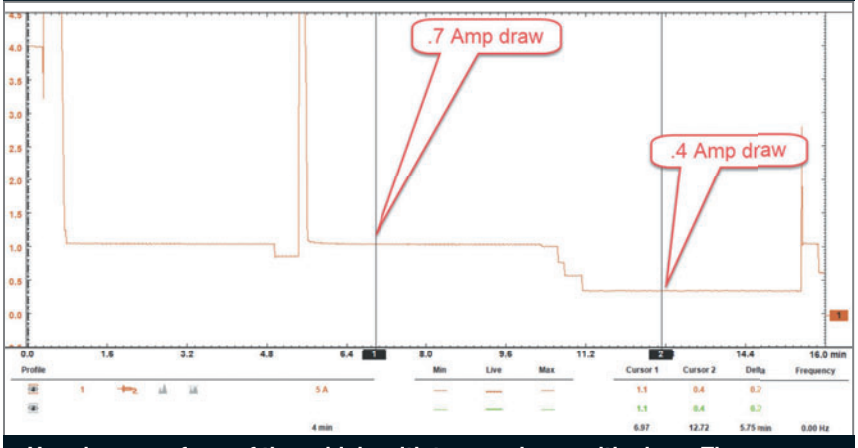


This is a schematic of the wiper motor showing the "logic" notation. Small details like this can be very important to the diagnostic process.



Here is a waveform of the vehicle with too much parasitic draw. The waveform shows the modules going to sleep, but the minimum current draw is 0.4 amps. This current draw is too much and will drain the energy from the battery if the vehicle is not driven daily. Consider what this kind of parasitic draw will do to the life of the generator and the battery.

This is the rear wiper motor/module and the logic module. This window motor works normally, and the only problem is the 0.6 amp draw — which will kill the battery if the vehicle is not driven every day.

If the current draw is not pinpointed, then start removing circuit breakers and the covered fuses you couldn't test with your DVOM.

When the fuse powering the circuit with the current draw is removed, your amp meter will let you know. Once the circuit has been identified, you are on your way to doing the pinpoint testing for the problem.

A Real-Life Example

A 2007 Chevrolet Suburban K2500 truck came to the shop for a no-crank problem. The battery and starter had been replaced in an attempt to fix the problem. The testing process started by hooking a Tech2 scan tool and polling the modules on the vehicle. The scan tool found no communication with any of the modules, with the exceptions of the BCM and the AntiLock Braking System (ABS) modules. There is also a parasitic draw problem that will deplete the battery energy overnight.

The vehicle owner said the vehicle had been bought at auction. It was supposed to be a low-mileage vehicle in good running condition. The vehicle had been sitting for six months and the battery had gone dead. An attempt at jump-starting the engine had only caused all the windows to go down, then all systems went dead.

This is a classic case of jumper cables being hooked up backward, I thought, which would explain all the dead modules. The reason the battery is going dead is a 0.4 amp continuous draw from the battery.

With the electrical trauma this vehicle has suffered, I recommended replacing or fixing all the electronic modules before any time was spent trying to find the parasitic draw problem.

The reasoning behind fixing the module communication problems first is so the vehicle electronics are all working properly. Anytime electronic modules are involved, it is important they are in working order. Defective modules are common causes of parasitic draw problems.

With all modules working properly, I started testing the voltage drop across the fuses. I started in the engine compartment fuse box, where the only fuses I found flowing current were those powering up the PCM and BCM.

With all the new modules installed in the vehicle and the wiper motor replaced, the parasitic draw is down to 0.022 amp after all the modules have gone to sleep. The problem is finally fixed.

Moving to the interior fuse panel, the only fuse with any current flow was the fuse that powered the rear window wiper motor. Of course, this was the last fuse in the fuse panel.

Using a wiring diagram of the rear wiper motor, I found something interesting: In the wiring diagram of the rear wiper motor, there is a note saying "logic" or "logic module." Anytime I see something like this, it is saying to me, "There is something inside that cannot be tested with an ohm meter." In other words, all I can test is the inputs and the outputs.

After studying the wiring diagram, I found the rear wiper motor has an input to the BCM. The rear wiper motor has its own little computer module that is not on the Controller Area Network (CAN) bus, but is in control of the rear wiper and washer operation.

The current draw is internal to the rear wiper logic module. There are two ways of testing this problem: One way is to unplug the wiper motor plug, which will cause the current draw to go away; and the other is to use a low-current probe to check the current draw on circuit 2040 (a red wire with white tracer).

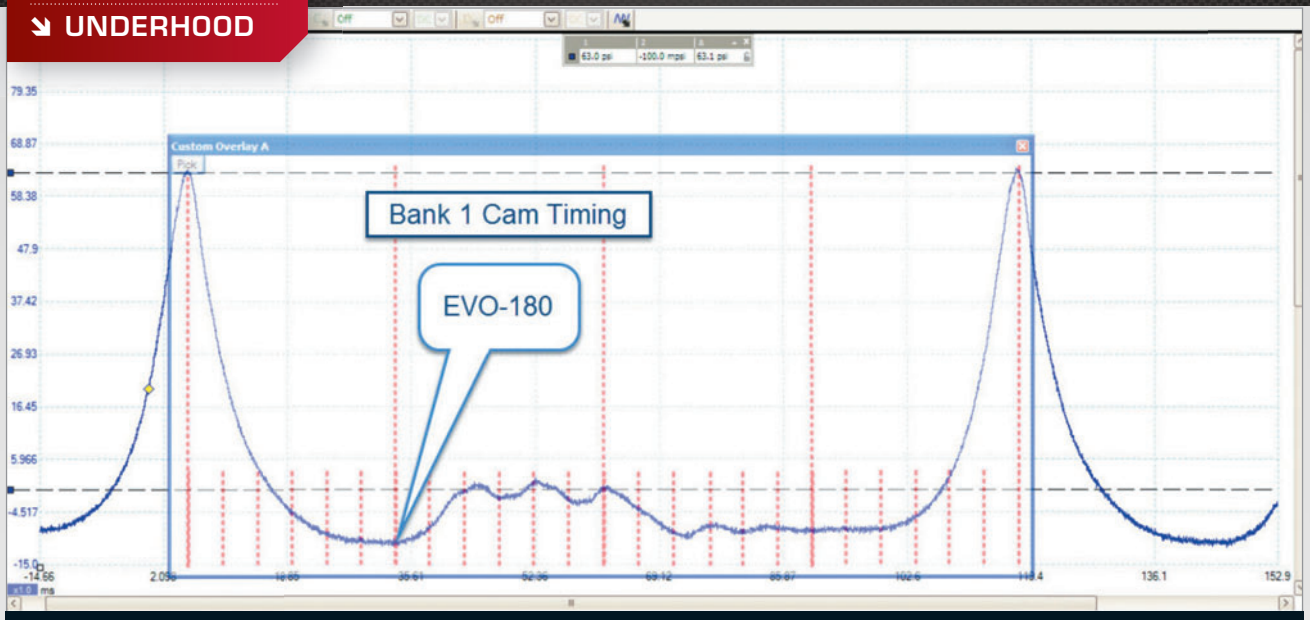
I prefer using the current probe, because the test in non-intrusive and will test the circuit with it intact and in its own working environment. You do not know whether unplugging the module will kill not only the module you are working on, but how it will affect other modules in the system.

With a new rear wiper motor installed, the current draw came down to .022 amp, which is normal for this vehicle. By using a systematic diagnostic process, jobs like this are both profitable and fun to work on.

ALBIN MOORE
CONTRIBUTING EDITOR

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

Email Albin at bwrench@yahoo.com



This shows in-cylinder running compression on cylinder bank 1. Notice the exhaust valve opens at the 180° mark of crankshaft rotation.

FUEL TRIM ANALYSIS FOR DRIVABILITY

THE BETTER YOUR UNDERSTANDING IS, THE MORE EFFICIENT YOUR DIAGNOSTIC PROCESS CAN BE.

BY **ALBIN MOORE** | CONTRIBUTING EDITOR

JUST SCAN IT

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Fuel trim analysis always is a very interesting subject, especially when it comes to using the fuel trims to analyze drivability problems. Have you ever stopped to think about the fuel trim and what it is telling the technician?

Several years ago, I remember being in a training class where the trainer stated that "the art of diagnostics is to get the problem to come to you, instead of you chasing after the problem." This is an interesting concept, since it leads a person to a different thought pattern of diagnostics.

Consider something as routine as finding a leak in a tire. I know the easiest way is to inflate the tire, then dunk it in a tub of water and see where the air is squirming its way to the atmosphere. Here again, the person looking for the leak is using a diagnostic process to quickly and efficiently make the problem come to them. Using a scan tool and fuel trim numbers for diagnostics is similar — with the tech using the trim numbers to tell him or her when and where to look for the problem.

One simple way to explain fuel trim is that the engine management system changes the fuel pulse width to maintain the air fuel ratio (AFR) at proper

Photos: Albin Moore

feed-gas levels for proper tail pipe emission and proper operation of the catalytic converter(s). Keep in mind, when using the trims, we need to be watching long term fuel trim (LTFT), short term fuel trim (STFT) and rear O_2 sensor trim numbers to come up with a total fuel trim. (A few OEMs actually list a total fuel trim and/or a rear fuel trim data PID.) It is easy to think of this AFR as a stoichiometric 14.7:1 ratio of air and fuel, but this is not always the case. Many times the engine will not run at the stoich AFR, because computer strategies will allow the engine to run either richer or leaner depending on the power needs of the engine. This is especially true with engines that are using wide band air fuel ratio sensors.

From General to Specific

When starting with a drivability problem analysis, it is most important to be aware of the kind of fuel management system the vehicle is using. First determine whether it is a speed density or a mass airflow (MAF) system. Without knowing this information, your resulting mistakes in the interpretation of the scan data can lead you down some dark, slippery roads.

Once the type of air/fuel management system is known, a correct diagnostic strategy can be designed. Without the proper diagnostic plan, the technician is just wandering around in the dark with no direction.

Fuel trim data is dynamic, which means it is alive and active. If you are trying to use the trim information to root out a drivability problem, you must view the data under a variety of engine load conditions. This is often best accomplished by driving the suspect vehicle and recording the data on your scan tool for later review.

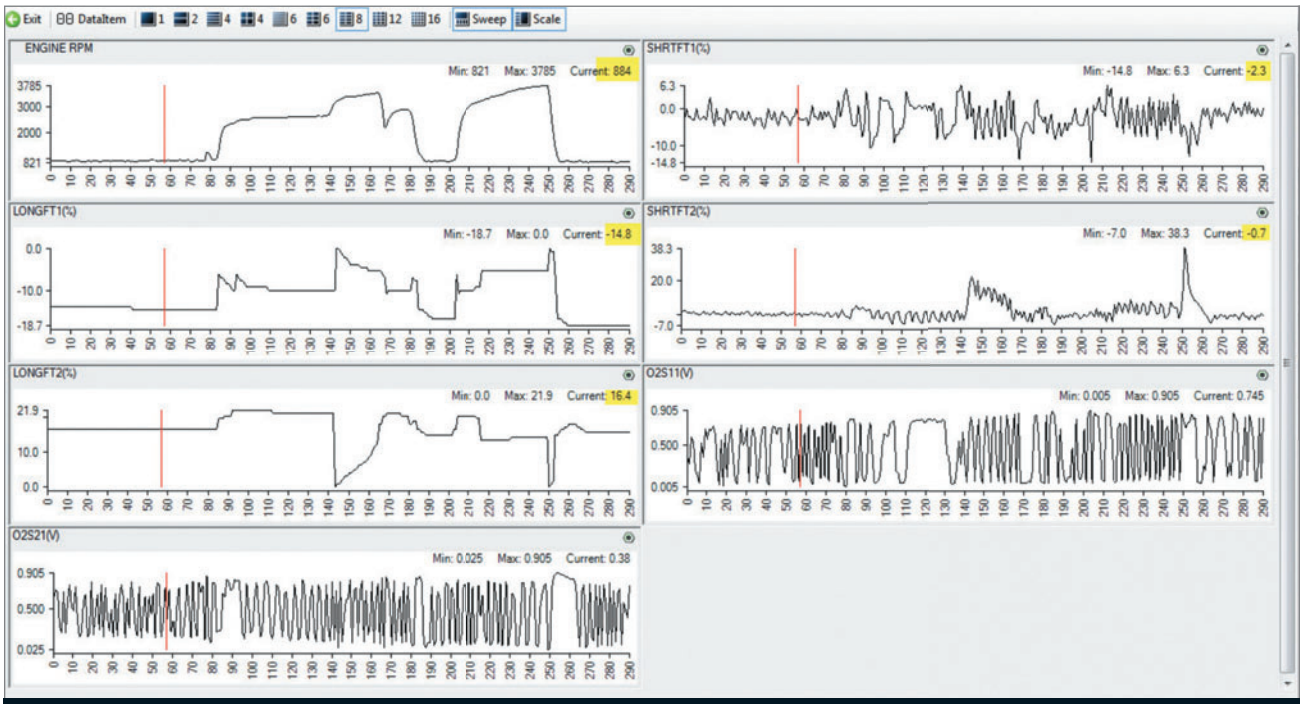
Fuel trim corrections will give the technician a direction for nearly any engine drivability problem. Before you throw your hands up and say that isn't true, sometimes information telling you what the problem isn't is very good information. How many times do you start a testing procedure and find information that is correct? This correct information helps the diagnostic tech to narrow the problem down to the pinpoint testing.

Let's say you are working on a poor power complaint. You test the fuel pressure and find it to meet the manufacturer's specification. This is good information, and with it you can rule out many things such as a fuel supply problem to the fuel rail.

So it goes with using fuel trim data. The trim data is telling you only the corrections the fuel management system is making to keep the air/fuel ratio where the programming says it should be.

In the case of a poor power complaint, the fuel trim data should be gathered at idle, 2,500 rpm and on a test drive. If you want to test

Read more on using fuel trim for diagnostic direction at MotorAge.com/direction



This shows fuel trim data taken at engine idle. Notice the bank 1 trims are -14.8 and the bank 2 trims are +16.4. Short trims look normal, which is an indication this valve timing problem has been going on long enough for the short term trim data to have been all learned in the long term trims.

the volumetric efficiency (VE) of the engine, you'll need to do a full throttle run through at least one shift point, followed by a steady cruise. If all the information is found to be in order, you have gained a lot of good information in a relatively short amount of time. With this information, you can rule out air/fuel ratio calculation and fuel delivery problems.

At this point, it might be a good thing to test the VE of the engine. The fuel trim information has given you a direction for more testing. In the testing business, I find it rare to find the solution to a drivability problem with the first test procedure. Drivability analysis is a process that always starts out wide and narrows the problem down with each different testing procedure.

An Ailing Trooper

Because most automotive technicians are visual learners, I find it easier to explain a concept by using a case study. This makes it easier for me to explain how to apply the theory to a real-world problem. The vehicle for the case study is a 1997 Isuzu Trooper. The Trooper is powered with a 3.2 L V6 engine, and there are 168,000 miles recorded on the odometer. The engine is hooked to an automatic transmission, and the fuel management system is using a MAF sensor to measure the air the engine is inhaling.

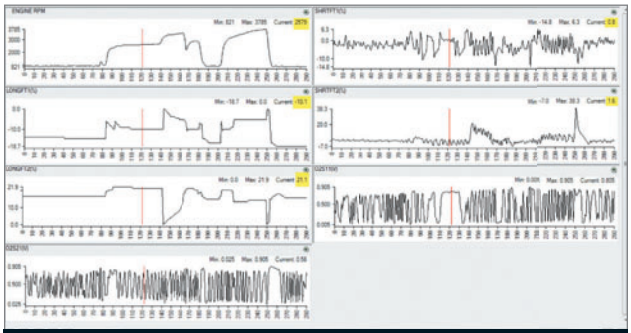
The customer complaint is rough idle and poor power. Scanning the engine computer for DTCs found a P0300 (Random Misfire) stored in memory. As diagnostic technicians grow in experience, we pick up little habits that are used in our craft. One of these habits I use is to walk to the back of a vehicle and put my hand over the exhaust pipe and feel the exhaust pulses.

When I put my hand over the end of the tailpipe on this car, I noticed the exhaust flow was not smooth. I got the feeling there was a slight misfire on some of the cylinders, which called for more investigation.

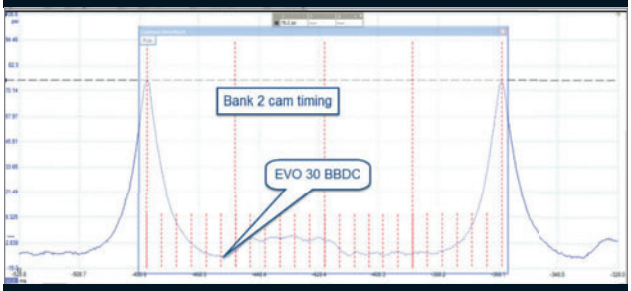
I started my investigating with a scan tool and fuel trim data. By looking at the fuel trim data, I was able to decide whether I needed to be looking for a fuel issue, an ignition issue or an airflow issue.

Looking at the scan data, I can see the long term trims on banks 1 and 2 are the reverse of one another; bank 1 is a -14 percent and bank 2 is a +16 percent. I've seen plenty of cars in the past where one bank was normal while the other was too rich or too lean, as I'm sure you have. But what would cause one side to be too rich (bank 1) and the other to be too lean (bank 2)? This data was telling me there is an airflow restriction on bank 1.

On this engine, the air mass entering the engine was being measured



Here is fuel trim data taken at 2,500 rpm. The long term has changed to -10 on bank 1 and +20 on bank 2. Short trims still look normal. Again, this problem has been around long enough, so all the short-term corrections have been moved to long term.



Here is in-cylinder running compression on cylinder bank 2. This waveform shows the exhaust valve opening at 30°v before bottom dead center. This is normal for this engine.

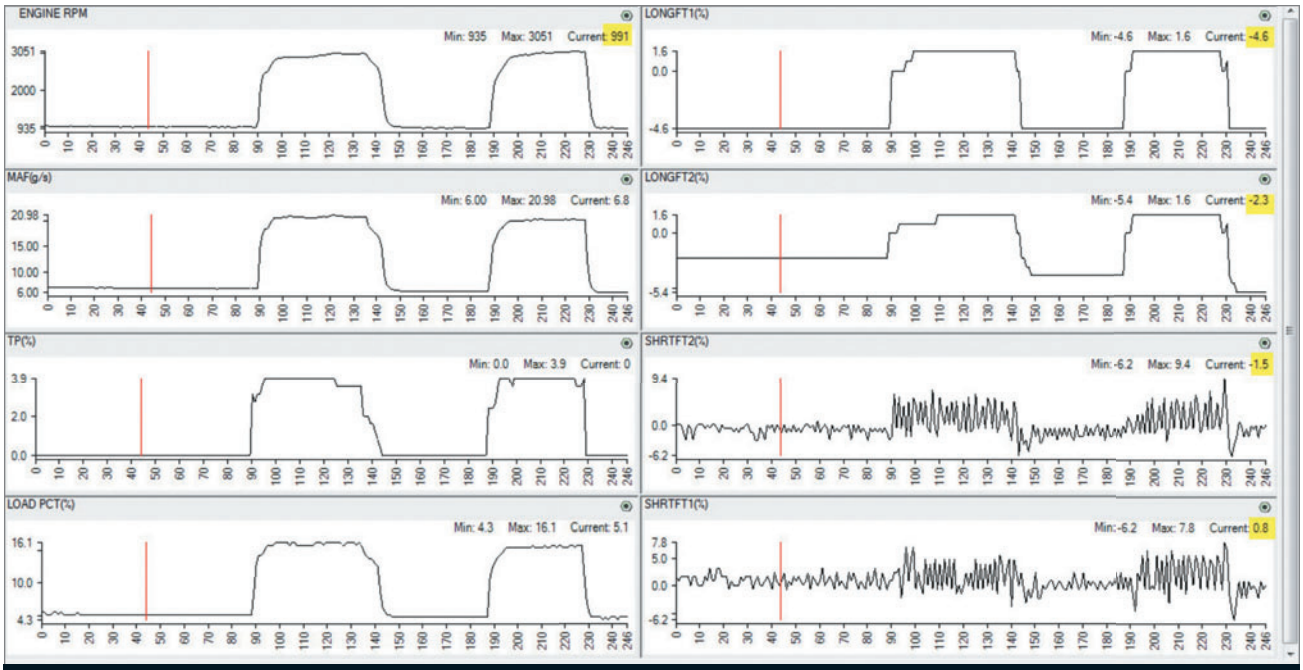
by a MAF sensor. The engine is designed to share this air equally between each bank. The engine also is designed to inject fuel equally into each cylinder bank. When the airflow to one cylinder bank is restricted, the division of air between banks is imbalanced. The restricted side is not able to flow the same amount as the unrestricted side. But the MAF sensor cannot distinguish this difference — and neither, at first, can the engine control module (ECM).

The oxygen sensors will pick up this air/fuel imbalance and do everything possible with fuel injector pulse width to correct for the air imbalance. The cylinder bank with the negative fuel trims is always the cylinder bank with the airflow restriction. So what could cause this imbalance, this restriction?

Continuing to use fuel trim data, I could quickly determine that this restriction to airflow is not a plugged catalytic converter. Restrictions don't always have to be physical ones, do they? The data is pointing directly to a cam timing problem. I can tell this by bringing the engine speed up to 2,500 rpm and watching the fuel trim change. In this case, they remained separated with bank 1 at -10 percent and bank 2 at +20 percent.

Verify and Repair

I am a firm believer in using more than one test to verify a problem. For cam timing problems, I like to use a pressure transducer and lab scope to back up my scan tool data. In this case, I removed a spark plug from each cylinder

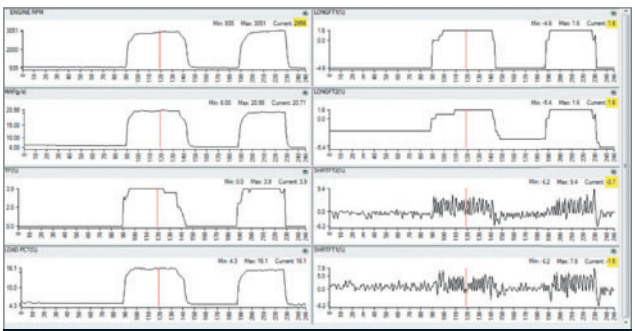


Here is fuel trim data at idle with the new timing belt. Notice the long-term trims are back to normal at -4.6 on bank 1 and -2.3 on bank 2. Short term is also normal at -1.5 and 0.08.

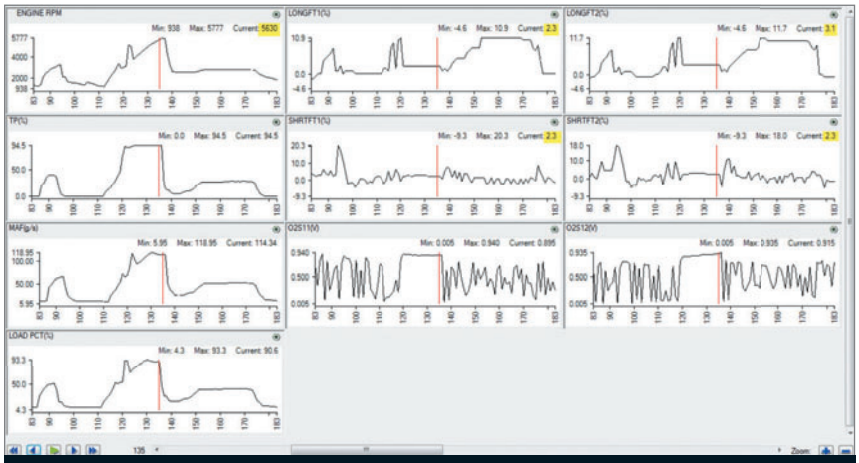
bank and screwed a pressure transducer into the spark plug hole, then started the engine and captured a waveform. This allowed me to see when the valves open and close while the engine is running.

The pressure waveform gives more information more quickly than taking a vacuum reading, compression test and a leak down test on the engine. Another plus for the in-cylinder running compression test: I didn't have to remove a lot of engine parts while looking for the problems. This makes the problem analysis procedure quicker, more accurate and at a lower cost to the customer. The best thing I like about this diagnostic process is that I get to play with the cool toys — and I love finding problems without getting my hands dirty!

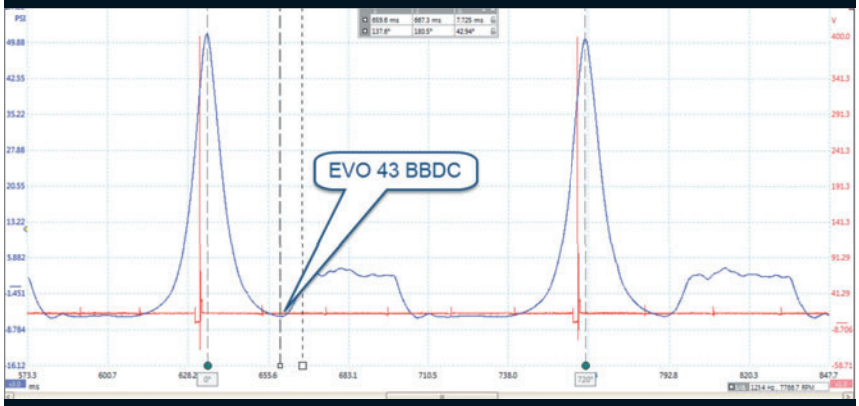
The in-cylinder waveforms showed the left bank 1 camshaft lagged in timing by about 30° of crankshaft rotation. With these two different tests, there is enough evidence to pull the accessories and brackets that are mounted to the front of the engine, then remove the timing belt covers and



Fuel trim at 2,500 rpm with new belt. Long-term banks 1 and 2 are 1.6, and the short term trims are near zero. This data is telling the technician the problem is fixed.



This shows fuel trim on test drive taken at wide-open throttle. Add the long- and short-term trims together to come up with the total trims, and they add up to a nice round zero.



This shows running compression with the new belt. This waveform was taken from cylinder bank 1. Both cylinder banks 1 and 2 are the same.

inspect the valve timing components.

With the timing belt covers removed and the timing marks aligned on the crankshaft and both camshaft sprockets, it was easy to verify that the bank 1 camshaft sprocket had jumped timing by two teeth retarded. By using a logical diagnostic process, finding the problem was easy and accurate.

A new timing belt, rollers, cam and crank seals were installed and then the after-repair testing was performed. By using the scan tool and fuel trim data, it was easy to see the fuel trims were back to their normal position and the engine idles nice and smooth. The normal engine power returned, and the vehicle owners were able to get back to their vacation plans.

As engines become more complicated and technology keeps marching on, the need for better diagnostic processes follows suit. This Isuzu engine is a rather simple one, but what would you do if a problem like this came in on an engine that is very difficult to gain access to the timing belt? What would you do if there were no timing marks on the camshaft sprockets to line up?

The need for better and more accurate diagnostic processes is not in the future. It is here now.

ALBIN MOORE
CONTRIBUTING EDITOR

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

Email Albin at bwrench@yahoo.com

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04-08 TSX
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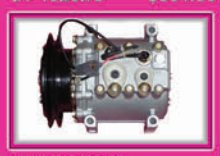

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HONDA
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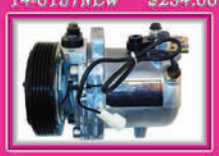
TRA090
14-0045NEW $135.00



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GET A DIAGNOSTIC GAME PLAN

A relative compression test can be taken in the car, using any scope and a DLC breakout box.

TIGHTER STANDARDS LEAVE LESS ROOM FOR ERROR THAN EVER BEFORE.

BY **"G" JERRY TRUGLIA** | CONTRIBUTING EDITOR

Before we start to diagnose a vehicle, we need to have a game plan — just like a coach or manager of a major league sports team. Your game plan needs to start with a route on where and how to proceed in diagnosing the problem at hand. We all have different ways to diagnose a problem vehicle, but there may be a better route to follow.

I base my procedure on what's right and what's wrong, just like the big box scope analyzers did in the past. The good thing about the old big box analyzers is that they forced us to start at the battery, starter, alternator, engine mechanical condition, emission gas readings, ignition and fuel. Remember: If you miss the basics, you miss the problem.

If we were going to diagnose a sagging roof, you would not install a new roof without checking the walls and the foundation first. Similarly, in diagnosing an engine performance problem, we need to start with the basics. This is why it's so important that at least two OE scan tools have a test to make sure that the mechanical condition of the engine is good. The reason why Ford and Toyota install these tests on their scan tools is that they have seen too many parts thrown at a problem by their own technicians, with no solution or fix

JUST SCAN IT

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Photos: Jerry "G" Truglia

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acheived. The root cause of the problem in many cases stemmed back to something basic, from a bad battery to a mechanical issue.

Many engines that we work on today have some form of variable valve timing. The use of the wrong oil can cause the variable valve timing system to portray a mechanical problem. The cam phasers will not be able to adjust to the proper settings if the wrong viscosity oil was used, due to improper oil flow. What I will attempt to do in this article is to provide you with a good game plan, along with the tools to use in diagnosing problem vehicles.

Want more? Read additional troubleshooting tips at MotorAge.com/troubleshooter

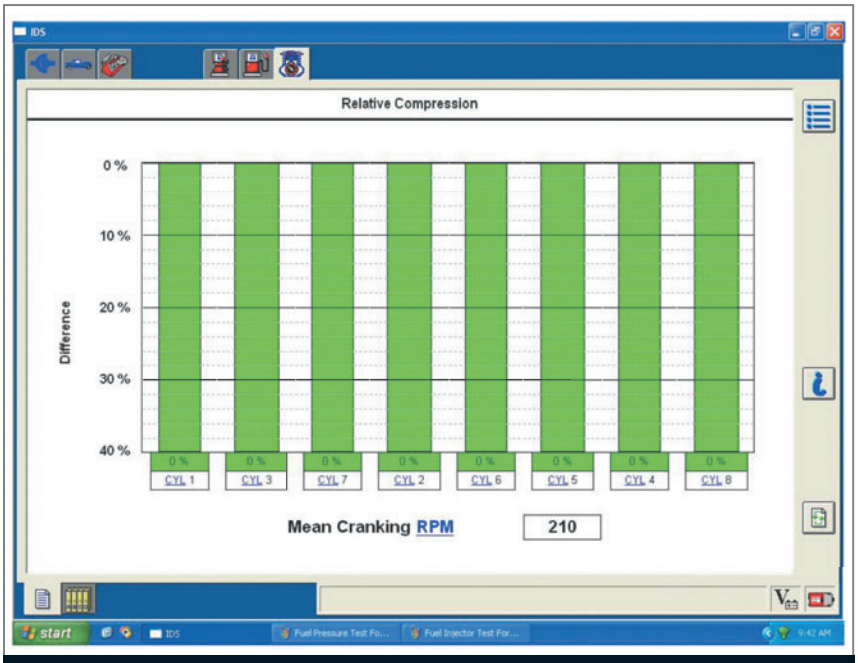
Where to Start

The first place to start is by interviewing the driver of the vehicle. A good Q&A session might lead you to looking into an area that you might have not checked without the information they provided.

The next step is to use the best tools you own — your brain, eyes, ears, nose and hands — to check out the problem. After a preliminary "look-see," research the problem using your service information (SI) source, followed by investigating Technical Service Bulletins (TSBs) that may be related to the issue.

With so many variations on even the most routine system, you have to know the particulars of the system you are working on before you even pick up a wrench. Information on iATN, Identifix, ALLDATA, Mitchell, Autodata, MotoLogic or even Google can be very helpful with identification, if the vehicle you are working on needs a reflash or has a silver bullet problem. Remember, when looking at a silver bullet solution, always check and test the components and the system before replacing anything.

After performing an investigation, connect one of the best tools to use to diagnose problems — the scan tool. It's easy to use and provides us a great deal of information in the shortest period of time. This should be followed by using either an Associated, MidTronics or other battery/starter/alternator tester that will ensure that you are starting with a good electrical foundation.



The relative compression test is a real timesaver. Some OEM scan tools, like the Ford IDS, incorporate the test right in the tool.

Most shop-level scan tools today provide for a full system scan that queries the entire vehicle's computer system and all related control modules (ECUs) to find any system faults. Sometimes a fault in one system can affect another system. For example, our shop once had a Dodge Dakota that had a complaint of a hard first shift. The shifting problem turned out to be caused by a PO136 (O_2 Sensor Bank 1 Sensor 2 heater malfunction). After Wayne Colonna (ATSG president and publisher of *Motor Age*'s POWERTRAIN PRO) turned us on to the correct diagnostic path, we found the connection between the O_2 heater to the shifting problem.

Initial Testing

Some scan tools (such as the Ford IDS, Toyota Techstream, OTC and Autel, to name a few), provide a relative compression test that takes less than a minute to perform. If your scan tool doesn't offer this option, you will need a different way to perform this test.

The relative compression test can be performed with any brand digital storage oscilloscope (DSO). The relative compression test can be performed in less than five minutes depending on whether the vehicle has "Clear Flood" capability. You can even perform this test right from the driver's seat, without even opening the hood of the vehicle:

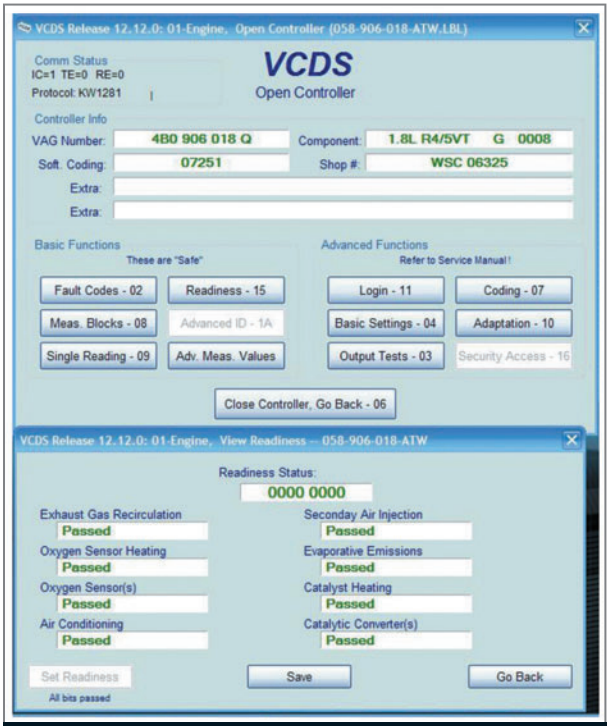
1. Connect a diagnostic link connector (DLC) breakout box to the connector itself, and then connect your labscope to pins 4 (Vehicle Ground) and pin 16 (Vehicle Power).

2. With the scope coupled (set) to AC voltage, hold the accelerator pedal to the floor while cranking the engine over for about a minute. The waveform that you capture will provide you with information on whether the engine has a mechanical problem.

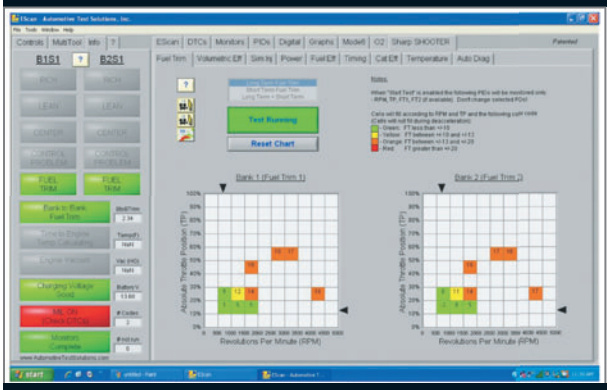
This test also can be done from the battery terminals while the labscope is coupled to AC voltage. Another alternative is using a high-current probe that is clamped around either battery cable while cranking the engine over.

Go Generic

Follow this test with using your scan tool in Generic/Global OBDII mode. I recommend this because on many



It's important to check the status of the computer monitors to avoid an unnecessary comeback.



Fuel trims are a great diagnostic aid, and this tool maps it out for you.

enhanced (OEM-specific) data lists, the data you see might be comprised of substitute values and not reflect what the sensors are actually reporting to the engine control module (ECM). Data values are displayed all the same way, regardless of whether you are working on a BMW or a GM. Generic/Global allows us to look at diagnostic trouble codes (DTCs), pending DTCs, Freeze Frame, Monitor Status and Mode $06.

Because all the information is available right there in a format that is the same on every vehicle, it makes it easier to have a good diagnostic game plan to follow. If the monitors are not "Ready/Set," for example, you might encounter a problem with an illuminated malfunction indicator lamp (MIL) that will not show up until the vehicle has met the enabling criteria. That results in a comeback that could have been easily avoided. The "You Stink Light" is not what the vehicle owner or you want to see.

Remember, the vehicle was brought in to be repaired and keep the light off. So, let's say the vehicle had an O_2 DTC and the exhaust gas recirculation (EGR) and evaporative emissions (EVAP) monitors are not ready yet. You are taking a big chance just repairing the O_2 sensor fault without running the EGR and EVAP monitors. When the monitors are not ready, there is a chance the MIL will reappear once the vehicle has met the enabling criteria. Try explaining that to an angry vehicle owner that knows just one thing: He paid you to turn the light off.

So, you might want to look up the drive cycle for the monitor that is not ready and run them. If you are working on an Audi or VW as displayed on the Ross Tech scan tool, you can run the monitors in your bay. Either method will allow you to confirm the vehicle is repaired before returning the vehicle to the owner.

You can use Pending DTCs to predict if there is a problem on the horizon, or you can look at Mode $06 data to also predict if there is a problem with a component that will fail and be elevated to a Pending DTC and onto a DTC. Mode $06 can also be useful to see why a monitor is not becoming "ready" or due to fail a test that is being conducted by the ECM.

Cars may be more complex, but the basics still apply even though they often are overlooked.

The BullsEye leak detection system uses CO_2 and a special foam agent that changes color in reaction to the gas to help find the most difficult leak. Here, the tank is porous and leaking over a large area, which is an unusual case found easily with new techniques.

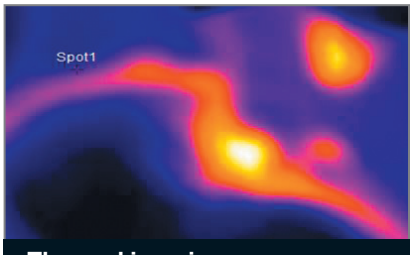
Fuel Trim for Success

The next step is to move onto one of the most important data values to look at: the vehicle's fuel trim. Remember, just because you see a command to add or subtract fuel while monitoring both short-term fuel trim (STFT) and long-term fuel trim (LTFT) does not mean that it's really happening. If you have a mechanical condition such as a bad pressure regulator, the computer cannot compensate enough to correct the fault.

If a mechanical condition is present, that will have to be repaired first because the computer assumes all mechanical conditions are good. Just as I mentioned before, the basics are very important: Everything has to be good with the foundation before moving on.

After fuel trim checks out of the way, I prefer to view the following parameter identifiers (PIDs): O_2, air/fuel ratio, load, spark advance, EGR position, engine coolant temperature (ECT), intake air temperature (IAT), rpm, and mass airflow (MAF) in grams per second.

Depending on the type of problem you are chasing, some PIDs may be more important than others. For example, with a cold engine, the ECT, IAT or battery temperature sensor (BTS) should be in a specific range, typically within 5 to 10 degrees of each other when the engine is cold. The calculated load PID can provide us useful information on whether the engine can breathe properly. At wide open throttle while



Thermal imaging cameras are becoming more affordable, and will see increasing use in automotive diagnostics.

graphing the data on a scan tool, the reading should be 90 percent or better on a vehicle that has a good air filter, intake manifold, intake and exhaust valves and a clear exhaust system.

The MAF sensor at idle should provide us data typically showing at least 1 gram of airflow per second per liter of engine size (if you are working on a 4.0 liter engine, you should expect to see a MAF PID reading of 4 gps or so). You can zone in and diagnose a P0420 (Catalytic Converter Efficiency Below Threshold) by graphing the front air fuel and rear O_2 sensors on your scan tool at idle, 1,800 and 3,000 rpm to see whether the converter is good or bad. This can be followed up with checking whether the converter is working by using a thermal imager to see the difference between a good and a bad converter.

Keeping up With New Techniques

Another problem area that has so many technicians beating their heads is a small EVAP leak. A smoke machine along with CO_2 is a great helpful tool, but sometimes it's very difficult finding a 0.020-inch leak or a charcoal canister problem without using a gas analyzer. Fortunately, you are not alone in the challenges you face, and there are some bright guys out there always looking for a new solution.

Recently, I was challenged with a tough EVAP leak problem. I was unable to find the problem looking for smoke, although I knew there was a leak by viewing the ball on the flow gauge of the machine. I used the new BullsEye leak detection system (created by Bernie Thompson of Automotive Test Solutions) and found the area of the leak with the electronic detector. I then could pinpoint the exact spot where the leak was coming after spraying the foam agent that's part of the system.

The foam reacts with the CO_2 and changes colors from pink to yellow. The area at the top of the tank where there was no leak stayed pink (see related photo), while the leaking area turned bright yellow.

In this particular case, the plastic had become porous and was leaking a little bit over a large surface area. A new tank solved this problem, and this new method made it a problem I could be assured of finding.

While many things continue to change and evolve in our business, many things remain the same. New tools and techniques will continue to make our diagnostic lives easier — but you still have to use the tools God gave you to achieve final success. MA

G. JERRY TRUGLIA
CONTRIBUTING EDITOR

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.

Email G. at gtruglia@tstseminars.org

SPEAKING OF DIAGNOSTICS

IT'S TIME TO AVOID COMMON MISTAKES AND CHARGE WHAT YOU'RE WORTH.

BY **"G" JERRY TRUGLIA** | CONTRIBUTING EDITOR

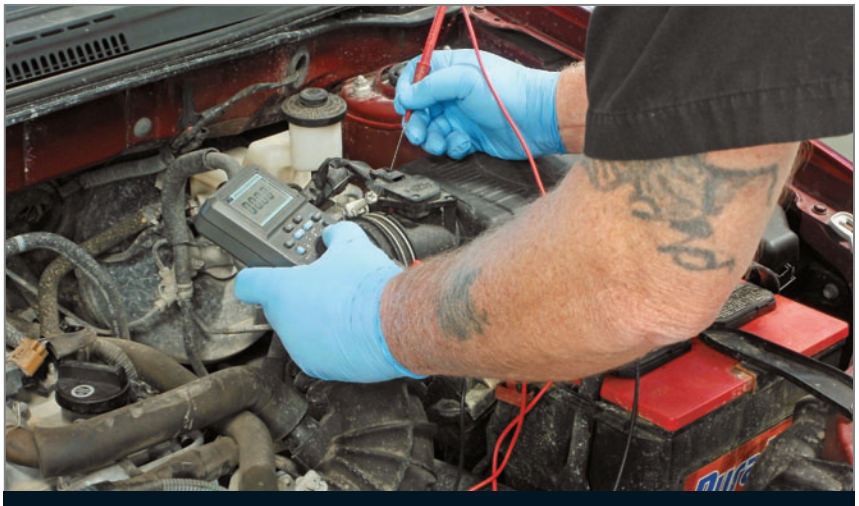
Editor's Note: Our guest columnist this month is Pete Meier, technical editor.

It's been my good fortune to have worked with a lot of different technicians. The majority were competent, honest, intelligent individuals who were successful in repairing customer problems most of the time. But is most of the time good enough?

Your customer expects their car to be fixed right the first time. That's what they paid you to do. Anything less is, at the least, an inconvenience to them when they have to return to your shop to have it done again. Customers don't like having to come back for the same issue — as I'm sure most of you are aware of.

A few of these "comebacks" are caused by faulty parts or an honest mistake made during the repair process. But many are the result of basic flaws in the diagnostic process, made in the very beginning that doomed the repair from the start. Here are six to watch out for.

1. Getting tunnel vision. Tunnel vision occurs when you become convinced the problem lies in a particular system, even though your testing shows otherwise. One common example I see all too often is immediately faulting the ignition system when diagnosing misfire complaints. Even though the ignition system tests fine, tunnel vision sets in and new plugs, wires and even coils are replaced before someone gets the idea to test the other engine systems for issues — and usually locates the true cause of the misfire as a result.



Before you even open the hood or raise the car, make sure you understand how the system you are going to work on functions. Time spent up front doing a little reading will save you time overall.

2. Relying on general information. There are no generalities when it comes to repairing today's cars. Every manufacturer has its own way of making things happen, and even that might be different among its various models. Always make sure you understand how the system you are diagnosing works on the particular vehicle you are repairing. For example, consider a late-model Jaguar with a charging rate of 15.3 volts. That seems high, doesn't it? How many of you said it needs an alternator? Be honest!

Actually, a rate of 15.3 volts after initial start is normal on this car. The ECM starts there and then selects one of three time limits (based on other inputs) before turning the charge rate down to 13.6 volts.

3. Not checking for related Technical Service Bulletins (TSBs). Depending on the source, it is estimated that between 30 percent and 60 percent of vehicle performance issues are the result of software programming in the various control modules. Many more are related to redesigned components. How are you going to find or repair that? You're not.

So before you spend hours trying to find a problem you can't, take a look at TSBs early on in your diagnostic process. Found one? Make sure you test and verify that it applies to the problem you have before pronouncing the car cured.

Photos: Pete Meier

4. Relying on "silver bullets." Many vehicles have pattern failures we all soon know about. But just because that fixed the last Ford (Audi, Mitsubishi, etc.), doesn't mean it will fix the one in your bay today — even if it shares the same initial symptoms. Use this information as part of your diagnostic process, consider the possibility, and then test to verify that it indeed is the cause.

5. Generalizing code definitions. While it is true that many Diagnostic Trouble Codes (DTCs) have generic definitions, many techs read these code definitions and take them literally. For example, a code sets for an oxygen sensor heater fault and the tech automatically condemns the sensor — without verification first.

Manufacturers might use standard definitions, but testing methods, enabling criterion and failure limits are uniquely defined. An EGR "Low Flow" code on a Ford is not determined the same way by the ECM as the same code on a Chrysler — and both will affect how you approach your diagnosis.

It is important to always read up on the code criteria used by the particular manufacturer of the vehicle on which you are working. Knowing exactly how the code(s) set will allow you to focus your troubleshooting methods directly at the problem at hand.

6. Not sticking to the basics. Another common mistake I've witnessed is techs not sticking to basic testing, especially when dealing with engine performance issues. This often is the result of, or can lead to, the dreaded tunnel vision. Follow a logical approach on every diagnosis — starting with baseline tests like relative compression, fuel pressure and volume and ignition spark quality. Only believe what your testing can confirm or deny.

Diagnosing cars takes continuous study and a commitment to excellence, and those of you who do deserve to be paid for your abilities.

What are You Worth?

One topic that comes up quite a bit is "How do we charge for diag time?" This includes any sort of diagnosis that is going to take more than a simple visual inspection. Some drivability and electrical issues can become quite involved, and take a lot of time to isolate, especially if it's your first time on that particular problem or vehicle. After all, you have a lot more homework to do. Then there are the tools you need to diagnose these problems, none of which are cheap.

Experience certainly plays a role as well. An experienced tech should be able to find the problem faster. But then, do you charge less time to the customer? A new tech might spend all day finding what turns out to be a simple fault. Do you charge the customer eight hours? In each case, how do you pay your tech? Should the experienced guy get paid less time than the new guy? Should the new guy be penalized for being new?

Most of the shops I've worked for in the past charged one hour at the shop rate and paid one hour flat rate. But how does that apply when the original complaint is "The MIL light is on," and you pull half a dozen codes that may or may not be related. What if, during your diagnostic process, you determine that it is necessary to measure engine compression on a motor that requires plenum removal to access the rear bank? How do we justify the need for additional time to the customer?

It seems to me that too many customers still think of us as "grease monkeys" and don't understand the skills it takes to repair today's cars. They have no problem spending $20,000 or more to buy it, but heaven forbid the repair costs more than $50!

One story I heard a long time ago is applicable to this discussion. It goes something like this:

A young man is driving across the desert when his car starts running rough. There is no sign of civilization as he continues down the highway, praying the car will make it to his destination and not leave him stranded in the middle of nowhere. Several miles along, the car is still running rough, and the young man is getting worried that he may be stuck in the middle of the desert overnight. As he crests a small ridge, he sees an old shack with two gas pumps out front on the side of the highway. Thanking God for his good fortune, he prays there is a mechanic there.

He pulls up to the shack and sees an older man, rocking in his rocker and sipping lemonade. The young man gets out of the car, and says, "Excuse me, sir. Is there someone here who can help me with my car?"

The old man rises, and offers to take a look. He first listens to the engine idling, then opens the hood, looking first to the left, then to the right. "I'll be right back," he says, and heads off to his garage. He returns momentarily with a small hammer in hand, leans over the engine and makes a light "tap" somewhere near the firewall.

The engine immediately runs as smooth as silk.

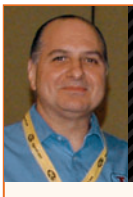
The young man is ecstatic that the repair was so simple. He asks the older man, "How much do I owe you?"

Without batting an eye, the old man responds, "That'll be $89.99."

"WHAT!" exclaims the young man. "Ninety bucks for hitting it with a hammer?"

"No, son, it's 99 cents for the hammer tap, and $89 for knowing WHERE to tap it."

Diagnostic technicians earn their living with a lot more than just their hands, and are professionals like any other. Charge what you're worth, and deliver what you promise.



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Email G. at gtruglia@tstseminars.org

YES, NO, MAYBE?

COMPLEX VEHICLES ARE WHY WE NEED SCAN TOOLS AND SOME OF US LACK HAIR.

BY **EDWIN HAZZARD** | CONTRIBUTING EDITOR

When a vehicle comes into your shop today, you need to be on the top of your game. Let's face it: Today's vehicles are a lot more complex than those of even 10 years ago. Vehicles 10 years ago were considered very complex compared to the 10 years prior to that.

The modern vehicle of today is comprised of many different features, which includes updated and more sophisticated electrical systems, better structural components and materials and in general a better life expectancy. After all, don't you agree that automobiles being built today last longer than those built 20 years ago?

Now to get to my point: When one of these vehicles comes to your shop, it could be for something as simple as a routine brake job or as complex as a Controller Area Network (CAN) communication problem. Regardless of the problem, you have to have several tools in place to repair these issues.

1. You need to understand how the system you are taking on works. And to do that, you need a good service information system. It is plain suicide to attempt to work on a vehicle today without one.

2. You need to use a capable and up-to-date scan tool. If you're asking yourself, "Do I really need a scan tool to do a brake job on a vehicle?" the answer is absolutely — for that, and for many other so-called "routine" services! You might need to use your scan tool to bleed the brake system or release the calipers so you can install those brake

CHECKING IT TWICE

2001 HYUNDAI ELANTRA
Vehicle Year/Make/Model

106,000
Mileage

2.0 L
Engine

AUTOMATIC
Transmission

COMPLAINT

A check engine light on along with a stalling condition are giving off different DTCs with different tools.

Photos: Edwin Hazzard


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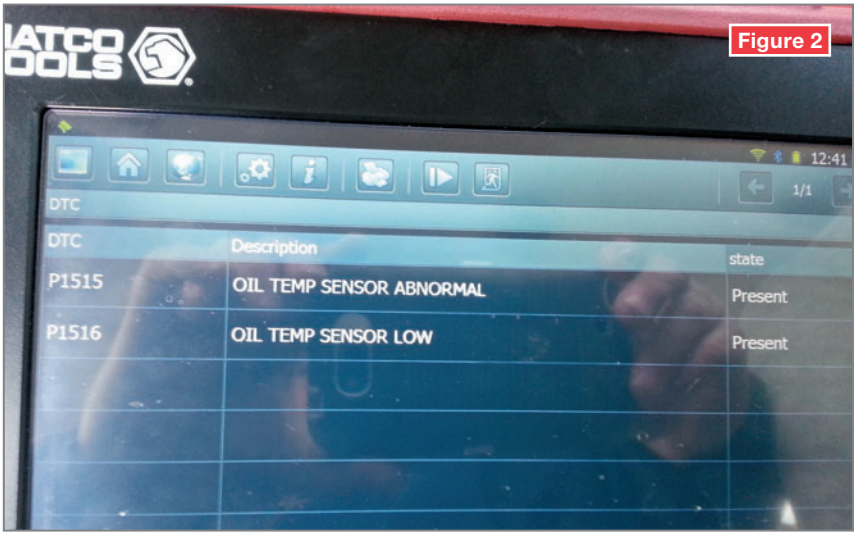
pads. That's part of the complexity of today's high tech vehicles: Without the proper tooling, you're not repairing the vehicle correctly.

3. You need to use a good digital multimeter (DMM). The days of using your test light to check a circuit on a computer that's only supposed to put out 5 volts is long gone. Don't get me wrong, a test light is still a valuable tool; but now the use of it needs to be considered carefully before relying on it to diagnose a particular circuit.

Now that you have a working knowledge of the system, all the correct tooling and an accurate service information system, fixing these vehicles should be a snap, right? Not so fast. Now the fun really begins!

As a mobile tech, I get calls that are sometimes easy, cut-and-dry jobs — or so they seem. Then there are some that will fight me tooth and nail. The ones that should be easy sometimes turn into the tough ones because one of the three tools previously discussed, for lack of a better term, aren't working as designed.



Agree to Disagree

On one particular job, a shop called me in for a 2001 Hyundai Elantra with a 2.0L four-cylinder, automatic transmission, showing 106,000 miles on the odometer. The complaint was a check engine light on and a stalling condition.

I grabbed one of my scan tools and proceeded to hook up to this car and pull the codes. Stored in the Engine Control Module (ECM) were codes P1515 (Oil Temperature Sensor Abnormal) and P1516 (Oil Temperature Sensor Low). I went to my service information (SI) system and pulled up the code definitions so I could see how these codes are deciphered for this specific vehicle. According to the SI, the codes were tied to the Idle Speed Control (ISC) actuator circuit.

So which one do you believe? Is the scan tool wrong? Or is the information system not giving the correct description? How do you decide? What if you only have one information system and access to only one scan tool? Many shops have access to more than one scan tool and or information system. If you happen to work at one of them, you're lucky. If not, then your job just got a lot harder. Remember, you only have a certain amount of time to diagnose this vehicle.

This is what makes the job of an auto technician more challenging — and it's the reason why some of us have more hair left on our heads than others. Fixing today's vehicles isn't always cut and dry. You may think that you have all of the correct information and tools needed to do the job, but then you find out that you don't.

Luckily, I happened to have another scan tool to try. I hooked up the second tool to this car and got a completely different code description compared to the first scan tool, and one that agreed with my SI code descriptions. So I dove into it some more and looked for a component locator in the information system I was using.

I went to the car — and the component wasn't where the information system said it should be. Fortunately, I had another information system to which I could compare the data. The second SI source proved to be more accurate. This kind of stuff is what makes a simple diagnostic turn into a head scratcher.

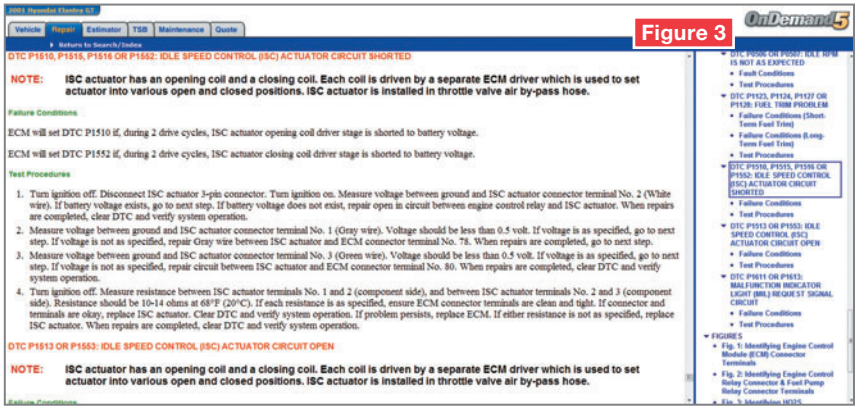
Fortunately, when you come across a discrepancy in the information that you find to be incorrect, there usually is a number you can call and report it. When they release the next upgrade, then, the fix should be included with the new software. Hopefully your call will prevent this from happening to the next tech who comes across this problem.

On this vehicle, the information system I used to get the code description had the incorrect location of the idle speed actuator. The second information system did have the correct location. Having multiple resources at your disposal is essential in fixing vehicles today. Pulling every available resource that you can obtain will not only speed up your diagnosis, but it will make your diagnosis more accurate. After finishing my diagnosis, this car was repaired by replacing the ISC.

To Hold, or Not to Hold

A different shop called me in to look at a vehicle that had an issue with the battery not holding a charge. This vehicle was a 2006 Chrysler Town and Country with the 3.3L V-6, automatic transmission with 98,000 miles on the odometer. The complaint with this vehicle was that after a couple of days of sitting, the car wouldn't start and the battery would be dead.

One of the first things I personally like to do is check the state of charge by doing a quick charge check. I start the vehicle and attach my test leads to the battery terminals while the vehicle is running, so I can get a "somewhat sorta" idea of the condition of the battery and charging system. This is by no means the absolute correct way to check an electrical system, but it is a way of getting a quick idea of what you're working with.



Because the customer complaint was that the battery goes dead after a few days of sitting, I knew from experience that there is probably a parasitic draw in the system. I started my test by setting up my tool to the voltmeter setting and attaching my test leads to both battery connections while the car was running at an idle. The 16.75-volt reading I got certainly caused my eyebrows to raise!

I checked the dash for any indicator lights that might be on, but no lights were lit. Judging by my readings, it seemed the vehicle was overcharging.

I connected to the Diagnostic Link Connector (DLC) to see whether there were any codes listed for an overvoltage or overcharge condition. There were no codes stored in either current status or in history, which seemed really odd to me.

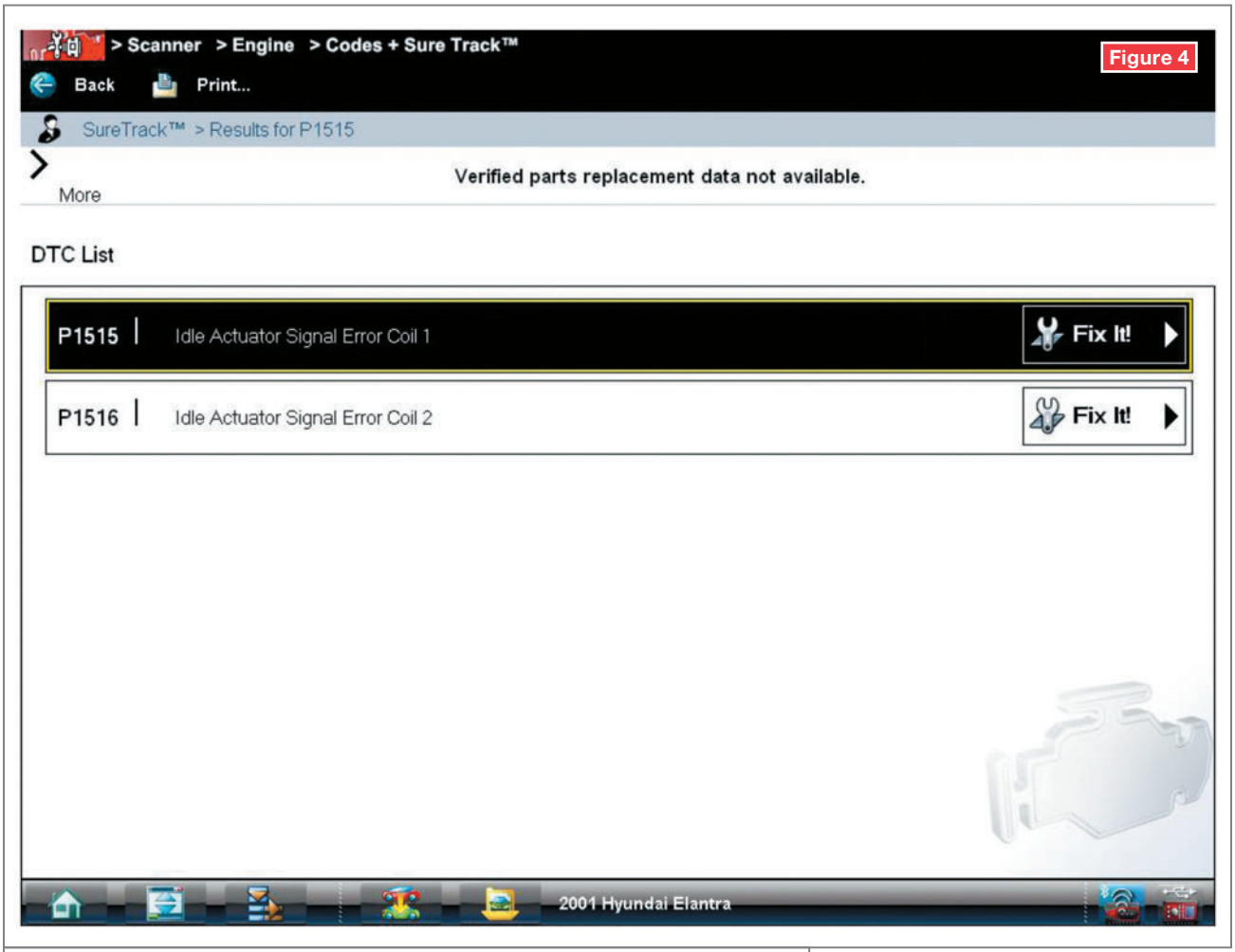


Figure 4

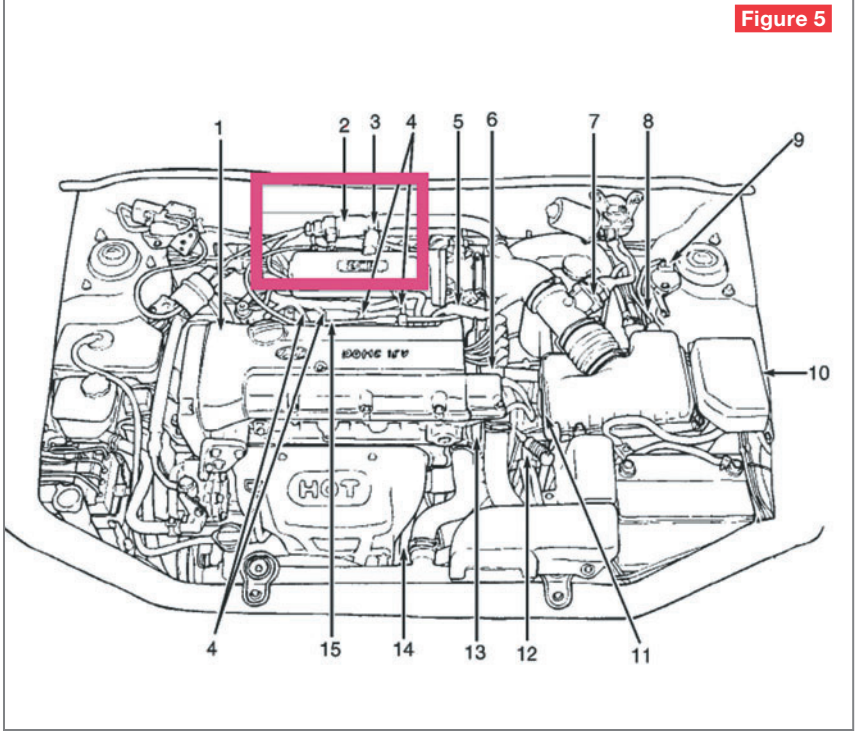


Figure 5

The next thing I did was a visual inspection of the battery to see whether it was bulging on the sides of the case, as that usually means the battery has been overcharged. The battery looked good with no signs of distress.

Being the skeptic that I am, I grabbed another meter from my tool arsenal to see whether the reading I was getting was the same as the reading I obtained from the first tool. Once again, the reading was completely different. In fact, it was a 2.5-volt difference. In today's world of high-tech, computer-controlled vehicles, that much of a difference is enough to affect the way a vehicle operates.

With these two readings, which one should I go with? The first tool is significantly more expensive and more sophisticated than the second tool. The second tool is much older and slower, so my guess would be the first tool gave the correct reading, right? Wrong! The second tool was actually correct.

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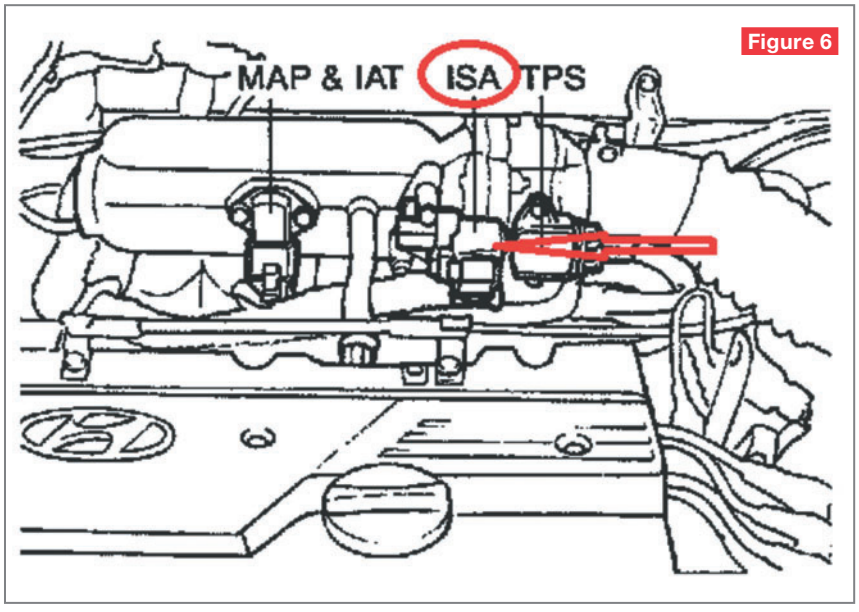

Figure 6

Figure 8


Figure 9

How did I know for sure? Based on my years of experience, knowledge of how the system works, and performing this test 1,000 times, I knew that what I was seeing on the first tool was incorrect. Remember my tool arsenal? I also had a backup DMM that I used, and the voltage matched the reading I had on the second tool. Imagine having to use three different tools before you're sure what you're measuring is correct!

The first tool will have to be sent out to the service center for repair. After confirming that the battery and charging system were working as they should, I proceeded with the diagnosis of the parasitic drain.

These two case studies bring to the forefront what can happen when a diagnostic problem that should be cut and dry is not. We rely on our tools, our information, our experience and our diagnostic thought process to be able to fix today's vehicles quickly and accurately. It's frustrating when we do not have the right information, or our tools provide misleading information when we try to do our jobs.


Figure 7

We pride ourselves on solving problems — repairing the vehicles that nobody else can repair. If you are part of that elite group with motor oil running through your veins, and you have that passion to be the best of the best, then I applaud you. This is not an easy business to be in, but it can be a satisfying one.

Never rely on what is presented, but always rely on yourself and your knowledge. If something doesn't seem right to you, check and recheck it again. This will make you a better technician in the long run.

EDWIN HAZZARD
CONTRIBUTOR

Edwin Hazzard has more than 30 years experience in the automotive industry as a tech, service consultant and mobile diagnostic tech. He is the owner of a successful mobile auto and truck repair service in Newburgh, N.Y.

Email Edwin at
ehazzard@automotivetechsystems.com

ERRATIC FUEL GAUGE OPERATION

Some 2004-2007 Ford Explorer and Mountaineer vehicles may exhibit the malfunction indicator lamp (MIL) on with diagnostic trouble code (DTC) P0463 on an erratic fuel gauge concern. This could be from sulphur contamination in the fuel, causing an open or high resistance on the fuel sender card.

Using MotoLOGIC® Repair & Diagnostics, a Web-based tool for automotive technicians available from MOTOSHOP Technology Tools, the correct service procedure for this issue can be identified and executed in auto repair shops.

Step by step

1. For vehicles with a customer symptom of erratic fuel gauge operation (with no MIL on), proceed to Step 1a. For vehicles with a customer symptom including the MIL on, proceed to Step 1b. If unable to verify the concern, do not continue.

a. Follow the appropriate pinpoint test (PPT) for Fuel Gauge Inaccurate in Workshop Manual (WSM), Section 413-01. If PPT test results lead to fuel pump module replacement, proceed to Step 2. If PPT test results isolate any problem other than fuel pump module replacement, repair as indicated and do not continue with this TSB.

b. Install a scan tool to retrieve any DTCs. If DTC P0463 is retrieved, proceed to Step 2. If DTC P0463 is not retrieved, this TSB does not apply. Follow normal WSM diagnostics.

2. Remove the fuel tank.
3. Remove the fuel pump assembly from fuel tank. Check MotoLOGIC to determine whether a kit or fuel pump assembly is required for repair. For vehicles that can be serviced with a kit, go to Step 4. For vehicles that require fuel pump assembly replacement, go to Step 12.
4. Remove the fuel level sensor assembly from the fuel pump assembly.
5. Detach the electrical connector from the fuel pump housing.
6. Remove the wiring harness from the fuel pump assembly flange by depressing the retaining fingers on the harness connector at the bottom of the flange and by pushing upward out of the flange.
7. Install the new wiring harness by feeding the wires through the flange hole and inserting the harness connector into the flange until an audible click is heard. Check for proper retention.
8. Reattach the electrical connector harness to the fuel pump housing. Prior to making the connection, place one loop in the pump wires away from the convoluted feed tube.

MOTOLOGIC REPAIR & DIAGNOSTICS

More on MotoLOGIC

MotoLOGIC features unedited original equipment (OE) repair and diagnostic information for most major manufacturers and is available from MOTOSHOP Technology Tools, a product portfolio from Advance Auto Parts, Inc., the largest automotive aftermarket parts provider in North America. To learn more, visit **www.motoshop.com/motologic.**

9. Reattach the signal wire (yellow) on the harness to the signal wire (yellow) on the replacement fuel level sensor assembly.
10. Wrap the ground wire around the signal wire one time and attach the ground wire terminal to the terminal on the fuel level sensor assembly. Check for proper retention. Ensure the ground wire is wrapped around the signal wire to prevent potential interference with the float rod arm.
11. Reattach the fuel level sensor assembly to the fuel pump housing, making sure that both the signal wire and the ground wire are routed through the gap between the fuel level sensor assembly and the fuel pump bracket. Torque the fastener at the bottom of the fuel level sensor assembly to 1 Nm.
12. Reinstall the fuel pump assembly into the fuel tank. Take care not to damage or bend the float rod or sender card during installation of the fuel pump assembly.
13. Reinstall the fuel tank.

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FIXING A SLOW TIRE LEAK

Occasionally, a customer will drop his or her vehicle off with a tire that's slowly losing air pressure over a period of days or weeks. The tire pressure monitor light is glowing, and the customer is tired of adding air. Now it's up to you to find out why.

By placing the tire in a water dunk tank, you can determine the source of the air leak by looking for bubbles. In this case, the problem is not a leaking Schrader valve or a nail. The air bubbles are coming from the tire bead.

It is possible that abrasive and corrosive elements have intruded between the tire and wheel, and have eaten away at the wheel's bead seat (see Figure 1). The good news is, it *can* be repaired! In most cases, the damage is not visible from the outside, so let's remove the tire from the wheel and get a closer look.

Bead seat corrosion is identified by what appears to be blistering of the wheel finish, causing a rough or uneven surface that makes it difficult for the tire to maintain a proper seal.

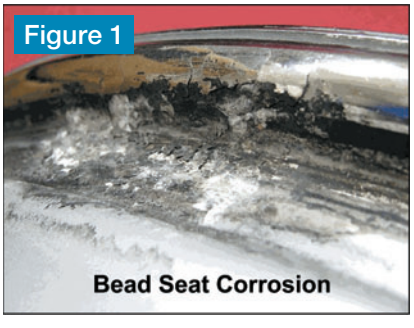
Figure 1
Bead Seat Corrosion

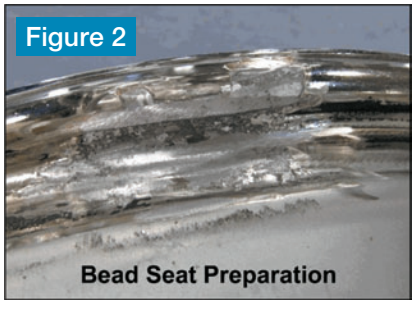
Figure 2
Bead Seat Preparation

NOTE: If the total combined linear area of repairable corrosion is more than 8 inches, replace the wheel. If the corrosion extends up the lip of the flange and would be visible with the tire mounted, ask the customer whether it's OK to proceed with the repair.

Correction

Many manufacturers, such as General Motors®, recommend this repair for their wheels. Use a clean-up (fine cut) sanding disc or biscuit to remove the corrosion and any flaking paint. You should remove the corrosion back far enough until you reach material that is stable and firmly bonded to the wheel (see Figure 2). Try to taper the edge of any flaking paint as best you can, to avoid sharp edges that may increase the chance of a leak reoccurring.

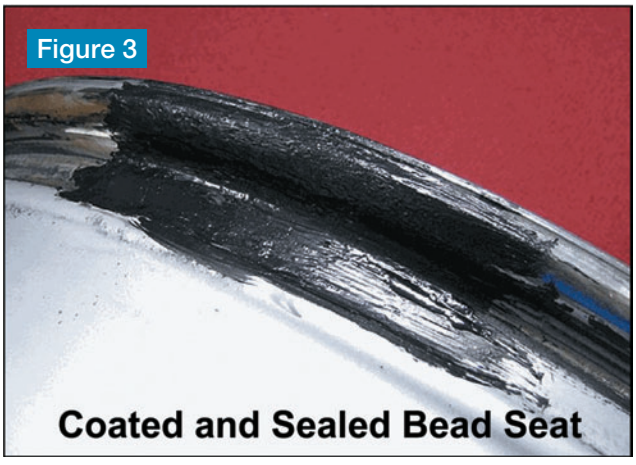
Figure 3
Coated and Sealed Bead Seat

CAUTION: *Only* remove the material required to eliminate the corrosion from the bead seating surface. Do *not* remove excessive amounts of material. Always keep the sealing surface as smooth and level as possible.

Once the corrosion has been eliminated, coat the repaired area with a commercially available wheel bead sealant (see Figure 3). Commercially available sealants are black, rubber-like coatings that will permanently fill and seal the resurfaced bead seat. Be sure to follow the manufacturer's directions for best results.

All that's left to do is remount the tire, test for leaks, install the repaired wheel and tire assembly, and reset the tire pressure monitoring system.

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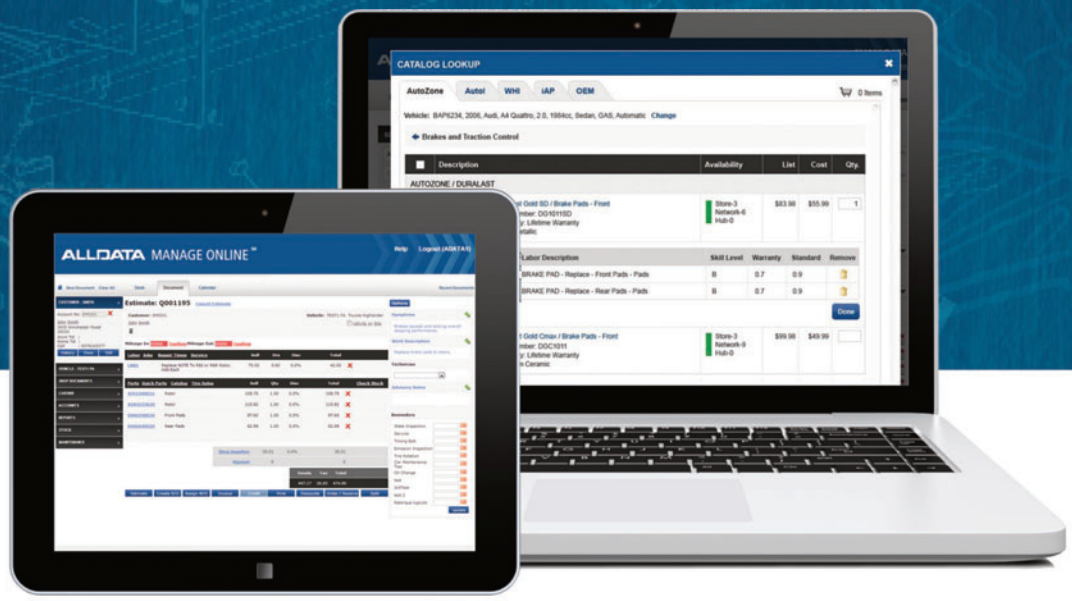

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REPEAT HVAC TEMPERATURE BLEND DOOR ACTUATOR REPLACEMENT

Have you ever had to replace a heating, ventilation and air-conditioning (HVAC) actuator more than once? If you have, you're not alone.

Our example is a 2007 Chevrolet Tahoe with dual-zone A/C. The customer complains that the driver's side blows hot air at all times, even with max cool selected, but the passenger side operates normally. Confirming the customer's concern shows that the HVAC system functions normally on the passenger side.

Your scan tool displays a diagnostic trouble code (DTC) indicating a malfunctioning driver's side temperature door actuator. When utilizing the bi-directional controls with the scan tool, the driver's side temperature actuator does not move.

Aftermarket service information shows there is a calibration update to address the DTC. The ACDelco TechConnect website has a link to check calibration IDs – and it's free. Comparison of the current calibration ID in the HVAC module to the available calibration IDs found that an update is available. The ACDelco website has links to subscribe to the ACDelco TIS2Web (Techline information system) and the General Motors Service Information (GMSI) sites, which allow the subscriber to program control modules and access factory service information.

After purchasing a subscription to both sites, the HVAC module is updated with the current calibration information. The system is retested, only to find that the same code returns and the system is still malfunctioning, so it's back to the DTC flow chart.

The flow chart goes through testing all of the circuits going to the driver's side temperature door actuator – as expected. The circuits all test within specification.

The next step is to replace the actuator. A new actuator is purchased, plugged in to make sure it works before it is installed, and the vehicle is put back together. It works just fine (looks like this is an open-and-shut case) so it's installed and the vehicle is put back together again. One final test on the way out shows that the new actuator is no longer working – another trip to the drawing board.

What went wrong?

The diagnostics were right – the door moved once. It must be a bad actuator, right? A second replacement actuator does the same thing. A validation of the movement of the driver's side temperature door (after removing the actuator), finds the door moves easily and smoothly to both stop positions. The best resolution is to step back and start over.

Starting the diagnostic path using GMSI, we find several related items to the DTC, instead of the single one that was available via the aftermarket information. One of the documents refers to the actuator moving out of a normal range to a mechanical stop; if this happens, the actuator needs to be brought back to the normal operating range to function. This step solves the concern with the new actuators.

The original actuator was bad, but neither of the replacement ones were bad. They should not have been tested out of the HVAC case, as this allows them to move outside of their normal operating range to the mechanical stop position. The subscription to the GMSI site allowed more options for the DTC and actually identified an issue that was not identified in the aftermarket service information.

ACDelco

ACDelco TechConnect website:
www.ACDelcotechconnect.com

The moral of the story: If you have done everything correctly and the vehicle still has the same problem, a different diagnostic procedure may give you a clearer perspective — and in this case, a solution to a frustrating repair situation.

A/C TROUBLESHOOTING PROCEDURES

The A/C system does not operate in a vacuum (no pun intended); it is reliant on other systems to operate at peak efficiency also.

▪ The cooling system should be inspected and tested. Follow the vehicle manufacturer's recommendation for flushing and replacing the coolant. Test that thermostat opens when it's supposed to and that the radiator cap maintains the correct pressure.

▪ Test that the cooling fan(s) or fan clutch engage and disengage when they're supposed to.

▪ Inspect and replace worn belts and hoses as a failure here could leave the vehicle stranded.

▪ Worn idler pulleys and belt tensioners can cause belt slippage, leading to poor cooling and A/C system performance.

Below are some general A/C system testing procedures; Visit our A/C Tune Up page located under the Technicians tab at www.4s.com for other helpful Diagnostic Inspection Worksheets.

VISUAL CHECK (ENGINE OFF)

▪ Identify system type

▪ Check system components and refrigerant lines for obvious damage (leaks or wear)

GAUGE HOOK-UP

▪ Install the correct gauge set (R12 or R134a) and check system pressure

▪ If both gauges read 0 PSI the system is completely discharged

▪ Evacuate the system

▪ Charge with one pound of refrigerant

▪ Leak test the system - if no leak is indicated - recharge the system before operating

TESTING CONDITIONS (ENGINE RUNNING)

▪ Set engine speed at 1,500 - 1,700 rpm

▪ Set AC controls to maximum cooling and high blower speed

▪ Position a high volume fan in front of the condenser

▪ Open all doors: Run the system for approximately 5 minutes, to stabilize the system

▪ Close all doors

▪ Set blower motor to low speed

TEST PROCEDURES

▪ Measure ambient temperature (2" in front of the condenser) Refer to the Pressure-Temperature relationship charts and determine normal readings

▪ Take readings from the high and the low side and record in worksheet

▪ Test for heat transfer at the evaporator and the condenser

▪ Check sight glass (if equipped)

▪ Consult trouble-shooting charts for the system being serviced and follow recommended procedures

Caution: Prolonged operation in the test condition mode may cause dangerously high system pressures due to poor air flow. Use only approved refrigerants such as R12 or R134a. Do not mix refrigerants.

UNDERSTANDING TPMS BATTERIES

A tire-pressure monitoring system (TPMS) sensor is engineered to perform well and survive under very harsh conditions inside a vehicle tire. Its typical operational life span is five to 10 years — depending on the type of sensor, how the vehicle is used and a variety of other conditions. TPMS sensor batteries are sealed in the sensor housing and cannot be serviced. When the battery is depleted, the sensor can no longer provide protection to the driver and passengers and must be replaced.

Key factors affecting sensor battery life include:

- **Driving vs. parked —** More transmissions are sent while the vehicle is driving, using more battery energy.
- **Sensor specifications —** Some sensors have an additional factory-enabled parking supervision mode, whereas others only transmit during motion.
- **Temperature extremes —** Exposure to very hot and cold temperatures can affect sensor operation and damage the battery.
- **Battery type —** CR type batteries have a lower self-discharge rate and broad temperature operating range. BR types have a higher self-discharge and poor performance at low temperatures, but are more able to withstand extremely high temperatures.
- **Sensor efficiency —** The Application-Specific Integrated Circuit (ASIC) in older-generation sensors consumed a lot more energy than current models.
- **Battery capacity —** Capacity typically ranges from 350mA up to 560mA across the industry.

Sensor battery diagnosis

It's not always easy to assess the actual condition of a sensor battery, unless it has already gone bad! When that happens, the sensor stops transmitting and sets off the vehicle's malfunction indicator lamp (MIL). A weakened battery may be more difficult to determine because the transmissions could become sporadic. Some TPMS scan tools have a battery status check, which can help identify a battery with reduced voltage.

Low-temperature troubleshooting

Not all sensor transmission issues are battery-related. Cold temperatures can create a frustrating TPMS "Christmas tree" intermittent light effect, from a low tire pressure telltale, system MIL or back-to-back combination thereof. For example, the first frost of the season or a big drop in overnight temperatures can set the stage for this scenario. When

temperatures drop, so does pressure, which can lead to the low tire pressure telltale. That's why it's important to maintain proper placard pressure at all times, especially with the change of each season, when temperature fluctuations are most likely. Extremely low temperatures can further cause sensor battery inoperability, thereby illuminating the MIL.

New tire service and sensor replacement

If a customer comes in for new tires and a bad or weak sensor battery is detected, consider recommending the replacement of all four sensors while the tires are off the vehicle. This will increase the initial overall cost, but will save the customer a lot of hassle and future charges for a second mounting and balancing, as well as the frustration of not being warned ahead of time.

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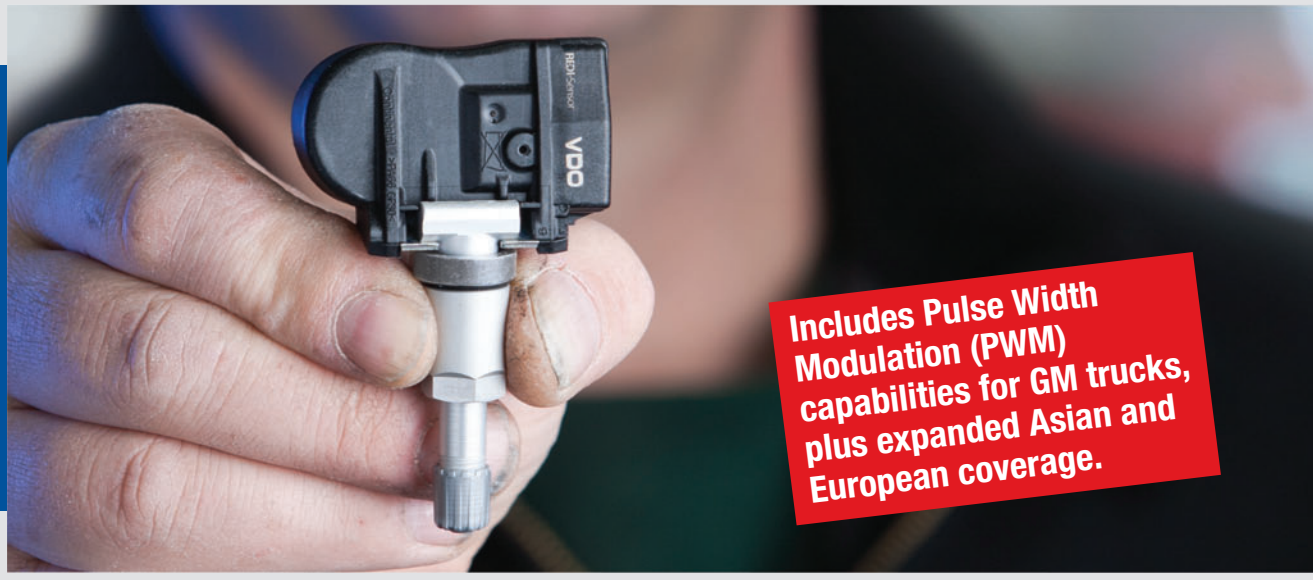

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KEEP COOLING SYSTEMS OPERATING PROPERLY

Because excess combustion heat can rise past 4,500°F and potentially destroy an engine, a properly operating cooling system is critical for proper operation.

Any cooling system repair should include a basic check of the coolant. Aging coolant can contribute to wear and tear as the old fluid coolant comes into contact with engine gaskets and component seals.

In addition to coolant condition, several other factors can contribute to cooling system malfunction as vehicles age, including:

- leaks
- thermostat failure
- radiator problems
- water pump issues

Even minor mistakes made in previous repairs, such as crossed wires and using replacement wire that is not to gauge, can have major consequences.

While excess heat energy can cause damage or even destroy an engine in 30 minutes, it is also important to remember that an engine running at too low a temperature can adversely affect performance as well.

Going the extra mile pays off when diagnosing fuel systems

Problems often crop up for even the most experienced technicians when servicing fuel pumps or modules. Looking beyond the obvious — and even being a bit proactive with customers — helps ensure the job is completed more efficiently and the new parts last longer.

Making a quick inspection for issues that are often overlooked can save hours of diagnostic time and trouble:

- Check the ground wire leading to the pump or module and in the harness for connection integrity — and test for ground continuity.
- Inspect for rodent damage: Vehicles parked for extended periods often fall prey to mice and other animals that may chew on the wiring.

When customers come in for service and you notice they're driving on "E," make sure they know that operating with little or no gas can contribute to premature failures and other malfunctions.

Delphi

For more tips and information on the full line of Delphi products, visit **www.delphi.com/am.**

Delphi pumps are equipped with an enhanced filtration system, which results in better control of contaminants and a longer product life. Plus, the secure seal between the pump and convoluted tube as well as a color-coded wire harness provide for easier installation.

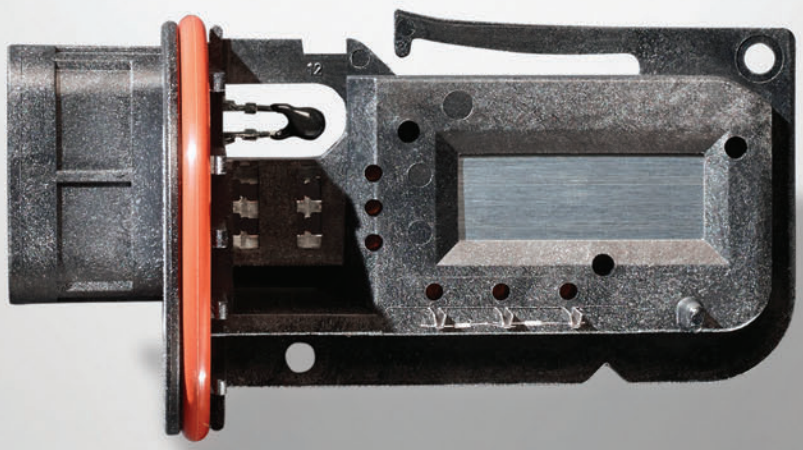
Do's and Don'ts for ignition coils

When it comes to ignition coils, original equipment (OE) quality equals reduced comebacks and satisfied customers. Delphi uses its OE engineering and heritage to deliver OE technology ignition coils for the aftermarket. And they back it with a 3-year/36,000-mile warranty.

Below is a list of best practices when performing ignition coil repair and replacements.

Recommendation	Reason
Never remove or disassemble the boot from the coil.	Disassembling the boot from coil could lead to losing the spring and / or suppressor, leading to engine misfires and RFI noise.
Never strike any part of the ignition system with a tool or other object.	This can lead to physical damage (micro-cracking that can't be seen), which can cause a system malfunction or failure.
Do not permit paint or other sprayed materials to be sprayed onto the electrical connectors.	Insulating-type spray can create a high resistance or open connection. Conductive-type spray can create an electrical short condition.
Always apply the specified torque to the specified mounting thru-bolt.	Loose thru-bolts could lead to failure under vibration. Over-tightened thru-bolts could lead to cracked coil mounting ear and / or premature thru-bolt failure.

Some Things Are Better New.



That's why every mass airflow sensor we make—whether with or without the housing—is built with calibrated all-new components and is never remanufactured. And with dual heated elements for fast response—typically less than 15 milliseconds to respond to 90% of flow change—they deliver 100% satisfaction for you and your customers.

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DELPHI

Not Just Quality. Delphi Quality.

WHO'S ON FIRST? WHAT'S ON SECOND?

To win the catalytic converter diagnosis game, you have to know who the players are and how they work together.

BY **JACK GEORGE,** EASTERN CATALYTIC

Trying to figure out why a cat went bad can be as confusing as the comical exchange in Abbott and Costello's famous baseball sketch in which the names of the players were actual questions.

Today, every vehicle is different, and carmakers are using a variety of technologies to get lower emissions and higher fuel economy, including manifold converters, pre-cats, and multiple converter systems with as many as eight cats.

All of this can lead to a lot of confusion. So, to properly diagnose and service these complex systems, you need to know what's on first, who's on second, and so on. If you can answer these basic questions, you have a good chance of coming up a winner:

- "Who" caused the problem?
- "What" kind of a system is it?
- "Why" did this happen?
- "I don't know," is there a TSB?

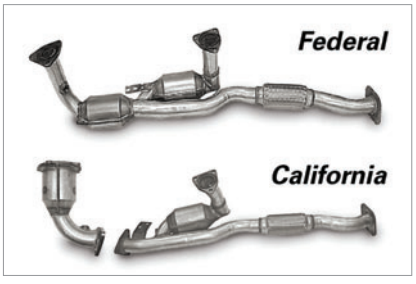
Jumping the gun and replacing the converters because of a particular fault code can lead to an unnecessary and expensive repair. The same goes for replacing the wrong converter in a multi-cat system. Federal and CARB systems can be very different, even for the same vehicle. A Federal Y-pipe may use one converter, while its CARB counterpart may have more (see Figure 1). Some vehicles have different combinations of manifold converter or pre-cats and underbody catalysts. That's why it's important to get familiar with the vehicle, the players in the system, and service history.

How are the emissions monitored?

To accurately diagnose, you need to know how the system is monitored, so you can find out "who" is doing "what." Cylinder numbering determines the location of bank 1 and 2. However, carmakers number differently according to engine configuration and layout. That means cylinder #1 on a Chevy could be on the left bank, but on the right bank in a Ford. Some inline 4s are split into two banks for fuel control and efficiency monitoring, while a straight 6 can have first three cylinders on bank 1 and the rest on bank 2. Look up the cylinder numbering to be sure.

Diagnosing multiple converter systems

Multiple converter systems can be tricky. For example, a Y-pipe configuration with two pre-cats and an underbody converter may have an O_2 sensor in each manifold (before the pre-cats), and only one monitor downstream of the final underbody converter. Unfortunately, the catalyst efficiency codes can't tag the bad cat. Because all three converters work together to deliver the efficiency, it is likely that only one is failing. You can use a temperature gun to help detect a rise in the downstream converter(s). Look for an increase of 100°F to 140°F, with the higher temperature range at the outlets of each converter indicating a working converter. Anything greater than 150°F means the converter is being overworked, possibly due to excessively rich mixtures entering the converter. This situation can cause damage to the remaining and otherwise healthy converters.



California and Federal systems are not created equal, as shown here for the 2000 Nissan Maxima. Only the one below with three 02 sensors and a different configuration will fit a California emissions vehicle.

Eastern Catalytic
www.easterncatalytic.com

Unfortunately, guessing at which converter is bad in this repair could turn out to be an expensive comeback. With the high cost of parts and labor, this is a call you do not want to make to your customer.

If you get to know the players and how they work together, you will avoid costly mistakes and stay at the top of your game. To view the famous comedy sketch, go to: "who's on first" on YouTube.

OE converters have catalysts designed to meet specific OBDII parameters, as set by the OEM...

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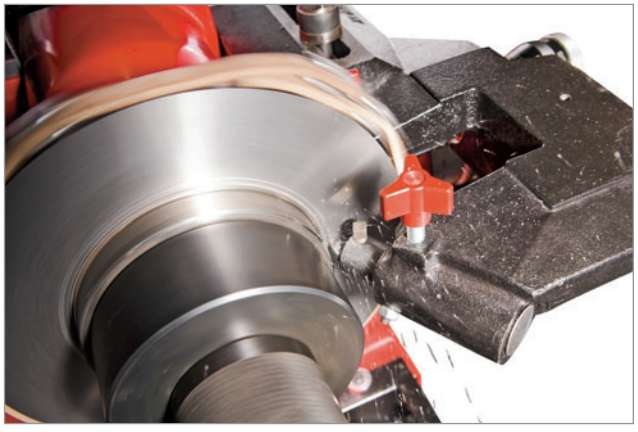
WHAT THE BRAKE PEDAL REVEALS

Q: The brake pedal is pulsating under your foot and the steering wheel is vibrating whenever the vehicle slows down or come to a stop. The pressure in all four tires is perfect and so is the alignment, so what could be causing the problem?

A: Steering wheel vibration during braking is typically caused by warped front brake rotors. When you step on the brake pedal inside the car, brake fluid is sent to the brake calipers. This causes hydraulic pressure to squeeze the brake rotor in between the brake pads. The brake rotor, in time due to normal wear and tear, can become "warped" or have uneven spots or wear on the surface. It can also warp because of expansion and contraction of the metal disc rotor because of driving through a puddle of cold water, or after a long trip on the freeway then applying the brakes, or due to severely worn-out brake pads that have been grinding metal to metal on the brake rotor.

Q: How does rotor warp cause pulsation in the brake pedal?

A: When the brakes are applied, the caliper and the brake pads squeeze the rotor, which causes the car to stop. The brake rotor is turning the same speed as the wheel. If the rotor is warped, the brake pads will pulsate inside the caliper as they come in contact with the high spots. This vibration can sometimes be felt inside the car at the brake pedal. The vibration is usually felt when applying the brakes in a panic type situation at higher speeds, and can also be noticed when coming to a full stop, like at a stoplight.



Here is an example of the truing process.

BendPak Inc. / Ranger Products

For more information about brake drum and rotor resurfacing, contact Ranger Products at **800-253-2363**; fax **(805) 933-9160** or visit **www.bendpak.com.**

Q: What can be done to correct the problem?

A: The brake rotor can be removed from the car and trued using a brake lathe similar to the Ranger RL8500. This combination brake lathe is designed to recondition the surface of rotors or drums by making them smooth, or "true" again (see illustration above).

The brake rotor will have a limit to how much of the material can be removed or shaved off, and this minimum thickness is usually stamped on the rotor or drum for the mechanic to see. If the rotor is below minimum thickness specifications, it will have to be replaced.

TWO NEW INNOVATIVE SOLUTIONS – ONLY FROM MOOG

As the automotive service industry's "Problem Solver®" and the preferred brand of professional technicians and NASCAR® crew chiefs, MOOG® Steering and Suspension specializes in developing innovative parts that improve on original designs by providing increased durability, enhanced performance and easier installation. This exclusive commitment to problem-solving innovation continues with two exciting new MOOG Problem Solver parts now available for millions of foreign-nameplate and domestic passenger vehicles:

Problem Solver Control Arm Bushings

Figure 1


Figure 2

MOOG's patent-pending new Problem Solver control arm bushings (see Figure 1) for vertical applications feature an innovative ball-and-socket design (see Figure 2) that eliminates stress-induced failures encountered in original equipment-style parts. Lasting up to 10 times longer than original equipment (OE)-style parts, these new MOOG bushings are available for millions of popular Chrysler, Ford, General Motors, Honda, Mazda and Toyota passenger vehicles.

OE-style control arm bushings used in vertical applications are commonly manufactured from a hard rubber compound that has been bonded to a housing and bolt sleeve. This material, when stressed by expansion and compression, can separate from the housing or sleeve, causing noise and a noticeable loss in steering and handling precision. In addition, the bushings' hard rubber compound makes it harder to align the sleeve during installation.

The MOOG Problem Solver design eliminates stress-induced failures while providing improved steering and handling feel. In addition, the new bushings are permanently lubricated and sealed from contaminants with premium MOOG boots and help speed the repair by ensuring fast, easy alignment of the bushing sleeve with the bolt hole in the vehicle frame.

Problem Solver Sway Bar Link Kits

Professional technicians using traditional sway bar link kits often have difficulty maintaining proper washer position and threading the locking nuts during installation. In many cases, the link bolt-end is flush with the outer washer, preventing proper engagement of the threads.

MOOG has the answer. The brand's exclusive new Problem Solver sway bar link kits (see Figure 3) eliminate installation issues encountered with traditional, non-socket style kits. These timesaving new sway bar link kits feature specially molded bushings that center and hold the washers in place during installation. In addition, the kits' technician-friendly barrel lock nut can easily be threaded onto the bolt in all installations, including cases when the bolt-end is flush with the washer.


Figure 3

Other key features of this new MOOG Problem Solver design are premium, heavy-duty urethane bushings that provide exceptional resistance to oil, heat and ozone; and robust, Grade 8 bolts and anodized T-6 aluminum solid hex spacers that help ensure superior strength and corrosion resistance.

To learn more about these and other exclusive MOOG Problem Solver parts, simply visit the brand's technician-focused **www.moogproblemsolver.com** website or contact your steering and suspension parts provider.

MOOG Steering & Suspension
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MOOG STEERING & SUSPENSION

THE PROBLEM SOLVER®

FEDERATED OFFERS PREMIUM BRAKING PERFORMANCE FOR TODAY'S VEHICLES

Federated Auto Parts has developed an addition to its friction offering with a new co-label line developed and supplied by Wagner Brake. The new product line is a premium offering designed for professionals that was exclusively designed for Federated members and their customers.

The line uses the highest performing formulas specific to each application. It includes System Synergy Technology (SST), which is an original equipment (OE) approach to brake design that ensures the interaction of all brake components to provide the ultimate performance.

Each set of Federated Professional Premium is engineered and designed to match the OE pad in fit, form and function, and uses premium formulations and shims designed for ultimate performance on each application.

SST focuses on managing the noise, vibration and harshness (NVH) issues through testing and validation of the various components used in disc pad designs. While many consider a disc brake pad one component, it actually consists of many different components — including backing plates, shims and hardware, along with friction material, slots and chamfers. Each component must be designed to work together to deliver ultimate performance.

Working with Wagner Brake experts, Federated has developed a product line that uses OE designs, and improvements in materials and component integration, to deliver superior performance to other aftermarket lines. The Federated Professional Premium line provides superior braking performance, long life and quiet operation for customers who perform premium brake service and have a reputation for using high-quality brand name parts.

Strong history

Federated has a history of working closely with high-quality manufacturers to develop exclusive products designed specifically for use by quality technicians and professional service providers. The Federated Professional Premium line of disc brakes is designed to take all the mystery out of all the different materials and grades available in the market today by using System Synergy Technology to focus on the best solution for each vehicle.

"We spent countless hours working with Wagner Brake experts in designing this line," says Phil Moore, senior vice president for Federated Auto Parts. "The results from both testing and customer feedback have been outstanding. This new product line delivers premium performance in every area, and we believe it will be a major benefit to our professional customers.

Federated Auto Parts
www.federatedautoparts.com

"Working with Wagner and Federal Mogul made this project easier, due to their commitment to quality and their outstanding manufacturing and R&D facility in Smithville, Tenn.," Moore adds. "We are proud to have a premium product line that is made in the USA."

Federated Professional Premium brake uses an OE approach to the design process that delivers the ultimate in overall performance for the professional service provider and is available exclusively from members and affiliates of Federated Auto Parts.

Federated Auto Parts PROFESSIONALS®

PICK YOUR PICKUP SWEEPSTAKES

Federated Car Care PROFESSIONALS

YOUR CHOICE:

This fully restored 1949 PICKUP

OR

a brand new 2015 PICKUP

Today's Innovations with Old Time Values

The Federated Car Care "Pick Your Pickup" Sweepstakes grand prize winner will have a tough choice deciding between a fully restored 1949 Pickup or an innovative 2015 Pickup. An easier choice is picking Federated as your parts supplier. Whether parts for a pickup or virtually any vehicle on the road, Federated has the best coverage from past to present.

To learn how you could become the grand prize winner in the Federated Car Care "Pick Your Pickup" Sweepstakes, or have a chance to win one of hundreds of other great prizes, contact your Federated Auto Parts distributor or visit www.FederatedAutoParts.com/pickup.

Federated Car Care PROFESSIONALS®

The Federated Car Care program is one of the fastest growing, complete support programs for the nation's best automotive service providers. The Federated Car Care Sweepstakes is open to any fully enrolled Federated Car Care Center member. Current members are automatically eligible. New members must be enrolled by August 15, 2014 to be eligible.

MOTORCRAFT MIKE ON A/C RECHARGING OR REPROGRAMMING

By now, you've likely prepared for the air-conditioning season by ordering your R134a, checked the operation of your A/C recycling station and your pressure gauges. But what else should be considered?

How about your scan tool and/or your J2534 pass-through device?

Yes, today's A/C service is more than finding leaks, recharging refrigerant and replacing desiccant cartridges; it also includes identifying control-module issues and updating software.

Many vehicles may suffer from climate-control issues that don't require recharging; they require reprogramming. And often these issues will come to the forefront of the customer's mind when the weather turns hot and the A/C doesn't get cold.

For example, some 2010 Ford Fusion models may exhibit low or no airflow from the panel vents during extended drives. When these vehicles come in for service with the intermittent concern, you likely will pull DTCs, test pressures, check switch and blend door operation and not find a thing. You may wonder what's going on.

Don't forget the "brains" of the system — the control modules. Control modules basically tell the system how to operate and when. Today's electronic automatic temperature control (EATC) systems depend on their control modules and the input and output devices that they are either networked with, or hardwired to, for information and control.

In the example above, the fix is to reprogram the climate-control module with the latest software update.

In fact, reprogramming is becoming a much more common procedure when repairing all systems on modern vehicles. Because climate-control systems are now using more control modules than ever to provide passenger comfort, a repair facility's ability to reprogram these modules can be the difference between success and failure when diagnosing these systems.

Keep in mind that not only the climate-control module affects system operation. Many reprogramming updates to correct climate-control issues are performed on the Powertrain Control Module (PCM) or Body Control Module (BCM). The PCM and BCM network signals are essential for correct operation; therefore, either of them may program updates to correct operating issues of the EATC system. You can see how these modules interact with the climate-control system by looking at the Communication Message Chart shown below.

Communication Message Chart

Message	Originating Module	Network Type	Receiving Module(s)
A/C clutch status	PCM	HS-CAN	BCM
A/C clutch status (gateway)	BCM	MS-CAN	HVAC module
A/C pressure	PCM	HS-CAN	BCM
A/C recirculation request	PCM	HS-CAN	BCM
A/C recirculation request (gateway)	BCM	MS-CAN	HVAC module
A/C request (gateway)	BCM	HS-CAN	PCM
A/C request	HVAC module	MS-CAN	BCM
ABS event in progress	ABS module	HS-CAN	PCM; C-CM

Charts like this are found in Ford workshop manuals.

Be aware that you do not have to purchase a manufacturer's scan tool to reprogram these modules. Reprogramming can be performed using a generic J2534 pass-through device. Every manufacturer has a website that enables aftermarket facilities to purchase control module programming.

Ford vehicle programming can be found online at MotorcraftService.com, designed specifically to support aftermarket repair facilities and service technicians.

When performing any module software procedure, use the following basic checks to ensure programming completes without errors.

- The 12-volt battery is fully charged.
- Install battery jumper box to maintain battery voltage throughout the programming procedure.
- Whenever possible, use a hardwired Internet connection.
- Turn off all unnecessary accessories.
- Follow all on-screen instructions carefully.
- Disable sleep mode, screen saver and hibernation modes on the laptop/PC computer.

And remember, Motorcraft® offers a complete line of replacement parts that are recommended by Ford and specifically engineered to fit Ford and Lincoln vehicles. Offering value with high quality and the right fit at competitive prices, Motorcraft parts are backed by the Service Parts Limited Warranty of Ford Motor Company: 2 years, unlimited mileage with labor included* and no commercial exceptions.

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2 YEARS. UNLIMITED MILEAGE. LABOR INCLUDED.*

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IT'S NOT YOUR GRANDPA'S EGR SYSTEM ANYMORE

BY **JIM NEWKIRK,** IDENTIFIX EUROPEAN SPECIALIST / CERTIFIED: ASE MASTER, L1, BOSCH BSC3

Vehicle: Volkswagen with Tier2 BIN5 TDI 2.0L CBEA Diesel EGR System

Trouble codes:

P047A (DTC 001146) Exhaust Pressure Sensor 2 (G451) Open Circuit

P047B (DTC 001147) Exhaust Pressure Sensor 2 (G451) Implausible Signal

Let's start with a little background on Volkswagen's new EGR system. To meet the extremely tight Tier2 Bin5 standards for emissions (maximum of 10 milligrams/mile particulate matter and 70 milligrams/mile NOx for diesel vehicles) the new Volkswagen 2.0L CBEA TDI diesel engine uses a complex EGR system in conjunction with a diesel oxidation catalyst + diesel particulate filter (known as the DOC+DPF), a NOx storage catalyst and a H2S (sulfur) catalyst to achieve efficient NOx and particulate matter reduction.

The EGR system consists of two parts:

1. High-pressure side — Exhaust gas is recirculated from the exhaust system after the Exhaust Manifold and controlled by a High Pressure EGR Valve. Exhaust gas is then fed into the Intake Manifold after the Throttle Valve.

2. Low-pressure side — Exhaust gas is recirculated from the exhaust system between the DOC+DPF and the NOx storage catalyst. Exhaust gas is then fed through an EGR cooler and Cooler Flow Control Valve to the intake air system at the turbocharger compressor inlet. An Electronic Exhaust Throttle Valve is included between the NOx storage catalyst and the H2S catalyst. This valve is used to control differential pressure between the NOx storage catalyst and turbocharger and assists with Low Pressure EGR return flow and catalyst regeneration.

In addition, there are two EGR pressure sensors and four exhaust gas temperature sensors to measure the flow state, temperature and general health of the Exhaust After Treatment components (see Figure 1).

Close monitoring of the EGR and Exhaust After Treatment components is critical for NOx reduction and proper regeneration of the DOC+DPR catalyst, the NOx storage catalyst and the H2S catalyst. A failure of any component will lead to excess emissions, and could potentially lead to failed catalyst regeneration cycles and eventual failure of the Exhaust After Treatment components.

WHEW! OK, so what does this all have to do with trouble codes P047A (DTC 001146) Exhaust Pressure Sensor 2 (G451) Open Circuit and P047B (DTC 001147) Exhaust Pressure Sensor 2 (G451) Implausible Signal? The codes indicate a potential problem with the G451 Exhaust Pressure Sensor 2 signal (implausible) or wiring (open circuit). This sensor monitors the pressure and flow in the Low Pressure EGR system. The function of combined Low Pressure and High Pressure EGR system operation is continuously adjusted depending on engine operating conditions and RPM. No-load engine operation results in high amounts of High Pressure EGR application and low amounts of Low Pressure EGR application.

With rising engine load and engine RPM, the recirculation of exhaust gases is shifted to the Low Pressure EGR system to increase the recirculation flow rate. This allows for optimum NOx reduction at mid to high engine loads. At high engine loads, the cooled Low Pressure EGR system is much more efficient than the High Pressure EGR system at adding the correct amount of exhaust gas recirculation for NOx reduction.

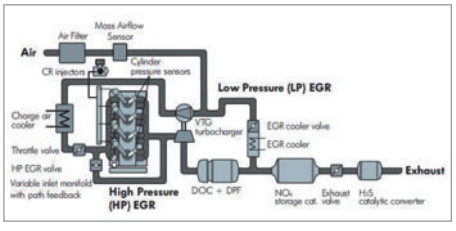

Figure 1. PHOTO: Volkswagen of America (VWOA)

The G451 Exhaust Pressure Sensor 2 monitors flow rate of the Low Pressure EGR system from after the diesel oxidation catalyst and the diesel particulate filter (DOC+DPR) to the EGR cooler assembly. The trouble codes indicate a problem with the G451 Exhaust Pressure Sensor 2 Signal or G451 wiring or connections.

To test the G451 Sensor:

1. Locate the G451 Exhaust Pressure Sensor 2 below a heat shield near the oil filler neck.
2. Inspect the exhaust pressure feed lines from the N213 EGR Valve 2 housing and from the base of the DOC+DPF assembly to the G451 Exhaust Pressure Sensor 2. The exhaust pressure feed lines must be intact, not leaking, not plugged or bent (Note: This is a critical step. Any leakage, restriction or damage to the pressure lines can cause the G451 to output an implausible signal.)
3. Inspect the G451 Exhaust Pressure Sensor 2 wiring as follows:

- Pin 1 (Black wire) = 5-volt power supply, ignition on, from pin T94/14 of the PCM.
- Pin 2 (Brown wire) = Good ground at all times from pin T94/79 of the PCM.
- Pin 3 (Green wire) = Signal return to pin T94/34 of the PCM. Values are about 0.48 volts with no exhaust pressure. The voltage will increase in a linear fashion as exhaust pressures increase.

4. Repair any wiring/connector defects as necessary.
5. If the G451 Exhaust Pressure Sensor 2 output voltage does not react as described and all of the wiring and pressure lines are OK, then the sensor is faulty and must be replaced.

In this particular case, the wiring to the G451 Exhaust Pressure Sensor was damaged. After repairing the harness normal G451 Exhaust Pressure Sensor operation was restored. The technology that is required to achieve mandated emission levels can seem overwhelming at first but with an understanding of how the system is designed to operate, the diagnostic process is not so far removed from Grandpa's EGR!

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Inoperative brake light
2011 Ford F-250 Super Duty XL 6.2L. The left rear turn signal/stop light bulb is out.

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WHEN TROUBLESHOOTING ELECTRICAL SYSTEMS, SAVE TIME AND MONEY WITH CONTACT CARE

In the old days, almost the entire electrical system of a vehicle consisted of just the battery, along with a few glass fuses. Times have obviously changed, and now, your average car has multiple computers, thousands of feet of wire and hundreds of electrical connectors. And for every electrical connector, there is another possible cause for failure.

The most well known electrical connector is, of course, the main battery connection. Any technician knows to check, clean and tighten battery connectors prior to troubleshooting an electrical problem. The many battery maintenance tools and chemicals on the market make this job easier, but what about the multitude of electrical connectors downstream of the battery? How are they maintained?

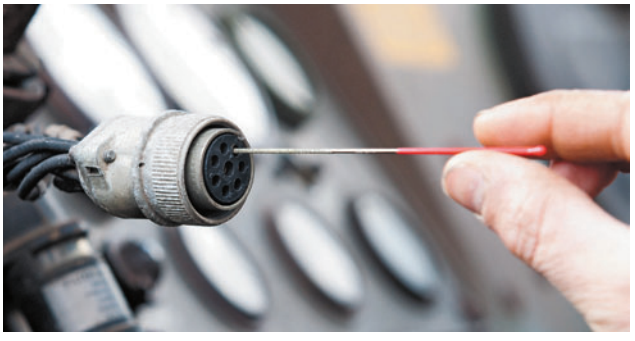
When we say "electrical connectors," we are of course referring to fuse boxes — spade, flat, round, bullet, micro and many other styles. These connectors are packed by the dozens to a harness, often assembled in supposedly "weather proof" housings that inevitably become corroded and fail because of moisture and oxygen. They deliver power, ground and signal to the vehicle's computers, sensors, relays, lights, electric motors, charging system, stereo, towing circuits, and anything else that uses power.

When these connections become corroded, they can cause short circuits, open circuits, intermittent power failures, melt fuses, parasitic draw, increased resistance (which trips computer fault codes), premature electric motor failures, and worst of all, bad ground connections.

If you listen to the original equipment manufacturers (OEMs), when a connector becomes too corroded for chemical cleaners, you are to simply replace the suspected connector. While this may be the ideal solution in an engineering lab — it may not be when you're in the shop on a Monday afternoon, with Mrs. Jones eagerly waiting for her random electrical problem to be fixed. That's when troubleshooting an electrical system requires the right tools to save time and get the job done.

Products such as Emery cloth, needle files, wire brushes, and welding tip cleaners are commonplace in most shops. But these tools can be ineffective, and will often damage electrical connectors.

Innovative Products of America (IPA®) has created solution to this everyday problem with its new category of Contact Care products. Through the use of patented designs, IPA's Contact Care tools can clean most types and sizes of electrical contacts found in automobiles, commercial tractors, trailers, plows, forklifts, ag, industrial equipment, etc. These tools will access many of the smallest



terminals in the industry, and are designed to precisely scrape corrosion from both male and female pins without damaging the integrity of the terminal.

Equally important when discussing contact cleaning is to address the misnomer that cleaning a terminal is bad because you risk removing the factory protective coating, which is designed to prevent corrosion. However, you have to ask yourself, if the factory protective coating works so well, how did the terminal become corroded in the first place? In fact, using IPA's Contact Care products to scrape corrosion, followed by the application of a chemical-based deoxidizer, will break the bonds of new corrosive agents on a microscopic level. In this process, a protective coating is then applied to prevent new corrosion from occurring. As a direct result, when serviced properly, terminals can be rejuvenated to prevent electrical failures from occurring in the future. This is also helpful in fleet preventative maintenance programs.

Innovative Products of America

www.ipatools.com

IPA manufactures cleaners for most pin types, from micro through large industrial contacts. IPA's complete line of Contact Care tools come in various sizes and in industry-specific assortments to save time and aid in troubleshooting electrical problems on almost any piece of equipment. Contact your professional tool distributor to select the ideal IPA Contact Care products for your shop.

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HD FLEET TECH'S ELECTRICAL TERMINAL MAINTENANCE KIT #8048

- Cleans male and female pins
- Extends harness life
- For trucks, trailers, cars, ag/construction equipment, industrial equipment, etc.
- Patented

Cleans Common Fleet Electrical Connections

Trailer light | Deutsch/Cannon | ABS Sensor | Spade Teminal | 7-way Round Pin

DISC BRAKE SYSTEM ANALYZER #7884

- The only tool to identify imploded brake hose and accurately detect the problem without breaking a line

GREASE JOINT REJUVENATOR® #7862

- Instantly open clogged grease joints!
- Lifetime warranty

Patented

ENGINE CALIBRATION SET UP KIT #7891

- Eliminate mistakes when performing engine setup procedures

DIGITAL FLOW METER NOZZLE #9048 NEW

- Accurately Monitor Fuel Transfer Operations
- Diesel, gasoline, kerosene

Choose Gallons, Liters, Quarts or Pints

LARGE 2 IN 1 CUTTER/STRIPPER #7896

- Self-adjusts to 10, 12, and 14 AWG automotive, house and appliance wire
- Catches, holds and strips wire in one quick motion

MANTUS™ TIGHT ACCESS TOOL #8041

- Serrated tips grip fuses, terminals and wires
- Cleans male spade pins

FUSE SAVER® MASTER KIT #8016

- Chase down short circuits without blowing fuses
- 5-30 amp breaker handles

6-PC. RELAY BYPASS SWITCH MASTER KIT #9038

- Energize a fuel pump with the push of a switch

IMPROVE ENGINE PERFORMANCE WITH GUMOUT MULTI-SYSTEM TUNE-UP

More than likely, you've been asked, "Do I need to use a fuel additive or a fuel system cleaner?" and "Are they worth it?" A quick-and-easy answer is yes, but to make the best recommendation on which product to use, you need to understand the science behind the products.

Over time, all engines lose performance and fuel economy. Much of this is due to the impact of fuel on key engine parts. Even high-quality fuel produces carbon deposits during combustion. These deposits build up on engine parts, limiting their performance.

Fuel also contains ethanol, which attacks metal surfaces and allows water to have a more corrosive impact. Gumout® performance additives are developed with the latest science to maximize engine performance in these conditions.

Gumout's latest innovation, Multi-System Tune-Up®, treats the entire fuel system with an exclusive, scientifically formulated blend of premium cleaning and conditioning agents to restore performance and fuel economy in any engine type.

A more complete clean

The intense heat of the combustion chamber can make important engine parts like piston tops and cylinder heads difficult to clean. While many fuel additives burn up before cleaning these hard-to-reach parts, the polyether-amine (PEA) used in Gumout remains stable, easily withstanding the 495°F heat.

PEA breaks the bonds between carbon deposits and engine parts, removing them from the fuel system. The result is cleaner piston tops and cylinder heads, as well as a cleaner combustion chamber. This reduces hot spots that can lead to pre-ignition and reduced combustion efficiency.

PEA also cleans other vital parts of the fuel system, such as fuel injectors, intake valves and ports, for maximized performance and fuel economy. Once deposits have been removed, PEA bonds to the metal surface of engine parts to prevent future buildup.

ITW Global Brands

6925 Portwest Dr.
Houston, TX 77024-8042
Toll-free: 855-888-1990
information@itwgb.com
www.gumout.com

More conditioning and protection

But cleaning is only part of the story. Gumout Multi-System Tune-Up also features a wider range of conditioning ingredients. Antioxidants help stabilize fuel and oil, particularly in engines that are used less often, to keep varnish from developing on metal parts. In addition, corrosion inhibitors keep key engine parts from degrading, helping to extend engine life.

Gumout Multi-System Tune-Up can be used in gas, ethanol, diesel and poured into the crankcase to stabilize oil. It's built to handle the requirements of modern engine technology, like gasoline direct injection (GDI), turbos and superchargers, and it's equally effective on engines without those systems, thanks to its advanced ingredients.

Tested and retested

We constantly put our formulas to the test — in the lab, on the track and on the street — to ensure they always meet the toughest standards of performance and safety.

Cleaner, better conditioned engine parts mean better performance. Prove it to yourself at **GumoutProveIt.com.**

GUMOUT®
PERFORMANCE ADDITIVES

SECTION 3C

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

Fig. 1–Valves

Cleaning and conditioning the entire fuel system allows Gumout to restore lost performance and improve fuel economy.

Even high-quality fuel can eat away at performance and engine life. This happens in two ways:

carbon deposits left behind after combustion and corrosion caused by ethanol.

Over time, carbon deposits build up on key engine parts. Gumout® bonds to those deposits and removes them to restore performance.

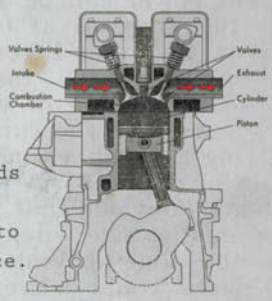


Fig. 2–Engine Fuel System

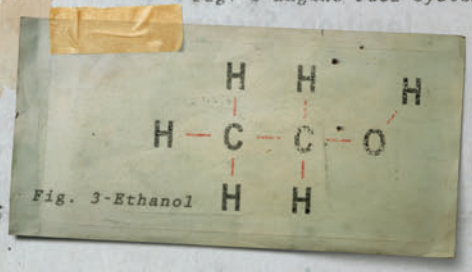


Fig. 3-Ethanol

Ethanol is a solvent that attacks metal surfaces, allowing water in the fuel system to have a faster and more corrosive impact.

Gumout products are specially formulated to prevent corrosion from ethanol and water, helping extend the life of critical engine parts.

Gumout is scientifically proven in the lab, on the track and on the street. See all the ways it can improve your performance at gumout.com.

801B-QR-002

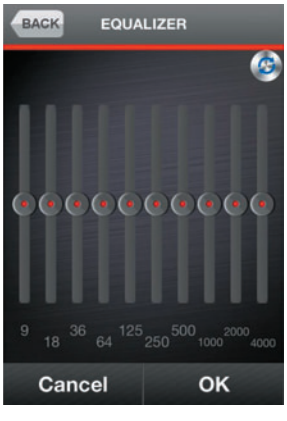
SCIENCE IN. PERFORMANCE OUT.™

GUMOUT® PERFORMANCE ADDITIVES

PINPOINT UNWANTED NOISES WITH SMARTEAR BY STEELMAN PRO

When a customer brings in a car with unwanted noises, what do you do? Some techs will use a screwdriver and put their ear up to it to find loose bearings. This is unsafe and not the optimal solution for finding noises. There are some techs that will actually fix a noise that the customer wasn't complaining about, which wastes time and money.

Smart Ear Lite



Smart Ear 1

Now there is a high-tech solution to finding and pinpointing squeaks noises and rattles anywhere within a vehicle. Smart Ear by Steelman PRO is designed to turn your smartphone or tablet into a state-of-the-art sound detection device. With three different versions — Smart Ear Lite, Smart Ear 1 and Smart Ear 2 — the technician can choose which model fits his or her needs.

Smart Ear Lite comes with a sound wand, aluminum probe, ear buds and a dual port connector. This version is ideal for the technician wanting to use a smart device as a stethoscope. Sound output levels are displayed in digital or analog format, and a sound wave graph is also shown. The aluminum probe attachment can help find loose bearings or vibrations coming from different components under the hood.

Smart Ear 1 comes with a sound wand, aluminum probe, one sound sensor clamp, ear buds, a dual port connector, and a dual port dongle. This version is great to use as a stethoscope, or the technician can use one of the sound sensor clamps to find noises. The clamp can be used to zero in on noises that are hard to reach or hear under the hood or chassis. The Smart Ear 1 app comes with an equalizer, so the user can zero in on specific pitches and frequencies of noises. Applications include, but aren't limited to, finding fuel injector misfires, loose bearings in an A/C compressor, or pinpointing noises in differentials, idler arms or tie rods.

Smart Ear 2

Smart Ear 2 comes with a sound wand, aluminum probe, six sound sensor clamps, Bluetooth wireless headphones, a docking station and a wall charger for the docking station and headphones. Smart Ear 2 has several features within the software that enables the user to pinpoint noises more accurately. The technician can name each clamp location within the app for ease of reference while testing. Diagnostic sound events can be recorded and emailed to other technicians to get a second opinion, or emailed to the customer to ensure the proper noise is being fixed. An equalizer within the sound settings can be used to hone in on specific noises as well.

The Smart Ear Diagnostic Tool line from Steelman PRO will help technicians save time and money when trying to pinpoint squeaks, noises and rattles anywhere within a vehicle. Simply purchase the Smart Ear hardware, attach your smart device to the Smart Ear hardware, download and initiate the app: You are ready to start finding unwanted noises!

JS Products Inc.

6445 Montessouri St.,
Las Vegas, NV 89113
P-800-255-7011
F-775-898-8773
www.steelmanpro.com

STEELMAN PRO

SMARTEAR™ DIAGNOSTIC LINE

STEELMAN® PRO

The Steelman®PRO SmartEAR™ Sound and Vibration Detection Hardware Kits and downloadable apps work with smart phones or tablets to create a state of the art sound detection tool allowing for ease of locating and pinpointing those hard to find squeaks and rattles

91925 SmartEAR L
NOISE & VIBRATION DETECTION

91927 SmartEAR 1
NOISE & VIBRATION DETECTION

91929 SmartEAR 2
NOISE & VIBRATION DETECTION

STEELMANPRO

FOR MORE INFORMATION GO TO
WWW.STEELMANPRO.COM/SMARTEAR

@STEELMANPRO

TODAY'S EXTENDED OIL CHANGE INTERVALS DON'T HAVE TO REDUCE LUBE SERVICE PROFITS

The FRAM Pro Series line of filters can help you get more dollars from every oil change service performed, while giving your customers peace of mind between changes.

The FRAM Pro Series provides the products and tools to sell premium oil changes. It is the first product line that aligns oil filters with the specific oil (Conventional, Synthetic Blended and Full Synthetic) with profit opportunity based on oil change trade ups. FRAM Pro Series brings filtration back into the conversation of oil changes.

Traditionally the market has offered the customer quality oil choices. For the first time, the FRAM Pro Series offers specially designed filters that align with those oil offerings.

- FRAM Pro Synthetic™ — For full synthetic oil changes up to 15,000 miles (24,000 km)
- FRAM Pro Plus™ — For synthetic blended oil changes up to 10,000 miles (16,000 km)
- FRAM Pro™ — For conventional oil changes up to 5,000 miles (8,000 km)

The FRAM Pro Series line of filters can help professional technicians get more dollars from every oil change service performed, while giving their customers peace of mind between changes. In addition, the end users are able to make an educated decision on filter protection for their vehicles, instilling confidence that they are using the best filtration products available.

What do these filters have to offer? Let's take a look

First up is the FRAM Pro Synthetic™, engineered to optimize synthetic oil life with protection up to 15,000 miles. The FRAM Pro Synthetic™ offers the ultimate engine protection. †† It is engineered for vehicles that require full synthetic oil, with a dual layer synthetic media reinforced with a durable metal screen to deliver up to 15,000 miles (24,000 km) of engine protection and 99 percent† Dirt Trapping Efficiency. A silicone anti-drainback valve holds a reserve of oil in the filter to help protect the engine during start-ups.

Next in line is the FRAM Pro Plus™, a trade up filter aligned with synthetic blended oil change intervals up to 10,000 miles. The FRAM Pro Plus™ offers superior engine protection †† and is engineered for newer vehicles that use synthetic blended oil with lengthened change intervals. As with the Pro Synthetic this filter has 99 percent † Dirt Trapping Efficiency and a Silicone anti-drainback valve holds a reserve of oil in the filter to help protect the engine during start-ups. This filter comes with a cellulose-fine fiber synthetic blend filter media.

Last up is the FRAM Pro™, a quality filter designed for conventional oil change intervals up to 5,000 miles. The FRAM Pro™ offers advanced engine protection with a 93 percent† Dirt Trapping Efficiency and has been specifically engineered for vehicles that use conventional oil with short change intervals. The media on this filter is a cellulose/synthetic blend.

FRAM backs this program with sales training and marketing support, as well as advertising and end user education.

This professional-grade product line means business, all the way. FRAM Pro Series—Engineered for the latest oil types and OE oil change intervals.

†FRAM Group testing of average filter efficiency of FPS8A, 3387A, and 4967 or equivalent FRAM FPP or FPS models under ISO 4548-12 for particles greater than 20 microns
††when compared to Fram Pro™ and Fram Pro Plus™ models

INFORMATION TOOLS THAT SIMPLIFY VEHICLE DIAGNOSIS & REPAIR

Remember the good old days, when it seemed so much easier to fix cars?

Back then, just about everything you needed to know was either between your ears or in a printed manual in the "wall of books" in your shop. That was before the advent of onboard computers in the '80s. And just as technicians were figuring those out, along came a whole new level of complexity to the business of repairing cars.

Today, technicians have much more to think about than just keeping the engine running. Everything in the car is more complex, including advanced navigation and communication systems, and even something as seemingly basic as the seats (which are actually among the most sophisticated systems in the vehicle). Pretty soon, self-driving cars may be on the road and emerging technologies like pedestrian detection and electronic scanning radar will be standard features.

So much information, so little time

The exponential growth of complexity has brought not only an explosion of information needed to repair vehicles, but also a proliferation of sources to access that information. What has not changed is the need to keep cars moving through the bays. Customers still expect to have their car back the day they drop it off, or at latest by the next day.

In general, service professionals get the information they need to diagnose and repair vehicles from three main sources:

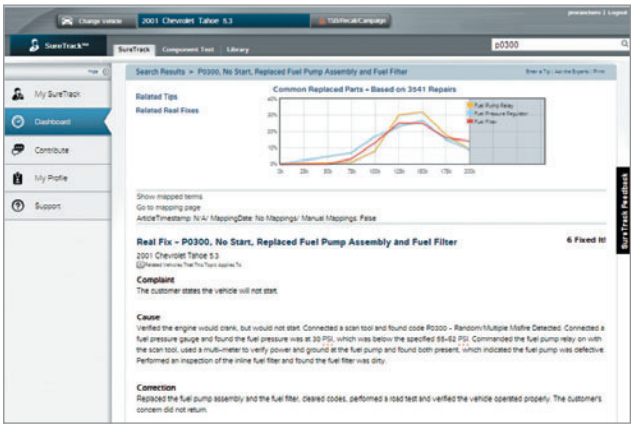
- Diagnostic trouble codes from the vehicle
- Online OEM reference data, and
- Real-world information from peers in the industry

Juggling all of these resources to quickly find the exact information needed can be a big challenge. The issue for technicians is no longer about availability of data to fix cars, but how to find the right data — and more importantly, how to find it quickly. To be most efficient, technicians should be able to search for repair information once from a single source.

Single search technology

This is where ProDemand™ from Mitchell 1 can help. In a single lookup, ProDemand delivers complete and accurate OEM repair information, along with powerful Real Fixes from thousands of professional technicians in SureTrack™. SureTrack is the diagnostic module in ProDemand that brings together a unique combination of intelligence and real-world experience, including:

- Detailed parts replacement records
- Repair timesavers and tips
- Guided component tests
- Extensive waveform library
- Interactive community of thousands of repair professionals



SureTrack Real Fixes are based on the experience of professional techs and millions of actual ROs.

This comprehensive OEM and industry information is presented in an easy-to-use format, powered by Mitchell 1's exclusive search technology called 1Search™. A technician types in a code, component or symptom, and in a single lookup gets immediate access to OEM descriptions, procedures, specifications and wiring diagrams, combined with the SureTrack resources — all in a user-friendly, tabular dashboard.

With easy access to all this data from a single source, there is no longer a need for multiple subscriptions and multiple forums to find information to diagnose and repair cars. Technology has certainly brought challenges to technicians, but searching for information does not need to be one of them.

Amidst so much complexity created by advanced vehicles, Mitchell 1's new generation of repair information tools has made finding the data to fix them much simpler. The streamlined search in ProDemand is just one example of how Mitchell 1 is continuing to keep things simple to help technicians fix cars more efficiently, from diagnosis to completion.

And that feels a lot like the "good old days" of auto repair.

MITCHELL 1

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Mitchell1®
In your shop, at your side

NAPA PROLINK: NEVER WRITE DOWN A VIN NUMBER AGAIN

With over 25 years of service, the NAPA Commercial Systems Group continually seeks to bring best in class software services to the automotive aftermarket, including installers seeking to become more profitable, grow their business and better service their customers. NAPA TRACS and PROLink are essential to shop success by providing a one-stop shop that assists installers in running all aspects of their business from estimating, to profit control, electronic parts ordering and invoicing. TRACS and PROLink also allows installers to streamline the parts buying process by providing a real-time connection between the shop computer and their servicing NAPA store. This connection improves efficiency, streamlines the work order flow process, increases order accuracy and improves the response time from order to delivery.

NAPA is proud to introduce another new time saving enhancement to the PROLink website — NAPA PROLink Mobile VIN Capture, a breakthrough new app for Apple and Android phone users. With the PROLink VIN Capture App, you can instantly scan and pass the VIN from your smart phone in the parking lot, directly to your NAPA PROLink Desktop account with these simple steps:

1. SCAN the VIN right from the dashboard or door panel, even in darkenss – or use the manual VIN entry option right from your phone.

2. SEND the fully decoded VIN instantly to the PROLink desktop. You may even name the vehicle or enter a brief description of what service the vehicle is in for.

3. START your NAPA PROLink catalog search or begin building an estimate, looking up labor times or optional technical repair data.

4. ORDER the parts you need from your NAPA PROLink desktop.

It's so fast, easy, accurate, and gives you the KNOW HOW to "ditch the pencil" for good. To download this powerful timesaving free application, search for "NAPA PROLink" on your phone's app store.

NAPA PROLink VIN Capture FAQs

Q: Does the PROLink VIN Capture App fully decode the VIN?
A: Yes, the VIN is instantly decoded and displayed on your phone as well as on the PROLink Desktop on your PC in a new area called "Recently Scanned VINs."

Q: After I scan a VIN, can I associate a customer or vehicle name with it?
A: Yes, a customer or vehicle name may be entered and associated with each VIN. This also appears on the PROLink Desktop.

Q: What can I do with a VIN after it's scanned?
A: Once scanned, the VIN immediately appears on the PROLink desktop in a new area called "Recently Scanned VIN's." From here you may view the fully decoded VIN, start a NAPA part search, estimate or access flat rate or optional Mitchell PRODemand technical data.

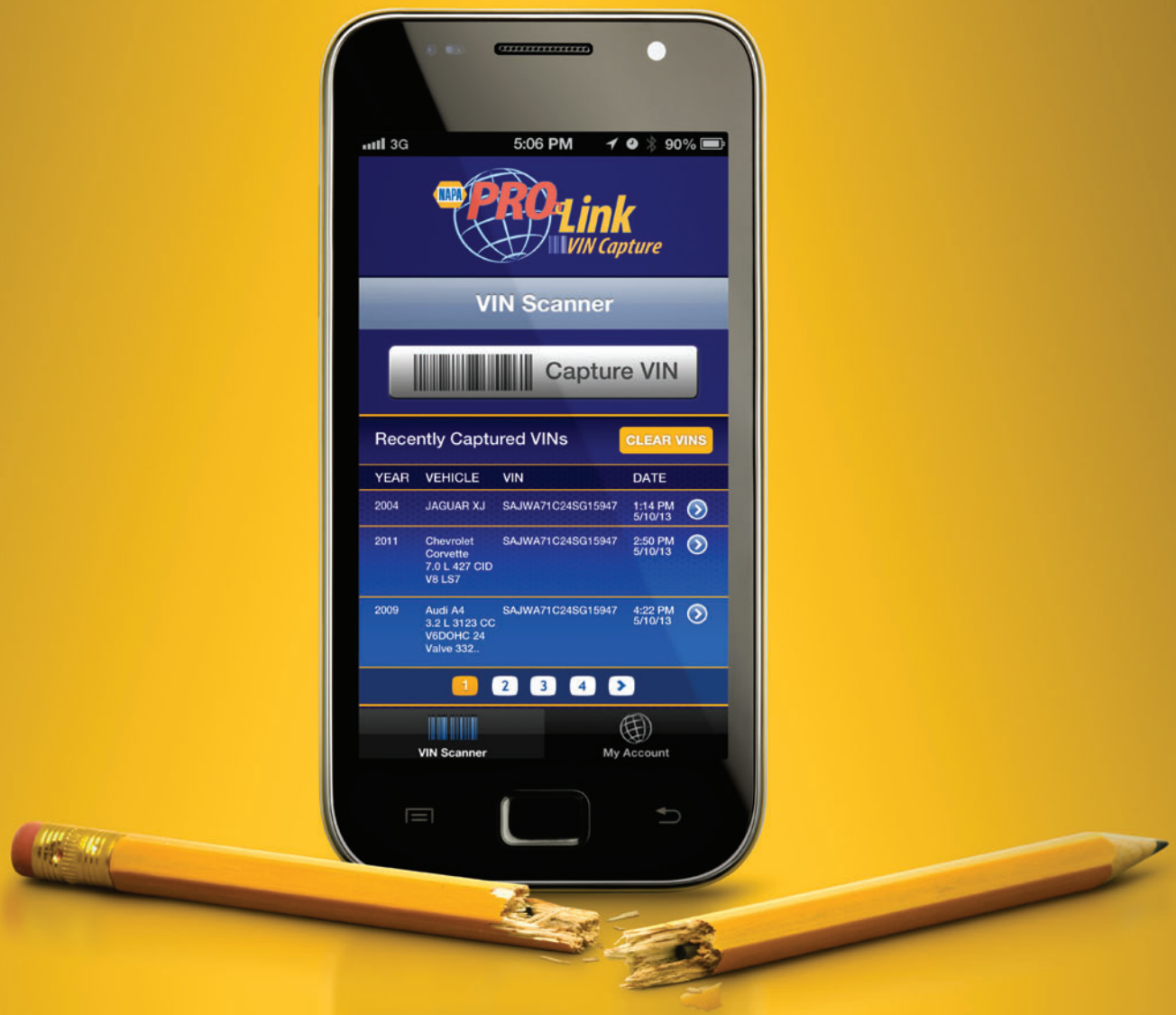
Q: Do you need a special login and password to use the PROLink VIN Capture App?
A: Yes, after loading the app on your phone, you will enter the same PROLink login and password credentials you use on your PROLink desktop to begin using the PROLink VIN scanner.

Q: How many captured VIN's can I save on my phone?
A: There is no limit and you may delete VIN's from your phone once you are done using them.

Q: How long does it take for a scanned VIN to appear on the PROLink desktop?
A: Scanned VIN's will appear immediately after the PROLink screen is refreshed or another PROLink option clicked.

Have additional questions or need help loading or using the PROLink VIN Capture App? Call the NAPA PROLink Support Team Monday through Saturday at 800-742-3578 or email us at **support@napatracs.com**.

NAPA PROLink



NEVER WRITE DOWN A VIN # AGAIN

Introducing NAPA PROLink Mobile VIN Capture, a breakthrough new app for Apple and Android smartphones. Now you can scan the VIN # directly from the vehicle to view the decoded information, instantly send it to your existing PROLink Desktop account, and search the NAPA Catalog for the right part every time. It's fast, easy, accurate, and gives you the KNOW HOW to "ditch the pencil" for good. Search for "NAPA PROLink" on your phone's app store to download this powerful, timesaving free app today.

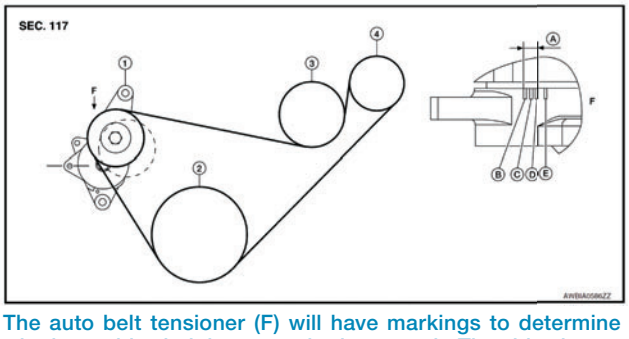
Not a NAPA PROLink user?
Contact your nearest participating NAPA AUTO PARTS Store or call 888-SET-NAPA.

NAPA KNOW HOW

PROPERLY CHECKING AND SETTING BELT TENSION

There's no way around it: checking belt tension requires tools. Nissan has an official gauge designed to check belt tension (P/N BT-3373-F), but any tension gauge will work. You should check and set the belt tension when the vehicle is cold. The gauge measures the amount of deflection in the belt with a controlled force applied. For instance, the 2003 Pathfinder A/C belt should deflect 12mm with 98 Nm of force applied. Using a different type of tool, you may be able to measure the amount of force it requires to deflect the specified amount. Either way, the proper tension or deflection measurement can be compared to a table in the service manual. Bear in mind that there is no "general rule" for tension because different belt styles, thicknesses and lengths will all deflect a different amount.

A newer drive belt will have a different published deflection or tension specification than an older belt. Consult the factory manual to determine the appropriate tension for each particular vehicle. This is because new belts will stretch, or break in, and Nissan accounts for that behavior.



The auto belt tensioner (F) will have markings to determine whether a drive belt has stretched too much. The side view to the right shows the markings, including acceptable range (A).

This spring-loaded automatic belt tensioner is actually the third version of the original (the last five digits began as EA200, then EA20A). A major benefit of buying Genuine Nissan OE parts is that they are constantly updating and improving designs.

This affordable tool allows you to check belt tension anywhere on the belt. Even a short length that "feels tight" will accurately report tension because of the design.

On many Nissan vehicles, belt tension adjustment is performed by physically manipulating a bolt to move an idler pulley. On other models, the accessory itself must be loosened and relocated to achieve the same effect. Both methods require periodic manual adjustment. If the belt is automatically tensioned with a hydraulic or spring-loaded assembly, there will be markings on the device to indicate whether the belt has stretched beyond service life. Another major benefit is that no periodic adjustment is necessary.

When installing a drive belt, you should inspect the adjuster for play, rust, the presence of oil, proper alignment, as well as if the belt bounces or slaps while running. For automatic tensioners, check for hydraulic leaks and spring tension to determine whether the unit should also be replaced. If a spring tensioner can be moved by hand, it's likely worn out.

A drive belt with too much tension applied may cause the bearing to whine when the vehicle is on. Do not get in the habit of over-tensioning belts because "it'll just get looser." While a belt may stretch a little after the initial installation and setting of the tension, this is no reason to cause damage to pulleys and accessories in the meantime. Set the initial tension, run the engine for five minutes at 2,000 rpm, then re-set the belt tension once and for all. If you used a Genuine Nissan OE quality belt, this should be the last time you see that car for a belt!

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NISSAN

Innovation that excites

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Next-day delivery on thousands of parts if the part you need is not in stock.*

Trust the Original. Genuine Nissan Parts.

parts.NissanUSA.com

*Contact your local dealer for order details and times. Exclusions apply. Subject to part availability. Nissan, the Nissan Brand Symbol, "Innovation that excites" tagline and Nissan model names are Nissan trademarks. Delivery truck shown is not street legal, but it would be kind of cool if it looked like that.

HOW TO MAKE AN INSTANT GASKET

When you need to put the part back in service ASAP, just use the right stuff.

BY **ANDREW CHARLESTON,** PERMATEX SENIOR PRODUCT MANAGER

Using a pre-cut gasket that's specified for the job is a no-brainer. Just pop it on, assemble the parts, and torque. But what if the gasket isn't available, or you can't get it in time? Techs frequently face this problem and solve it with a chemical gasket maker. But after making the gasket, there are occasions where you are left wondering: Did I allow enough time for setup? Is the gasket cured properly? Is the torque right? Will it seep or cause a leak?

Figure 1. Formulated in cooperation with GM and Ford, the Right Stuff is automatically applied on new car production lines.

Figure 2. The "strength before cure" capability of the Right Stuff will help put this water pump back in service immediately.

Here is some information that will put these nagging questions to rest and help you get the best out of your gasket-making efforts:

Not all gasket makers are created equal

RTV silicones are the most widely used gasket makers on the market. Extremely versatile and capable, they can be used in a variety of applications; however, they do have limitations. Silicones need time to set up before assembly and may require up to a 24-hour cure before the part can be used again.

If you're dealing with a metal-to-metal fit on the mating flanges, RTV silicones are not your best choice. If not completely cured, silicones do not have the strength to hold their bead when torque is applied and will lose their seal. This can cause contamination from possible seepage of sealant into the part, or loss of the vehicle's vital fluids.

Advanced elastomeric gasket makers provide "torque and go" performance

Now, there is an advanced generation of gasket makers that will let you make a gasket and put the part back in service immediately. It's called *the Right Stuff* from Permatex, the innovative leader and pioneer in gasketing technology. Formulated in cooperation with GM and Ford, the Right Stuff is used on their production lines and OEM certified for service (see Figure 1).

Figure 3. Advanced elastomeric rubber formulation protects against vibration and thermal expansion.

The key ingredient in the Right Stuff is a very durable, elastomeric rubber formulation that gives it "strength before cure," allowing it to hold up under torque, so it does not need a curing period. Upon assembly, the vehicle can be returned to use immediately. The Right Stuff will outperform OE gaskets in non-fuel applications, and is very effective at sealing scored or pitted surfaces (see Figure 2).

Permatex

Learn more about gasketing technology from Permatex at:
www.permatex.com /trainingvideos.htm

Zero leaks in fleet tests

In rigorous fleet testing of more than 5 million "leak-free" miles of daily, heavy-duty commercial use, the Right Stuff proved effective in protecting against leaks caused by vibration and thermal expansion (see Figure 3).

Service caution: Permatex the Right Stuff and other form-in-place gaskets should not be used in place of a head gasket or parts in contact with fuels.

Permatex®

ALWAYS DEMAND A TRUSTWORTHY SEAL.

Chemical gasket technology to fit any application for a fast, reliable seal.

Permatex
permatex.com

WHAT'S STOPPING YOU?

A functional brake system is essential to a vehicle's operation. To complete The Perfect Brake Job®, in addition to brake pads, service providers also need the right rotors, calipers and hardware – quality parts that help the brake system perform like new.

Recognized for its innovation and engineering know-how, NAPA Brakes offers the aftermarket's most complete line of brake components. Unlike other suppliers, our "good-better-best" approach to replacement brakes is engineering-based, and all products meet or exceed original equipment standards.

Advanced friction formulations

Most replacement brake decisions focus on friction material, the brake component that supplies the system's stopping power. In some ways, choosing the right friction formulation is like choosing ingredients to bake a cake. As with cake flavors, there are a variety of friction formulas available today, each of which can be appropriate depending on preference or need.

For drivers who want the most enhanced braking "flavor," NAPA Brakes offers strategically combined formulations in Adaptive One® Premium Replacement Disc Brake Pads. The only brake pad of its kind, Adaptive One feature two ceramic formulations in one pad set. The inner pad is formulated for optimal stopping performance, while the outer pad eliminates noise and dust. This combination helps the pads consistently adapt to a variety of braking conditions, including wide temperature variations. Recently enhanced formulations improve stopping distances by 20 percent, and reduce noise by 44 percent.

Adaptive One pads come with polymer-coated steel shims to dampen noise and vibration, as well as radial tuned slots and contoured chamfers to reduce noise while increasing braking performance.

Advanced rotors

No brake pad will perform to its maximum potential if not paired with the appropriate rotor. With expanded coverage, superior quality and exclusive features and design configurations, the NAPA Brakes line of rotors is the most reliable and comprehensive in the aftermarket.

Reactive One® Rotors from NAPA Brakes provide for up to 30 percent longer-lasting pad life, unmatched aesthetics and a perfect pedal feel. Created from high-carbon damped iron, they remain cool, quiet and vibration free.

A specially formulated polymer coating covers the rotor surface outside the pad swept area to keep edges and vanes rust-free for a clean appearance. Cool Track™ vents provide a nice strong bite without sacrificing smooth braking. And, the optimized pad-to-rotor surface contact improves pedal feel.

Advanced calipers

NAPA Brakes offers both loaded and semi-loaded calipers. Each caliper is supplied with hardware, dust boots, O-rings, seals and brackets (where applicable).

NAPA Total Eclipse® loaded (LE) calipers are pre-loaded with quality OE-grade friction, OE-style seals and bleeder valves, and an exclusive protective coating, which acts as a rust inhibitor and protects against salt spray and moisture. New hardware is included and installed (where applicable), reducing the risk of future leaks or uneven braking or pad wear that can be caused by calipers hanging up or dragging. Precise lubrication of critical areas prevents the caliper from binding.

Giving service providers the freedom to choose the friction material for the brake jobs they perform, NAPA Total Eclipse semi-loaded (SE) calipers have an exclusive protective coating and are available bracketed and non-bracketed. Application-specific rear hardware is included and installed (where applicable), and the calipers feature the same OE-style seals and bleeder valves as Total Eclipse loaded (LE) calipers, along with precise lubrication of critical areas.

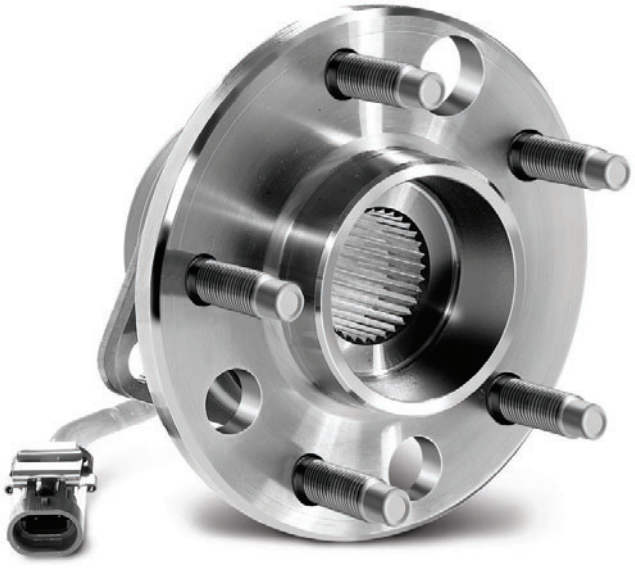
In addition to the quality features that are built into the NAPA Total Eclipse Calipers, a free 2-year/24-hour roadside assistance program covering jump-starts and towing is included with every purchase.

The perfect brake job

Because not all brake parts wear at the same rate, it can be difficult for a driver to know when or what parts need replacement. Whether doing a routine inspection or replacing worn parts, The Perfect Brake Job® from NAPA Brakes provides reliable, step-by-step inspection and replacement procedures.

NAPA Brakes
3100 Windy Hill Road
Atlanta, GA 30339
Toll-free: 800-272-9562
www.theperfectbrakejob.com

RESTORE PROPER ABS FUNCTION



Problem: Anti-lock braking system (ABS) light on, or false ABS activation after wheel bearing hub replacement.

Vehicles affected: All ABS-equipped vehicles

Condition: Vehicle had a wheel bearing hub replaced on one side.

Repair procedure: If you diagnose a bad hub bearing on one side of a vehicle and the ABS wheel speed sensor or tone ring is integral to the bearing, you may need additional repairs to restore proper ABS functioning.

In many cases, replacing one hub bearing will cause the driver to feel ABS false activation when coming to a slow stop on dry pavement. False activation is usually described as a pulse in the brake pedal when not expected. The pulsation comes from the ABS valves cycling the supposedly locked-up wheel. This is due to the difference in signal strength from the wheel speed sensors (WSS) side to side. The problem is usually associated with an air gap difference or wiring and/or connector integrity.

In many cases, removing the WSS from the other side, if possible, and cleaning the mounting surface may repair the problem. The rust build-up actually lifts the WSS from the bearing, increasing the air gap and weakening the signal.

Another possible issue is play in the bearing, which causes sine wave frequency change and/or AC voltage variation. The new bearing will have little to no play. The remaining hub has acceptable play, but can still affect signal strength. Again, the difference in signal from side to side may be enough to trigger false activation.

If the WSS is integral and not serviceable, replacing the hub bearings in pairs may be the only answer. The ABS system is activating as designed so no warning light will be illuminated in most cases. It's a good idea to discuss this with your customer to prevent unnecessary surprise repairs in the future and prevent the dreaded "It never did this before you worked on it" conversation.

Raybestos Brake Products

Brake Parts Inc
4400 Prime Parkway
McHenry, IL 60050
Toll Free: 800-323-0354
www.raybestos.com

SKF OFFERS INSTALLATION GUIDELINES FOR MERCEDES SMART CAR FRONT WHEEL BEARING

The typical solution for replacing the front wheel hub on a 2013-2008 Mercedes Smart Car is a front wheel hub assembly, including a front wheel hub and knuckle. However, SKF now offers the first wheel hub only solution for the Mercedes Smart Car. SKF part number BR930861K includes three unique precision machined pins that enable the installer to press the hub unit into the knuckle assembly.

Included below are complete instructions for the removal and installation of the wheel hub from the knuckle. Be sure to read all instructions before starting replacement, and remember to follow the manufacturer's recommended guidelines for removal and installation of the steering knuckle.

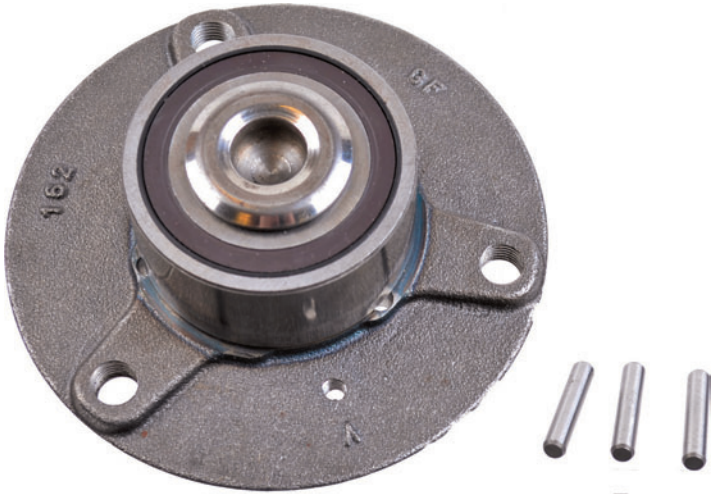
1. To remove the wheel bearing assembly from the knuckle, set the wheel bearing assembly and the knuckle securely onto a press table. Always follow the manufacturer's guidelines for operating the press. The bearing should be pressed from the center of the wheel bearing assembly on top of the orbital formed center.
2. Align press to the center of the back side of the wheel bearing assembly centering on top of the orbital forming.
3. To install the new wheel bearing assembly, use the enclosed three metal dowel rods to assist with the installation.
4. When the three metal dowel pins are aligned into the holes on the hub assembly, it will allow the hub assembly to be pressed correctly on the outer edge of the bearing so that it can be properly seated into the knuckle.

WARNING: No grease or lubricants should be used when pressing the hub assembly into the knuckle. Never press the new bearing into place using only the center of the wheel flange spigot or the back orbital formed center. This can damage the bearing.

5. Align the new wheel bearing assembly knuckle securely onto the press table.

Center the press onto the center of your adapter so that it uses even pressure on all three of the metal dowel pins during installation.

6. Check the hub assembly after completing the press installation of the wheel bearing assembly to ensure correct seating of the hub assembly and smooth rotational operation.



Always test drive the vehicle and recheck fit and function of the hub assembly and related components.

SKF

For more information about SKF, contact your local SKF representative, visit **www.vsm.skf.com**, call 800-882-0008 or visit the SKF e-catalog at **www.SKFpartsinfo.com.**

Interested in additional technical information?

SKF helps technicians stay informed through social media with the SKF Parts Info Twitter page and YouTube channel. Follow us on Twitter @skfpartsinfo or subscribe to SKF's YouTube channel *www.skfpartsinfo.tv* and access its latest training and installation videos, technical tips and product information 24/7.

Knowledge in.

SKF is committed to manufacturing premium wheel hub bearings that you can install with absolute confidence, knowing that they typically last 3-4 times as long as value grade hubs. So we put over a century of bearing knowledge and manufacturing experience into every wheel hub bearing we make.

Knowledge out.

We're also committed to supporting the technicians who install our products. So our SKF training trucks – mobile classrooms staffed by ASE Master-Certified technicians – are on the road every day, in every part of the country. Providing engineering knowledge. Sharing technical tips. And equipping you with the knowledge you need to sell the benefits of OE quality fit, form and function.

Protect your reputation – and your customers. Learn more at **www.vsm.skf.com** or join the discussion at the sites below.

YouTube www.skfpartsinfo.tv @skfpartsinfo

Right To Repair Be Car Care Aware Know Your Parts

The Power of Knowledge Engineering

SKF®

STANDARD AND INTERMOTOR CLONEABLE TPMS SENSORS: READY TO USE RIGHT OUT OF THE BOX

You know that Standard® and Intermotor® offer a complete tire pressure monitoring system (TPMS) line featuring direct-fit cloneable TPMS sensors, mounting hardware, service kits, shop tools and new QWIK-SENSOR™ Cloneable MULTI-Coverage Sensors.

You also know that Standard provides technicians with the best of both worlds — an original equipment (OE)-matching TPMS sensor with advanced technology built-in to make it ID cloneable, saving time and money in the bay.

But did you know that the same Standard and Intermotor cloneable TPMS sensors can be factory relearned, work with all major TPMS service tools and are ready to install right out of the box?

As a leader in TPMS technology, Standard provides real clarity in this key growth category, providing more than 98 percent full-line vehicles-in-operation (VIO) coverage. Standard and Intermotor TPMS sensors are engineered to match OE fit, form and function, plus they have the technology to be ID cloned to the sensor they replace using a simple TechSmart® cloning tool. Each cloneable sensor has its own unique sensor ID, the right protocol and matching body style. Standard cloneable TPMS sensors offer the technician the choice of bypassing complex factory relearn processes, therefore saving time and money while maintaining OE fit, form and function. Standard now offers more than 60 cloneable sensors covering more than 85 million VIO — in fact, 24 of 25 top-selling Standard and Intermotor TPMS sensors are now ID cloneable.

TechSmart provides the tools needed to service, diagnose and repair TPMS sensors. The T55000 cloning tool enables technicians to clone the ID of the existing sensor to the new cloneable sensor. The T55003 is a full function Gen II TPMS activation and programming tool with OBDII removed to create a mid-level shop tool.

TechSmart's T55001 TPMS relearn and scan tool kit services all import and domestic vehicles, reads and displays trouble codes — as well as complete sensor information including tire pressure, broadcast frequency, battery status, sensor ID and tire location and much more.

Standard, Intermotor and TechSmart offer a comprehensive TPMS line, which includes cloneable sensors, mounting hardware, service kits and advanced shop tools.

Standard's advanced cloneable TPMS technology

For more information, visit **www.standardbrand.com, www.intermotorimport.com** or **www.techsmartparts.com.**

If it's not a perfect clone, who knows how it will perform?

With over **98% coverage** and clone-able TPMS sensors that match or outperform OE, Standard® is the perfect TPMS solution for you and your customers.

Clone-able
STANDARD® TPMS SENSORS

The right match…every time.

standardbrand.com

TOYOTA PRIUS AND HYBRID DRIVE SYSTEMS TRAINING

WORLDPAC Training Institute (WTI) has developed a highly regarded Toyota Prius and Hybrid Drive Systems class for skilled technicians and forward-thinking independent repair shop owners seeking to expand service offerings to include hybrid vehicle technology.

Benefits of offering hybrid vehicle service include increased ROs and profits associated with a growing population of hybrid vehicles, differentiation from competitors, and an overall increase in positive customer perception as a result of differentiating the business as a high-technology vehicle repair solution.

Over 1.5 million Toyota Prius Hybrids sold in the USA!

WTI's Toyota Prius and Hybrid Drive Systems class offers advanced-level training that equips attendees with the knowledge and know-how to service the Toyota Prius as well as hybrid models such as the Nissan Altima and Ford Focus since these vehicles are manufactured using licensed Toyota hybrid technology. Attendees also obtain elaborate materials and hands-on guidance to ensure skills learned in the classroom can immediately be put into practice back at the shop.

For example, attendees learn how crank no-start problems can be challenging when dealing with a hybrid vehicle's high-voltage (HV) battery because the electrical system is completely different than non-hybrid vehicles. This makes troubleshooting a challenge. It is not uncommon to be doing routine maintenance on a Generation 1 Prius (2001-2003) only to end up with an engine that cranks but will not start. Something as simple as overfilling the crankcase with engine oil can cause a no-start situation because they only hold 3.9 quarts of oil; four is too much. Or when changing the air filter, a small piece of debris can easily get lodged over the mass air flow (MAF) sensor and keep the engine from running. As well, dirty throttle bodies are common due to the variable valve timing engine design. Any of these scenarios on a Gen I Prius may result in codes P3190, P3191 and P3101. These codes let you know the engine cranked but did not start. Unfortunately, because of the interdependent relationship of these codes, using standard troubleshooting techniques to isolate the problem may compromise your ability to do so

The problem is that the engine cranks using the electric motor called MG1 and the HV battery. It spins more than 800 to 1200 rpms for several seconds and it is difficult to tell the difference between the engine cranking and the engine idling. Once the codes are set you cannot crank the engine again until the HV computer is cleared. Then, depending on the battery condition, you may only get a few cranks before it sets a low State of Charge condition code and disables the HV system all together. If the HV battery gets low, you are dead in the water with no foreseeable way to recharge — meaning misdiagnosing the vehicle can quickly become be an expensive and timely proposition.

The majority of major issues that can arise when dealing with these codes can be avoided by following a few simple steps. When diagnosing this problem, check the oil level and drain some out if questionable, clean the throttle plate if dirty, clean the MAF sensor element, and check the codes and freeze-frame data in the HV ECU for the P3101.

All WORLDPAC Training Institute (WTI) classes are created explicitly for the independent shop and are designed and taught by experienced professional automotive instructors. Learn more about the WTI, as well as Toyota Prius and Hybrid Drive System class dates and locations at www.worldpac.com/wti-prius.

WORLDPAC Inc.

37137 Hickory St.
Newark, CA 94560-5522
800-888-9982 ext. 5470

TOPICS COVERED

- *Serial-parallel hybrid drive operation and diagnosis*
- *HV battery & inverter diagnostics and service procedures*
- *Inverter and transaxle cooling system service and common issues*
- *High-Voltage Electronic AC system operation*
- *Electronic power Steering (EPS) common issues*
- *Electronic Controlled Regenerative Braking System*
- *Transaxle operation and service procedures*
- *Engine operation - Atkinson cycle and fuel delivery strategies*
- *Zero leak standard - EVAP system operation and diagnostics*
- *Gen 1, Gen 2, and Gen 3 overview of changes and features-Common issues, diagnostics, and repair*

the latest products & TECHNOLOGIES TO HELP YOU WORK SMARTER AND KEEP YOUR SHOP PROFITABLE

LOCKING LUG MASTER KEY SET

Steelman™ PRO's new 16 Piece Locking Lug Master Key Set includes keys for most aftermarket locking lug nuts. This means when a customer comes in and doesn't have a lug key, you can easily remove the key without damaging the wheel the right way, according to the company. The keys are made of chrome vanadium steel and finished with black oxide to hold up to a lifetime of use.

For more information, visit
www.steelmanpro.com
Steelman PRO

MANIFOLD BUNDLE

The Spirit Manifold is now packaged with a set of 5-foot EZ Turn™ Anti-Blowback Hoses as part number USAM5HAEZ. The Spirit Manifold provides comfort and control, while the EZ Turn™ Hoses prevent refrigerant burns and make it easy to connect to the AC system while under pressure. The EZ Turn Anti-Blowback fitting has a thrust bearing that reduces friction so the service hose can be easily connected to the access fitting while under pressure, the company says. This becomes extremely useful when working with a high pressure 410A system.

For more information, visit
www.uniwelkd.com
Uniweld Products

FRACTIONAL WRENCH SET

KTI introduces KTI41305, a high-polish, smooth finish, 24-piece professional series combination fractional wrench set. Made of heat-treated chrome-vanadium steel, this set includes a lifetime warranty. Wrench sizes include (in inches): ¼, 5/16, 11/32, 3/8, 7/16, ½, 9/16, 5/8, 11/16, ¾, 13/16, 7/8, 15/16, 1, 1-1/16, 1-1/8, 1-3/16, 1-1/4, 1-5/16, 1-3/8, 1-7/16, 1-1/2, 1-9/16, and 1-5/8. This set come in a heavy-duty pocketed roll pouch with two Velcro® bands for closure, the company reports.

For more information, visit
www.ktool.com
K-Tool International

ELECTRIC FUEL PUMPS

The all-new Holley Mighty Mite electric fuel pumps are big on performance, but small in size and price, the company says. They're quiet, easy to install and work with gas, diesel, blended alcohol and E85. They will support up to 400 hp on a carbureted engine. They are self-priming and have a 12-inch dry lift capability for more flexible mounting. They are proudly made in the USA, according to the manufacturer.

For more information, visit
www.holley.com
Holley

WHEEL ALIGNMENT SYSTEM

The new John Bean V3400 Wheel Alignment System features readings in less than two minutes. Fully featured hardware offers drive through design, wireless communication, automatic camera tracking and high mobility to allow sharing between bays or relocation within the shop as needed.

www.johnbean.com
John Bean

HYBRID A/C COMPRESSOR OIL

Tracer Products introduces TP-9775-0008 Hybrid A/C Compressor Oil for use in all hybrid vehicles. This OEM-based ester lubricant provides lubricity and compressor protection, while its high dielectric properties help reduce the risk of shock hazard to technicians. Packaged in an 8-ounce easy-pour bottle, this formula is ideal for technicians who prefer adding oil to a compressor prior to installation, the company states.

www.tracerline.com
Tracer Products

BOOM MAT

Boom Mat now offers its quality damping material in a convenient 30 sheet pack of 12½ by 24 inches — large enough to complete the interior of a large SUV, wagon or van. The material is made

with a viscoeslastic polymer layer protected by a durable aluminum wear surface that is resistant to extreme heat or cold. It improves sound quality by absorbing unwanted noise and sound waves from road and engine noise while damping vibrations that surround audio output.

www.boommat.com
Design Engineering

REMOTE HOSE CLAMP PLIERS

Low constant operating force applied to the wide, comfortable ergonomic pistol grip on the new Snap-on Remote Hose Clamp

Pliers (SHCP2) results in reduced effort and less hand fatigue during operation. With its longer cable, the SHCP2 provides more accessibility. Because it is flexible over its entire length, the SHCP2 can reach in and around obstacles that "slide style" remote hose clamp pliers cannot, the manufacturer states.

www.snapon.com/handtools
Snap-on

LED HEADLAMPS

Philips' new LED Headlamps deliver powerful, precise illumination and a bright white 5600K light output that is closer to the color temperature of daylight, while dramatically improving overall night drive visibility, the company says. A complex reflector design optimizes and evenly distributes light to create an ideal beam pattern and increased visibility while reducing glare.

www.philips.com/automotive
Philips Automotive North America

LEVERLESS TIRE CHANGER

The ProGuard Plus Leverless tire changer is an advanced version of Coats' current ProGuard tire changer, featuring a pneumatic wheel clamping system, dual-bead roller system, and semi-automatic top roller indexing. Other standard features include an auxiliary bead depressor (to help keep the bead in the drop center without coming into contact with the face or the spokes of the rim), the Robo-Arm® powered assist device and a built-in adjustable wheel lift, the company says.

www.ammcoats.com
Hennessy Industries

HOSE-TO-HOSE CONNECTOR

Avoid the bulky, expensive powered crimping systems typically used to build hose connections. The new Smart Splice™ Hose-

to-Hose Connector offers a permanent repair using a crimp-and-frame system — a threadless hose fitting technology that eliminates the problems of damaged threads and over-torqueing of the fitting, according to the company. Technicians can create leak-free connections between cut ends of A/C Reduced Barrier Hose in only five-minutes, and with no waiting for special-order OE lines.

www.airsept.com
AirSept

SAFETY EYEWEAR

New Uvex Hypershock™ safety eyewear combines premium sports-inspired style and best-in-class lens performance for maximum appeal and protection. Available in Matte Black, Smoke Brown or Clear Ice, the eyewear's wraparound frame delivers superior coverage, while streamlined padded temples and a molded nosepiece deliver a secure, comfortable fit, according to the maker. The lenses feature proprietary Uvextreme Plus anti-fog coating for superior protection against fog and scratches.

www.uvex.us
Honeywell Safety Products

JUMP STARTERS

Clore Automotive presents the JNCAIR, a 1,700 peak amp jump starter, from Jump-N-Carry. This unit features Jump-N-Carry performance, plus the convenience of an integrated, industrial grade Air Deliver System, the maker states. The JNCAIR features a high performance, replaceable Clore PROFORMER battery, designed to deliver high peak amps, extended cranking power, numerous jumps per charge and a long service life. Its extra heavy-duty polyethylene case withstands even the toughest work environments, and its Industrial Grade Hot Jaw clamps easily penetrate corroded battery terminals. The JNCAIR adds convenience to the workplace, featuring an integrated, industrial grade Air Delivery System, equipped with a 12-foot air hose and built-in air pressure gauge.

www.cloreautomotive.com
Clore Automotive

CORPORATE PROFILE

ADVERTISEMENT

CLUTCH PROBLEMS

NO RELEASE CAUSES

No release is probably the most common of all clutch problems. The purpose of the clutch is to couple and decouple the engine and transmission. Poor clutch release makes it difficult to impossible to start and stop the vehicle or change gears.

Common release problems are:

- Air in a hydraulic release system;
- A flywheel that has been machined too thin; or
- A flywheel where the step or cup dimension is out of specification.

Yet, another condition may be that the disc damper can interfere with flywheel crank bolts resulting in no release as well.

Flywheel step and cup dimensions are critical to proper clutch operation. Too tall of a step or too shallow of a cup can create a "thick disc condition." A thick disc condition will reduce or eliminate clearance between the disc, flywheel and clutch friction surfaces and cause release problems. Flywheel run out should also be inspected.

The conditions listed above account for the majority of "no release" problems, but other, less common conditions do contribute to no release as well: Bent drive straps on the clutch, worn pilot bearings, a bent release fork, or a worn or binding release cable can all contribute to release problems. Any component in the release system that flexes, like a fork or fire wall, can "absorb travel" and cause no release.

Causes of Release Problems

External:

- Contaminated hydraulic fluid;
- Incorrect release system adjustment;
- Air in the hydraulic release system;
- Defective or worn release system components;
- Defective or worn pedal bushings or brackets; or
- Flexing of the firewall or any release component attachment point.

Internal:

- Misalignment of clutch components;
- Corroded, damaged or improperly lubricated input shaft splines;
- Worn pilot bearing/bushing;
- Worn bearing retainer;
- Bent or worn release fork or pivot ball;
- Worn linkage components;
- Stretched release cable;
- Excessive or incorrect flywheel machining;
- Bent clutch drive straps;
- Bent or distorted disc;
- Improper transmission lubricant; or
- Improper bolting of the clutch.

Courtesy of Schaeffler Group USA.

SCHAEFFLER AUTOMOTIVE AFTERMARKET

Phone: 800-274-5001
www.Schaeffler-Aftermarket.us

LUK INA FAG

WATER PUMP PLIERS

The new, 16-inch Alligator® XL (No. 88 01 400) offers the performance and comfort of water pump pliers, while being lighter in weight and having a greater gripping capacity than comparable pipe wrenches. Its forged box-joint design provides a true top and bottom grip that makes for quick and comfortable use, the company says. It self-locks on pipes and nuts, providing for no slipping off the work piece and requiring low hand force. Plus, the Alligator XL's thin head and joint area enables it to fit into hard-to-reach places.

www.knipex-tools.com
KNIPEX Tools LP

OIL STAIN REMOVER

Oil stains are bound to happen in any shop, and cleaning these stains can be a challenge. The new fast-acting, easy-to-use Valspar Oil Stain Remover absorbs and lifts oil stains without scrubbing, the company says. It quickly lifts stains from concrete, the company says, and it also serves as an important preparatory component for any concrete painting or staining project. It also can be used on brick and asphalt.

www.valsparpaint.com
Valspar

CLONEABLE SENSORS

SMP has added six new cloneable sensors to its growing tire pressure monitoring system (TPMS) sensor line. The sensors match the original for fit, form and function, the company says, and they can easily be cloned with the existing sensor ID, eliminating the need for a factory relearn. These new Standard and Intermotor part numbers cover an additional 4 million VIO for Nissan, Infiniti, Acura, Honda, Chrysler, Jeep, and Dodge Truck through the 2013 model year.

www.smpcorp.com
Standard Motor Products

DRAIN PAN

The new 30600 Professional Super Single Axle Drain Pan solves the problem of gear oil and grease drips and spills on wheels and tires, and on shop floors when servicing the axles of trucks and trailers. Manufactured in the United States from lightweight, high-density polyethylene (HDPE), the pan can be securely attached to the wheel using two or three lug studs with finger tightened nuts, according to the company. It's contoured to rest flat with the sides gripping the wheel's drop-center. The pan fits most 22.5- and 24.5-inch, 10-hole hub or stud-piloted steel or alloy super single, wide-base and dual wheels.

www.kentool.com
Ken-Tool

ULTRASONIC SENSORS

APG introduces the MNU Series Ultrasonic Sensors. Designed to operate as a slave device, MNU are self-contained sensors that measure distance, level or volume, with a standard Modbus RTU protocol (RS-485) output. Available in sensing ranges from 4 inches to 40 feet, the MNU is a robust yet affordable sensing solution that offers reliable readings with high accuracy (± 0.25 percent of detected range) and excellent resolution (0.1 inch), the company says.

www.apgsensors.com
Automation Products Group

DIAGNOSTIC SYSTEM

AutoEnginuity has released ScanTool 12.1 for the Windows platform, a diagnostics system for the professional vehicle service industry, the company reports. The ScanTool 12.1 features improved Audi/VW enhanced coverage by adding thousands more trouble code descriptions and even more defined tables. Other important features include improved Nissan Leaf 2013MY coverage (to include Stroke Sensor Zero Point Learning), improved Mazda body controller 2013MY coverage, added Dodge Dart 2013MY model coverage, added GM Injector Coding for 6.6 Liter LML and 6.6 Liter LGH engines and added Subaru CrossTrek model coverage and 2012-13MY Power Steering coverage expansion.

www.autoenginuity.com
AutoEnginuity

BACKSAVER

Mohawk Lifts introduces the Backsaver for all Mohawk 10,000-pound to 18,000-pound, two-post lifts. The Backsaver allows technicians to hang tires from lift swing arms, saving them from having to bend down to lift heavy tires and preventing potential sick days or workers' compensation claims from back pain. The Backsaver is easily installed in 10 minutes and with a 100-pound capacity is capable of holding the heaviest passenger car and light truck tires, according to the manufacturer. Heavy rubber coating on the Backsaver prevents damage to expensive wheels and rims.

www.mohawklifts.com
Mohawk Lifts

REAR VISION SOLUTIONS

Brandmotion is shipping two new Rear Vision solutions for select 2011-2014 Chrysler vehicles, both of which are designed to integrate with the factory installed radio display. The 9002-8531 features an OEM-validated Panasonic camera with a lip-mount design for placement versatility and a re-engineered mounting base that minimizes drilling. The 9002-8531 fits 2012-2014 models of the Chrysler 300, Dodge Charger and Dodge Journey. The 9002-8532 mirrors the 8531's features and characteristics, but is designed to fit the 2011-2014 Jeep Grand Cherokee, as well as 2011-2014 models of the Dodge Durango and Caravan, Chrysler Town & Country and Ram C/V Tradesman, according to the company.

www.brandmotion.com
Brandmotion

INTAKE VALVE CLEANERS

CRC Industries introduces the GDI IVD Intake Valve Cleaner designed to remove harmful deposits from all types of gasoline powered engines. The GDI IVD Intake Valve Cleaner achieves this by delivering CRC's advanced technology-based chemical solution - COzol - directly to the valves at 150 times the concentration of any other premium fuel system additive on the market, the company says. More important, it is easy to use – simply spray past the MAF sensor through the air intake. When used every 10,000 miles, CRC GDI IVD Intake Valve Cleaner will help to increase power and torque, stabilize rough idle, solve rough starting problems, reduce emissions and improve fuel economy.

www.crcindustries.com
CRC Industries

SLEEVE PROTECTION

DEI's new Titanium Protect-A-Sleeve with LR Technology offers sleeve protection. Developed specifically for any application where extreme high heat is present, these Titanium sleeves will protect wires, lines and cables when exposed up to 1800°F direct heat/2500°F radiant. Developed with DEI's LR Technology, these high-temperature rated sleeves provide superior thermal protection for street vehicles or race engines, protecting fuel, oil lines, spark plug and electrical wires from direct or under hood radiant heat, the company reports. The sleeves will fit many of today's larger diameter spark plug wires for protection against hot exhaust manifolds and headers. Water and heat resistant, they are also ideal for Powersports – ATV/UTV, motorcycle, personal watercraft, snowmobiles and marine use.

www.apgsensors.com
Automation Products Group

EXTENDED LIFE OIL FILTERS

International Distributors USA Inc. (IDUSA) has a new line of Premium Guard Extended Life Oil Filters. The new Premium Guard line is designed to deliver engine protection up to 10,000 miles when used with synthetic oil. It is engineered with a high capacity for trapping and holding dirt. Based on a test conducted by South West Research Institute (SWRI), it offers 98 percent Multi-Pass Particle Removal Efficiency, which offers over 98 percent weighted average efficiency through the life of the filter, the company states. The new Premium Guard Extended Life line includes 11 spin-on oil filters and 25 cartridge oil filters. The new product line is made with premium components to improve both performance and reliability. The spin on filters include a silicon gasket and anti-drain valve that can handle extreme temperatures from -40 °F to +400 °F, a silicon anti-drain valve that offers longevity and higher retention power to protect the engine during start up, a 0.5mm steel can housing to withstand high pressures, and a built-in relief valve that by-passes the filter media in the event of blockage to prevent oil starvation.

www.pgfilters.com
International Distributors/IDI

DIAMOND-COATED POINT/CONTACT CLEANERS

The professional solution for cleaning and enhancing spade electrical contacts, the Diamond-Coated Point/Contact Cleaners (No. 8047) are the newest addition to IPA's line of contact care tools. This three-piece pro series set features a highly abrasive diamond coating designed to increase the contact life of electrical connections and reduce diagnostic guesswork. Twice as thin as the smallest available file on the market, these files are also ideal for general filing applications, according to the company. To cover a large range of contact sizes, the set includes a 6 mm, 9 mm and 15 mm wide, ultra-thin files, complete with non-slip, high-viz handles for comfortable use.

www.ipatools.com
Innovative Products of America/IPA

NOT ALL FUEL ADDITIVES ARE CREATED EQUAL

Your customers deserve the best products, and they trust you for quality recommendations. Gumout® cleans and conditions more engine parts than other additives — including piston tops, cylinder heads, GDI injectors and the combustion chamber. See how Gumout puts science to work in every bottle to help maximize engine performance. Visit www.gumout.com to learn more.

Gumout

MADE WITH PRECISION

GMB Wheel Hub Bearings utilize precision race grinding for smooth and durable operation, high heat-resistant performance grease for superior lubrication and 100 percent factory-tested wheel speed sensors (where applicable). The combination of these features, plus GMB's more than 75 years of manufacturing experience, results in a quality product that you and your customers can depend on. Call 800-421-5019 to learn more.

GMB North America

AUTOMATIC LEVERLESS TIRE CHANGER

The new R80DTXF tire changer features an automatic bead lifter, variable speed turntable and bilateral bead loosener with direct hand-operated controls. It also offers a traveling drop-center tool, top bead assist rollers, dual lower bead lifting discs and a nylon non-marring wheel restraint device. A 31-inch capacity turntable with adjustable hardened-steel RimGuard wheel clamps help shops broaden their service range. Visit www.rangerproducts.com for details

Ranger Products, a division of BendPak Inc.

TOOLS & DIAGNOSTIC EQUIPMENT

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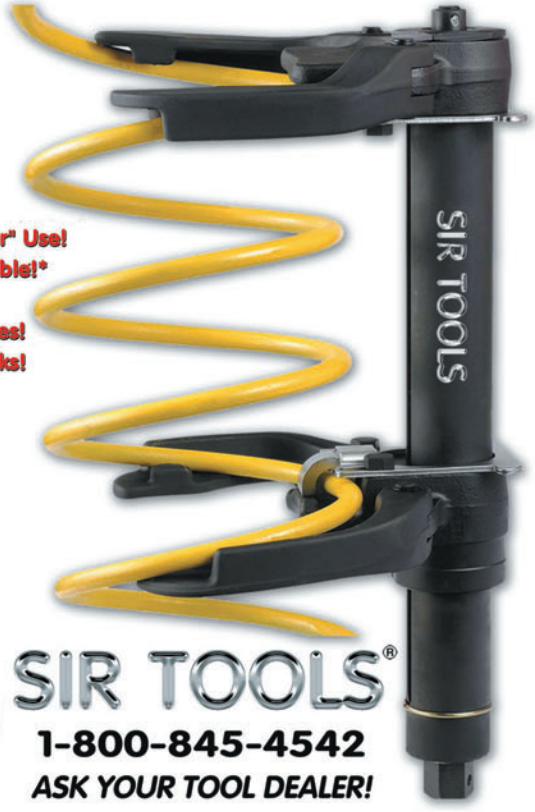

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YOU CAN USE YOUR 5-GAS ANALYZER FOR MUCH MORE THAN JUST EMISSIONS TESTING.

BY **PETE MEIER**
Technical Editor

MotorAge.com/jun14trainer

Can you remember the last time you used a 5-gas analyzer for anything other than performing a mandated tailpipe emissions test? If it's been a while, you may want to blow the dust off the machine and put it to daily use after watching this month's "The Trainer" video.

5-gas analyzers measure the component gasses found in the vehicle's exhaust stream, specifically; hydrocarbons (HC), carbon monoxide (CO), carbon dioxide ($C0_2$), oxygen (O_2), and nitrides of oxygen (NOx). In the few areas that may still be requiring tailpipe emissions checks, it's the HC, CO and NOx that are of concern. The level of these gasses, though, can also be a great diagnostic tool when tracking down drivability issues.

For example, HC (think raw fuel) values that are high can point to a lack of complete combustion. CO levels are generally an indication of combustion efficiency and the air/fuel ratio, with high values typically indicating a rich condition. O_2 is also an indicator of the air/fuel ratio being fed into the engine, with high levels generally indicating a lean problem. Understanding the relationship between the different gasses that make up the exhaust stream can provide you with a great way of narrowing down that stubborn drivability complaint.

And its use is not limited to the tailpipe. Ever thought about using your 5-gas machine to check for an evaporative emissions leak? That's HC leaking out, right? What about testing for a leaking injector? If raw fuel is leaking into the intake, the 5-gas analyzer will quickly confirm that for you with just a whiff or two.

What about cylinder head gasket leaks? This is more of a problem than you may know, but testing for the presence of HC at the radiator can quickly help you nail down a leaker.

With some help from our friends at ANSED Diagnostic Solutions, we show you how to use a 5-gas analyzer for these tests and more. MA

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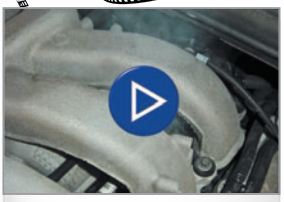

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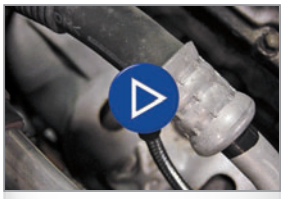

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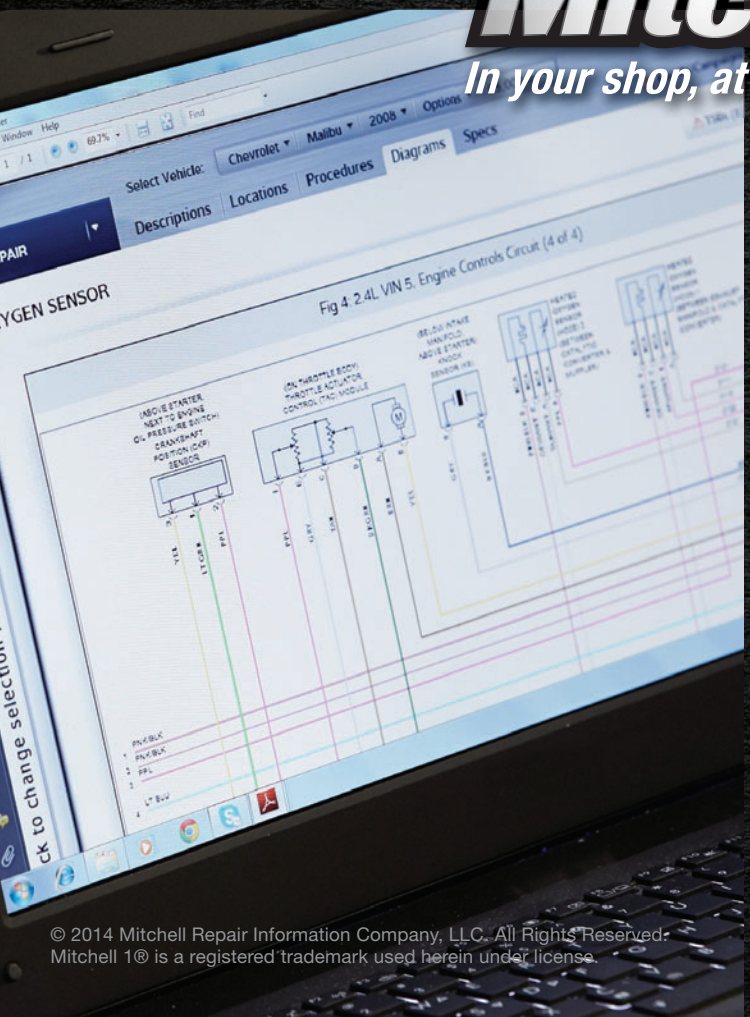

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