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June 2013

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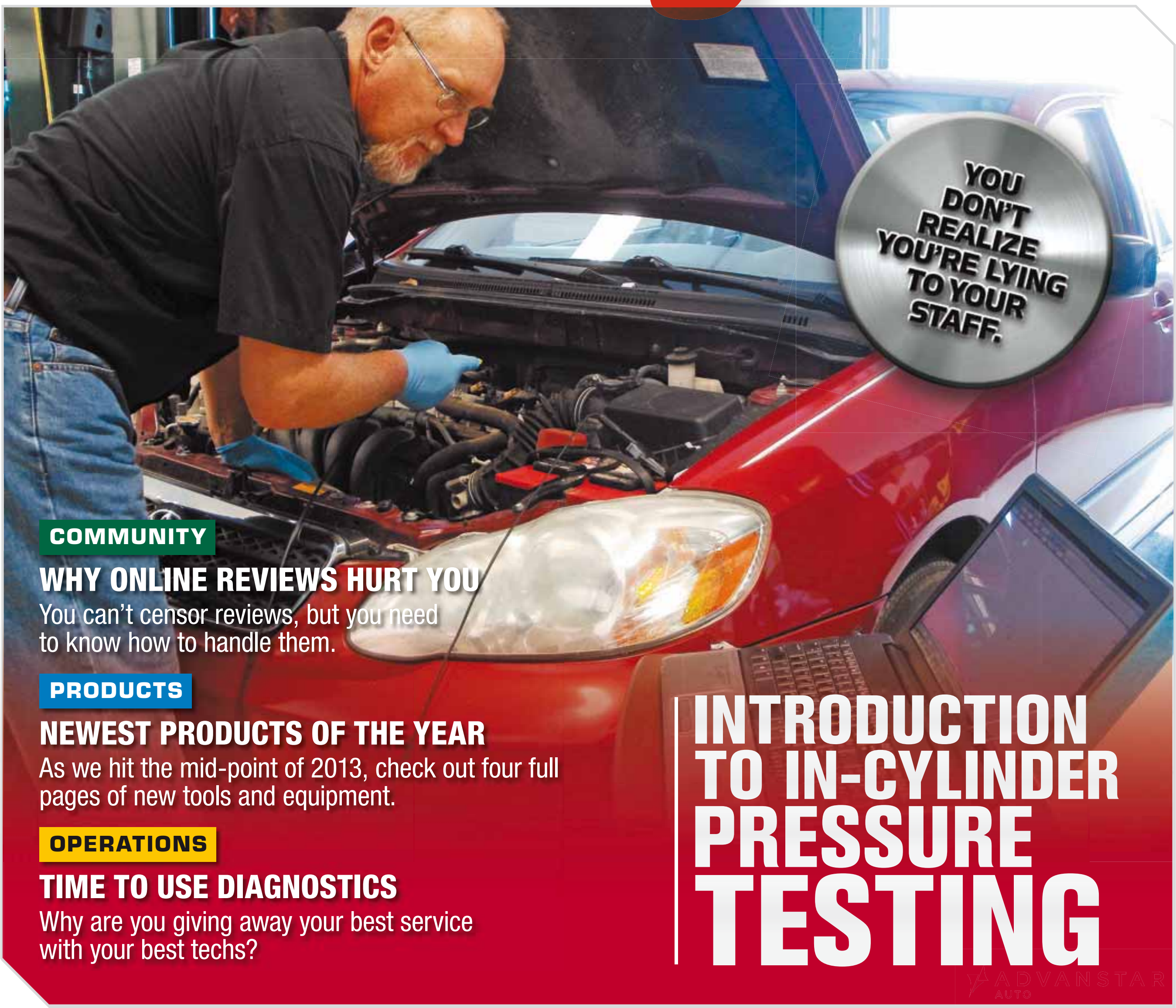
AUTOPRO WORKSHOP

Vol. 132, No. 6

Advancing the Automotive Service Professional Since 1899



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WHY ONLINE REVIEWS HURT YOU

You can't censor reviews, but you need to know how to handle them.

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NEWEST PRODUCTS OF THE YEAR

As we hit the mid-point of 2013, check out four full pages of new tools and equipment.

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Why are you giving away your best service with your best techs?

INTRODUCTION TO IN-CYLINDER PRESSURE TESTING

TRENDING

ASE INTRODUCES NEW G1 CERTIFICATION

You now can buy training guides for the new test.

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CHASING DOWN CAT CODES

The No. 1 code techs deal with is one of the most misdiagnosed.

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TRENDING
INDUSTRY NEWS, NOTES AND HAPPENINGS

ONLINE COVERAGE

THERE'S MORE ONLINE:

DELPHI ANNOUNCES DREAM SHOP SWEEPSTAKES
For the grand prize in the annual contest, Delphi will equip one tech with Delphi parts, tools, equipment, supplies and training.
»» MOTORAGE.COM/DREAMSHOP

SKF OFFERS TIPS ON SERVICING HUB BEARINGS
SKF offers two hub bearings and six ABS sensor cords (with cap) to service 2004-08 Chevrolet Colorados and GMC Canyons.
»» MOTORAGE.COM/SKFTIP

OXFORD HIGH WINS HONORS
Oxford High School in Oxford, Mich., took first place in the state final of the annual Ford/AAA Student Auto Skills Competition.
»» MOTORAGE.COM/OXFORDHIGH

FRANK EDWARDS ACQUIRES KAPS WAREHOUSE
The longtime Parts Plus WD purchased the KAPS assets, including two Idaho facilities.
»» AFTERMARKETBUSINESS.COM/KAPS

HIGH COSTS OF INEFFICIENT WAREHOUSES
Paper-based picking & inventory management systems might be costing more than you suspect.
»» AFTERMARKETBUSINESS.COM/COST

THE IDEA EXCHANGE
There's no better way to get great ideas for your business than by paying a visit to another successful shop.
»» ABRN.COM/IDEAEXCHANGE

PLASTIC REPAIR NECESSITIES
Being able to repair varied types of plastic parts has become a necessary skill for shops & techs.
»» ABRN.COM/NECESSITIES

CERTIFICATION

ASE introduces new G1 certification specialty

In response to requests from the industry for a certification category aimed at entry-level technicians and those doing routine maintenance, ASE will debut a new Auto Maintenance and Light Repair certification test this month. Designated as G1, this new specialty certification measures a technician's knowledge over a wide range of automotive systems as it relates to maintenance and light repair. To earn certification in this new specialty, candidates must achieve a passing score on the exam and have at least one year of full-time work experience.

"Since about 70 percent of all work being performed in repair shops across the nation is maintenance-based, this new test category will focus on the knowledge necessary to successfully perform the most common maintenance and light repair tasks," says Tim Zilke, ASE president and CEO. "If you are a technician performing maintenance and light repair services, the new ASE Maintenance and Light Repair (G1) certification is for you."

Developed by industry experts and the certification professionals at ASE, the Auto Maintenance & Light Repair is slightly different from the regular ASE certifications. The new test will have a one year requirement of hands-on work experience in auto maintenance and light repair to qualify, and half of that requirement

[ASE Certification] CONTINUES / PAGE 7

Photo: Pete Meier

BREAKING NEWS
ASSOCIATIONS

ASA-MICHIGAN LAUNCHES MEMBER-ONLY WEBSITE

ASA Michigan has launched a new "Members Only" community website, www.MiASACommunity.com, and has revamped its main site, www.ASAMichigan.com, which contains a brief video about the community website.

"At our strategic planning session last fall, we recognized the challenges of the 'new normal' for automotive repair facilities and the importance of their time and ability to travel to meetings after a long stressful day. Members would also call us about missing one of our webinars, needing a business aid /form of sort or some information from the State of Michigan, etc.," says Ray Fisher, president of ASA Michigan. "We also discussed the value of

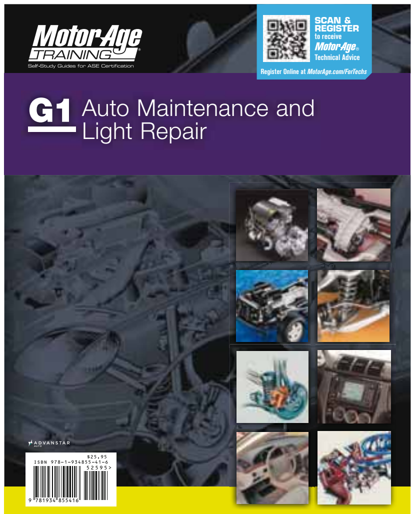
[ASA-MI] CONTINUES / PAGE 8
Discussion is on-going in MotorAge.com forums

[ASE Certification]

CONTINUED FROM PAGE 6

training. However, like all other ASE certifications, the credential will be valid for five years and will be available through the more than 400 ASE testing locations across the country. The cost will be the same as well.

The new G1 certification provides an assessment of an individual's technical knowledge for performing bumper-to-bumper maintenance and light repairs in the critical areas of engine systems, automatic transmission/transaxle, manual drive train and axles, suspension and steering, brakes, electrical and heating and air conditioning.



Approximately 1,000 technicians participated in the pilot test held during the winter testing session to complete the development process prior to launching the G1 test in June. The first general testing will be available in the 2013 July-August test window.

The G1 test contains 55 scored questions, plus 10 unscored research questions, and those taking it will have an hour and a half (90 minutes) to complete it. The questions, written by service industry experts familiar with all aspects of maintenance and light repair, are entirely job-related. Like any other ASE certification, the G1 tests the skills technicians need to know to do the job; theoretical knowledge is not covered.

You can find more information on and purchase study guides (pictured at left) with a pass or don't pay guarantee from *Motor Age Training* at www.passthease.com.

CURRY'S AUTO LAUNCHES THE HYRBID SHOP DEALER PROGRAM

Curry's Auto Service, one of the largest independent auto service and repair shops in the Washington, D.C., area, has partnered with Automotive Research and Design (AR&D) to form a new joint venture exclusively for hybrid vehicles, called The Hybrid Shop (THS).

This new service will specialize in serving the hybrid segment of the automotive aftermarket, and will bring an environmentally-sound alternative to battery replacement to restore hybrid battery power for greater fuel economy, cost savings and vehicle performance. This new service offering brings unprecedented opportunities for revenue growth and innovation through a complete dealer package now available.

The hybrid vehicle market has experienced a continued upward growth trajectory in recent years. In 2013, there are:

- More than 2.7 million hybrids on the road;
- 57 new models available for purchase by various automobile manufacturers; and
- Hybrid vehicles account for approximately 4 percent of the total new car market.

The U.S. Department of Energy forecasts that the hybrid vehicle market will grow more than 10 percent by 2015, with the number of new models produced expected to double, and even triple over the next 10 years.

First Landing Auto Care, Virginia Beach, Va.; Lloyd's Tire and Auto, Santa Cruz, Calif.; Fifth Gear Automotive, Lewisville, Texas; and Good Works Auto Repair, Tempe, Ariz., are the first dealers to have gone through The Hybrid Shop's four-day, on-site technician training, Hybrid Electric Vehicle Maintenance, Service and Diagnostics Course. They now all are fully certified to provide the battery conditioning service.

The Hybrid Shop dealer opportunities available also provide shop owners and dealer partners with a variety of new revenue streams and areas for continued business growth in the expanding hybrid market, including:

- Battery conditioning and rebuiling
- Motor-generator (electronic machine) testing, diagnosis and replacement
- Power inverter and control system testing
- dc-dc converter testing
- Other hybrid specific maintenance
- Normal vehicle maintenance.

Dealer opportunities are available to existing shop owners that desire to add hybrid vehicle services to their current offerings. The Hybrid Shop offers two participation options, dealer or affiliate partner. A dealer can expect to:

- Bring a complementary business to their existing business
- Become a leading expert on hybrid repair and technology
- Tap into the fastest growing segment of the auto repair market and deliver a green, environmental friendly service that will translate into as much as 85 percent gross profit for their dealerships
- Receive area exclusivity, one conditioning machine, a five-day training course, and marketing support from The Hybrid Shop.

"Our new partnership with AR&D as well as the exclusive technology and service offerings THS provides to the growing Hybrid market represent a tremendous business opportunity to shop owners and dealer partners," Curry's Auto Service Co-Founder and CEO Matt Curry states. "As the hybrid vehicle market continues to expand, Area Dealers and Affiliate Dealers have a unique opportunity to serve hybrid customers in this growing area, to help them maximize their green footprint and improve the performance and economy of their vehicle in a cost-effective manner, while setting their organizations on a path to continued revenue growth and expansion."

For more information, visit www.go2hev.com.

[ASA-MI]

CONTINUED FROM PAGE 6

members being able to share ideas, best practices and provide feedback on various topics similar to an electronic bulletin board type of format in the past. And lastly, we needed to make sure that access to everything was convenient and available 24/7/365."

Fisher explains that the community website has multiple folders that include a virtual library, people, groups, discussions, blogs and news.

"The website will be progressive, but for example, we started the library with four folders titled automotive repair industry, collision repair industry, mechanical repair industry and webinars. Documents or links that apply to both industries we place in the automotive repair industry folder and of course the others follow accordingly," Fisher adds. "We also found that it was sometimes difficult for the members to attend the webinars regardless of what day or time we held them, so we added the webinar folder within the library. As long as the material remains relevant, the webinar will be accessible to the member 24/7/365."

Fisher continues, "The opportunity for the membership to interact is invaluable today. With vehicle technology, social media, higher customer expectations, leaner operations, etc., the members need a place to share best practices and ideas immediately so they are not alone. Media allows consumers to make decisions quickly and our members need to be able to respond with educated decisions and they need to know they can go to one source to get it."

Asked what other things are on the horizon, Fisher responds "I'm looking forward to our new 'Skype with Ray' which we will hold the third Thursday of the month. Again, using technology we wanted a venue for the industry to have personable dialogue with ASA sharing their concerns, giving us ideas or even just to say, 'Hi', without having the time and financial expense of meeting somewhere physically – so we are testing this venue and will decide in September."

When asked about the format "It will be somewhat topical with an open floor towards the end and we plan on having a guest speaker from time-to-time which we believe will provide many opportunities for attendees to hear things 'right from the horse's mouth' sort of thing."

Fisher concludes, "There have been so many things affecting our industry and we needed to be responsive. Our task must remain focused on what helps members and industry be successful regardless of how painful it might be, because if we want them to remain members, they have to stay in business; and if we want them to stay in business we have to have walk through some of these difficult changes because making them just 'feel good for the moment' is short term thinking – as a professional organization, we owe the industry here in Michigan that respect!"

AMI accepting 2013 applications for CARS scholarships

The Automotive Management Institute (AMI) is accepting applications for the $1,000 Zurich "High Octane" Scholarship. AMI's resource development effort, EXCEL, in conjunction with Zurich, formerly Universal Underwriters Group, established the scholarship, which is awarded to an Automotive Service Association (ASA) Mechanical Division member who strives to be, or is presently working in a management capacity.

Zurich introduced the scholarship program specifically to address the educational needs of the automotive aftermarket. A leader in the automotive insurance industry, Zurich provides a range of customized products for the automotive aftermarket.

The scholarship will be applied toward the recipient's expenses to attend the 2013 Congress of Automotive Repair and Service (CARS) in Las Vegas, Oct. 16-18. CARS is sponsored by ASA and offers an educational lineup of AMI seminars, technical training courses and industry sessions, a trade show and the opportunity to network with other automotive service professionals.

Automotive Service & Repair Week (ASRW) is the premier event dedicated to the automotive service and repair industries. Created in 2008 to bring all segments of the industry together under one comprehensive, all-inclusive event, ASRW features two events: NACE and CARS.

To be eligible for the award, the following requirements must be met: applicants must work in the mechanical repair industry; must demonstrate an interest in self-improvement through education and training; must own or work for a business that is an ASA member in good standing; and, if the applicant is not the business owner, must be recommended by the owner. AMI Trustees and their employees, and Zurich and its employees, are not eligible to apply.

To request a scholarship application, call AMI at (800) 272-7467, ext. 101, or fill out a scholarship application online at www.amionline.org. Applications must be received by AMI on or before Aug. 23, 2013. The scholarship recipient will be notified by AMI on or before Aug. 30, 2013.

ASA board discusses internal issues

The Automotive Service Association (ASA) and its board of directors reported in a news release that they are disheartened to share some unfortunate news. The members of the board feel it is their responsibility to share this information with ASA's membership as well as the broader industry, which has supported ASA for more than 60 years, the organization states in a release.

ASA has been victimized by theft committed by a former employee. The proper authorities were contacted and are taking concerted action to hold that person accountable for the crimes committed. The individual was terminated with cause earlier this year. Following this discovery, two executives have stepped down, per the release.

In regard to the theft, ASA states that it is relieved to report that the association was insured and took immediate action. Its insurance partners expedited the process and ASA recuperated a portion of its loss. In

[ASA Issues] CONTINUES / PAGE 9

Discussion is on-going in MotorAge.com forums

To view Techsmart Insert Click on here

[ASA Issues]

CONTINUED FROM PAGE 8

addition, proper measures have been taken to prevent further such activity.

It's important to note that the NACE and CARS events, which are produced for ASA by Hanley Wood Exhibitions, were not compromised, ASA reports. Those events, and any related income, are handled directly by Hanley Wood and are completely separate from ASA's finances.

The board believes the association will be stronger going forward as a result of these unfortunate circumstances. ASA is a grassroots organization that has survived many decades because of the leadership and strength of its volunteer board members. The newly elected board is committed to ensuring the association meets the needs of its members and affiliated associations through collaboration and transparency. The recent announcements specific to the board's vision and the hiring of an interim executive director support the board's resolve to usher in a new era at ASA.

"The issue has been addressed and ASA is looking forward to the future. I expect great things from the association in 2013 as well as years to come," said Darrell Amberson, AAM, ASA chairman.

The ASA board of directors realizes there may be some unanswered questions. ASA has been advised by its attorney as well as the authorities not to provide further details due to the pending investigation.

AASP-MN awards $17,000 in scholarships to students

The Alliance of Automotive Service Providers of Minnesota (AASP-MN) awarded $17,000 in scholarships to help post-secondary automotive students pay for tuition during the 2013-14 school year. The scholarships were in the amount of $1,000 per student and were made possible by a successful fundraising drive within the AASP-MN membership, as well as a generous donation from the Minnesota State I-CAR Committee. All recipients will be entering the second year of a NATEF-certified automotive program based in Minnesota.

Congratulations to this year's recipients:

DeAndre Adams, Hennepin Technical College, Brooklyn Park – Auto Body Collision Repair program

Cole Anderson, Ridgewater College, Willmar – Automotive Service Technology program

Eric Beranek, South Central College, North Mankato – Automotive Service Technology program

Kayla Berg, MN State College Southeast Technical, Winona – Automotive Service Technology program

Jorey Brazell, MN State Community & Technical College, Detroit Lakes – Automotive Service Technology program

Charles Brunschon, Century College, White Bear Lake – Automotive Service Technology program

Zachary Gamradt, St. Cloud Technical & Community College, St. Cloud – Auto Body Collision Repair program

Justin Hiltwein, MN State Community & Technical College, Moorhead – Automotive Service Technology program

Nicholas Lindemer, Century College, White Bear Lake – Automotive Service Technology program

Tanner Maus, St. Cloud Technical & Community College, St. Cloud – Auto Body Collision Repair program

Faron McCleary, MN State Community & Technical College, Detroit Lakes – Automotive Service Technology program

Zach Reisner, Hennepin Technical College, Brooklyn Park – Auto Body Collision Repair program

Benjamin Shiek, Dunwoody College of Technology, Minneapolis – Automotive Service Technology program

Jacob Sik, Hennepin Technical College, Eden Prairie – Auto Body Collision Repair program

Brian Smith, St. Cloud Technical & Community College, St. Cloud – Automotive Service Technology program

Ryan Stenzel, Ridgewater College, Willmar – Auto Body Collision Repair program

Bryant Zahradnik, Dakota County Technical College, Rosemount – Auto Body Collision Repair program

Twenty-nine students from 12 schools applied for the scholarships. Applications were reviewed by a committee of industry representatives, with consideration given to scholastic achievement, education and career goals, financial need and written recommendations.

The scholarship awards are the centerpiece of AASP-MN's Automotive Education Fund, which was established to provide financial resources to support automotive students, enhance automotive programs and raise awareness of career opportunities in the independent automotive service industry.

The Alliance of Automotive Service Providers of Minnesota (AASP-MN) is an association of independently-owned automotive service businesses and industry suppliers dedicated to improving the state's automotive service industry and the success of its members.

Casite unveils its new website

In the continuing celebration of its 90th anniversary, Casite has launched its new website at www.Casite.com featuring a bold graphical interface with easy to use navigation functions.

It is another step in the company's new branding initiative launched at last year's AAPEX Show with new packaging for Casite's line of Motor Honey automotive chemicals.

"Our new website helps unify our brand story and makes it easy for consumers to find information on our products," said Pedro Tan, business development manager, The Casite Company. "Vehicle owners can now easily find comprehensive information on our oil additives, gasoline additives, diesel additives, leak stoppers, tire repair and detailing products with one click from our home page."

Casite is celebrating its 90th anniversary with its "Show Me Your Motor Honey" Facebook promotion. The contest began on February 1, and will continue through October. Each month nine lucky contestants will receive a $90 Visa gift card.

The nine winners for March are: Brandy Amburgey, Diana Caldwell, Kathryn Deardorff, Alan Irving, David Maas, Bill Price, Larry Myers, Colton Schroeder and Les Squires.

COMMUNITY

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

ASE GUIDES

QUESTION OF THE MONTH

SPONSORED BY Federated Auto Parts

☑SURVEY: With the dog days of summer fast approaching, let's see if you're ready to handle the hot weather. A customer comes to your shop complaining the car's temperature gauge starts to read higher when he's driving in the city, but quickly returns to normal once he's on the highway. The most likely cause of this problem is:

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

Visit MotorAge.com/june13survey to answer and register for the monthly prize drawing from Federated Auto Parts.

FROM THE BLOG SPHERE

Why online reviews can hurt your sales

You can't censor all of the reviews, but you need to know how to handle them.

BY **NMAORAIS** | WORKSHOP MEMBER

Online reviews and websites are not a new trend, but business owners are still not totally convinced they should take the time to worry about them. As the world moves into a more digitally connected era, businesses need to understand that websites like Yelp, TripAdvisor, Google Plus Local and even Facebook are the new word of mouth.

Customers don't trust what you say about yourself. A lot of business owners collect reviews from current customers and re-post them on their websites. While that was a great tactic in the years before social networks, now this strategy is weak. According to Michael Hulme's study, "Your Brand: at risk or ready to grow," only 8 percent of U.S. customers trust what businesses say about themselves, and only 7 percent of U.S. customers trust reviews posted on the business' website.

Posting the reviews you receive on your Facebook page or website won't bring you any sales. Customers believe businesses would leave out the bad reviews, and what they see does not reflect the truth.

How to overcome it: Don't use systems that post your reviews automati-

MotorAge.com **BEST OF THE BLOGS**

BECOME A BLOGGER
MotorAge.com/BestBlogs

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

The road to the perfect shop

Management_Success/Glendale, Calif.

Most owners in the automotive industry would agree that the following list is what the perfect shop would be for them:

1. It would be a very profitable and expanding business.

2. It would produce high-quality service for the customers.

3. The employees would treat the customers with the same care factor as the owner would.

4. It would run well without the owner having to be there.

5. It would be "A Self-Fixing Business," meaning any problems would be easily handled.

But, there seems to be different levels of success in obtaining their vision. In talking to them, it becomes apparent that, while most are sure they are on the right road, they don't seem to know exactly how to do it. This is because there is no agreed-upon method of getting there. If you talk to 15 shop owners, you will tend to get 15 different answers on the route to achieving this vision.

The answers for each shop are different. It is because each owner has different strengths and weaknesses and each shop is in a different overall condition.

Benz ME2 motor organizer computer encrypting menu

fcar/China

After submission to ME2 motor, Fcar motor vehicle diagnostic computer encrypting student will show clearly items, pick "controller code" to move into submenu. Read and execute code.

Select the first detail of submenu: "Read and execute code",F3-W or F3-G automotive diagnostic scanner first read computer encrypting unit No., computer encrypting, chassis No., and timely if to convey computer encrypting to new manipulate moduel. If pick "No", then back to earlier menu. If pick "Yes",then timely to close ignition change, next show clearly return aged manipulate module with new manipulate module and timely to open ignition switch. Fcar motor automotive diagnostic computer encrypting student presentations read vehicle computer information. Transfer the atop written knowledge and timely if to bear out identification.

After approve, Fcar motor car diagnostic computer encrypting student adjudicator this manipulate module if interlocked or not. If interlocked, then timely "failure to acknowledge, vehicle motor manipulate unit has been locked!", and revisit to principle menu.

cally on your pages. Besides cluttering the pages and annoying your customers, the lack of interaction will prevent you from reaching more people. Also, instead of posting just the good reviews you get, add a plug-in on your website and show all the reviews you get. That way, you will show your customers that you are confident about the quality of your product, and you care about what they say. Read the rest at MotorAge.com/reviews. MA

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MotorAge.com/insidelook

Targeting promos
You need to target those jobs that will make you money, so says Mike Lee in this seminar clip.
MotorAge.com/target

A look at CV compressors
Delphi shares this clip on its variable displacement design.
MotorAge.com/delphicv

Cooling system basics
Ross Hayner gives a quick overview of how modern cooling system components challenge the chemistry of a vehicle's cooling system.
MotorAge.com/coolbasics

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Noteworthy

comments from *MotorAge*'s online communities

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

jrubich:
If your organization does not have a systematic way of managing business intelligence, then you are at a competitive disadvantage. On the other hand, it can be a clear point of differentiation for your organization.

dieseldan:
As we gently guide and direct our employees to see the big vision, they are more likely to respond and catch the vision and help you in your efforts.

dnieves:
Every time I hire someone in our front office I take two to three days of them shadowing me on everything I do. I have them take notes, I role play with them, then I will slowly have them take phone calls, handle customers with me along side so I can coach and maybe step in and prevent a disaster.

1Commett:
Sometimes slowing down and thinking things through diagnostically speaking is the most satisfying part of the repair.

tooltym:
It could also be because the customer had a past good experience with the dealership/service writer/mechanic etc. Ultimately, it ends up in the bay because the service writer said yes, or they didn't feel the need to offer the customer a referral.

Aleksandr Thomas via Facebook:
Flat rate only benefits the owners in the end. Even if some employees can beat the rate, not everyone can, and in my experience it more often than not promotes lower quality workmanship.

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

LEARN MORE: MotorAge.com IS UPDATED CONTINUALLY

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Pros and Cons of Rebuilding Continuously Variable Transmissions
Produced in cooperation with ATSG.

AUGUST 2013
Cooling System Service and Testing
Produced in cooperation with TST.

OCTOBER 2013
Reading Wiring Diagrams
Produced in cooperation with ATSG.

NOVEMBER 2013
Electrical Testing Techniques
Produced in cooperation with TST.

STREAMING PROGRAMS

New N.Y. regulation affecting cat replacement
New York has a new regulation that will affect what replacement converter is used on your vehicle.

Meet the MOOG problem solvers
Discussed in this presentation are the latest innovative ideas from MOOG, the support and training MOOG offers the professional technician, and the role they play supporting those unsung NASCAR heros...the crew chiefs.

ASA's five areas of focus
After a recent association assessment, ASA has identified five areas of service will lead the strategic direction going forward.

2013 INDUSTRY CALENDAR

31

JULY 19-21
ASA-Arizona Sunrise Convention
Phoenix

SEPT. 9-11
AAIA Fall Leadership Days
Dallas, Texas

SEPT. 20-22
ASA-IL CAN Conference
Exhibits and management and technical training.

OCT. 16-18
ASRW - NACE and CARS
Mandalay Bay, Las Vegas

Q+A WITH MARK BOYLE

DIRECTOR STEERING AND SUSPENSION,
FEDERAL-MOGUL

PROBLEM SOLVING HAPPENS IN THE BAYS EVERY DAY. THIS MANUFACTURER ALSO MAKES IT HAPPEN WITH YOUR PARTS.

BY **PETE MEIER** | TECHNICAL EDITOR

There are innovations being made daily around the industry. New technologies you'll use in the shop over the next few weeks, months and years are in the works today.

Federal-Mogul's MOOG is one such brand working on just that. The steering and suspension components line uses technology from NASCAR to better its parts. It also stays ahead on training via MOOGProblemSolver.com and its St. Louis, Mo., training facility. We spoke with some of MOOG's Problem Solvers, including Mark Boyle, Federal-Mogul, director steering and suspension, North America, and Larry Haudrich, engineering designer for MOOG.

MA: **MOOG is known as a problem solver. What are some characteristics that make MOOG a leader?**

MB: MOOG has been the predominant chassis parts brand in the aftermarket since 1911. This leadership can be attributed to our unique focus on engineering parts, specifically for the front-line professionals who are repairing the vehicles every day in the bay. That's also why MOOG is known in the aftermarket as "The Problem Solver." Our engineers apply innovative ideas and technologies to solve the problems that cause conventional parts to fail.

MA: **How do you come up with these new technologies and solutions?**

MB: Everything starts in our engineering center in St. Louis. ... What makes it really unique for MOOG, is that we have our engineering team (there). We get over 350,000 calls on our tech line (also in St. Louis), and these are calls that are coming in from technicians and installers every day. So if they call in and maybe we get a particular question, opportunity, issue or something about a particular part or application, the tech line can relay that over to engineering: 'Hey, we got three calls this week on this OE ball joint, we think something may be happening there.' The engineers bring in the vehicle, they analyze it, they see what the opportunity is to do a problem solver and then engineering does their magic.

MA: **The MOOG sticker on NASCAR (cars) is more than a way to get your name in front of the public, isn't it?**

MB: It's much more. It dates back to the earliest days of NASCAR brand national and cup racing. Multiple generations of companies have relied on the MOOG Steering and Suspension parts and the engineering behind that to help win races and season championships. ... The value of this partnership also comes through in what we've learned in developing and testing the latest designs that our engineering team down in St. Louis develops. And all of this happens in the heat of a Cup race. There's a lot of banging going on in a race, drivers are doing everything they can to gain advantage when they're running at 200 mph. Our parts stand up to this and they take a beating.

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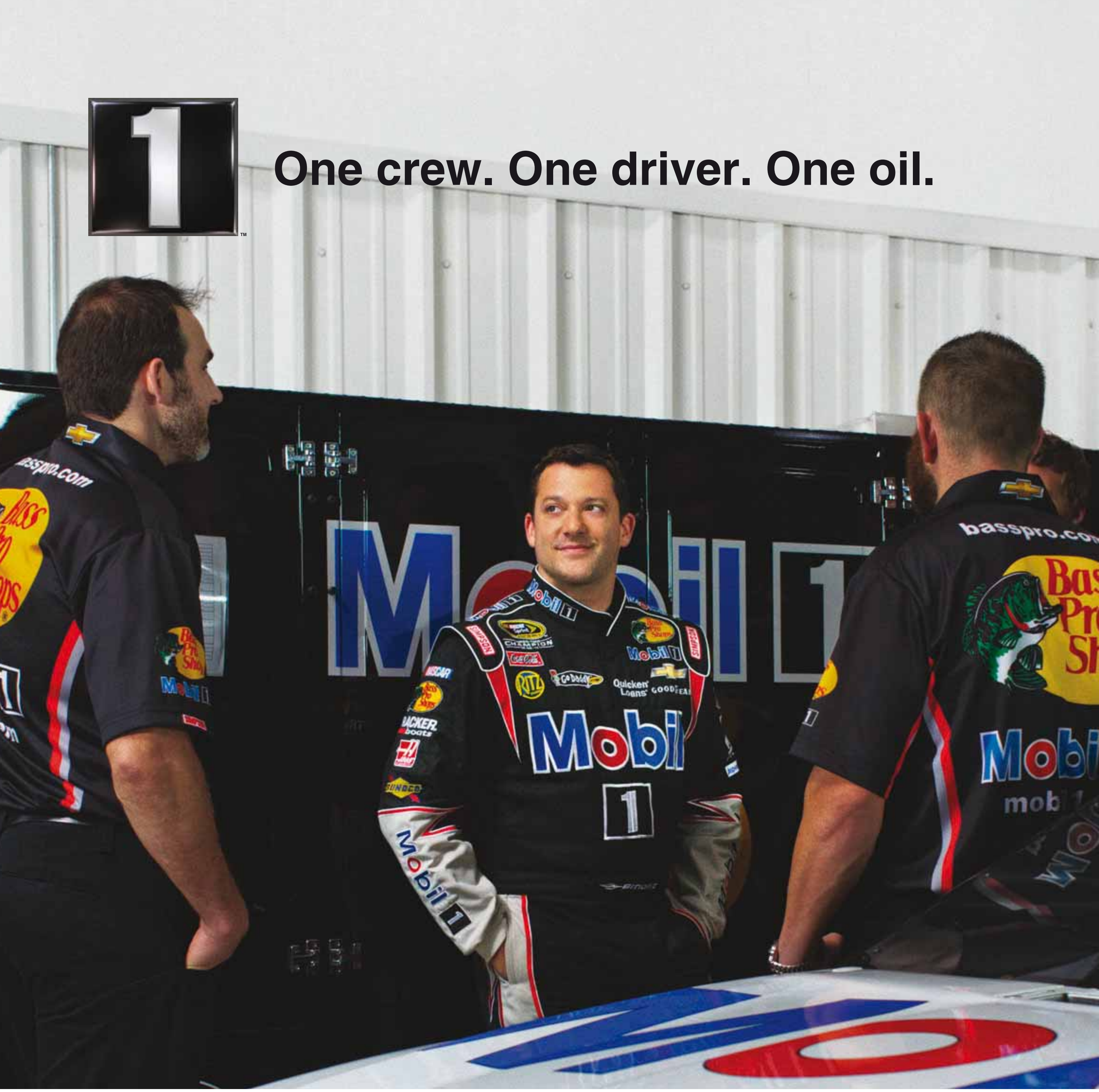
MA: **How valuable is the feedback you receive from NASCAR?**

LH: We have a director of motorsports, Tim Nelson, who's in daily contact with these teams. The feedback we get form the track, our design for the passenger cars and light trucks utilizes the same metal-on-metal bearing design, the full ball stud, the bevel washers, just like they're using on the racetrack. We figure if it can handle the bump and grind of NASCAR, it'll be great for everyday use.

Photos: Federal-Mogul



Tony Stewart will be the first to tell you he couldn't do it without his pit crew. NASCAR® is a team sport, and Mobil 1™ is a crucial player. Like over half of all NASCAR drivers, Tony Stewart chooses Mobil 1 technology to help him win races. Who's on your team? See more at **facebook.com/mobil1**

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MANAGEMENT

USING DIAGNOSTIC TIME

THIS TIME REALLY IS VALUABLE AND NOT A LOSS LEADER LIKE YOU MIGHT THINK.

BY **BRIAN CANNING** | CONTRIBUTING EDITOR

PROBABLY one of the most misused and abused members of the technician team in many shops is the diagnostic technician. I am not talking about inexperienced and unskilled guy that we throw at weird noises and unexplained symptoms because we don't really trust him and have nothing else to give him.

I am talking about the highly skilled, highly experienced guy that is, or should be, our diagnostic tech because of sheer knowledge, broad experience and strong diagnostic ability. This guy is worth his weight in gold, though far too often we sell his services very similar to the way we sell and advertise a $15 oil change. Diagnostics in today's environment are tough; require a very special skill set and temperament, but far too often we give these services away, missing huge opportunities for sales, profits and believe it or not, customer good will.

The selling of diagnostic time is one of the most misapplied, mismanaged activities out there and often finds us by necessity using our most experienced and highly paid technician and charging the customer as though he or she has a coupon for 25 or 50 percent off. By description, diagnostics are undefined and open ended and therefore need to be managed very carefully, assuring that they are thorough and complete for the customer's sake and profitable for the sake of our shop. Most of us shudder at the prospect of a tough diagnostic job because, by its very nature, the outcome is unclear. But rather than doubling the pain by making the undertaking unprofitable, we need to strive to make it an important and a very profitable part of our business. A great first step in this is to stop giving it away.

When we give diagnostic time away, or sell it cheaply, we are saying to the customer that the most difficult, the most demanding, the most intense service we provide has little or no value. On top of that, we are taking a service that is, in most cases, performed by our most knowledgeable, experienced and highest paid technician and taking what could and should be an extremely profitable transaction and turning it into a money loser.

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MOTEL
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MITCHELL 1 UNVEILS SURETRACK DIAGNOSTIC SYSTEM

Mitchell 1 announces the release of SureTrack™, a new all-in-one repair information resource that brings together a unique combination of intelligence and expertise to help aftermarket automotive shops increase accuracy and efficiency from diagnosis to completed repair.

"SureTrack combines a powerful suite of resources that will set a new standard for automotive repair excellence by bridging the gap between symptom and accurate repair," said Ben Johnson, director of product management for Mitchell 1. "In a nutshell, SureTrack provides a short and direct path to the most likely repair for specific symptoms on a specific vehicle. We're dedicated to always helping our shop customers improve productivity and efficiency, so we're delighted to launch this resource that will truly allow them to fix cars faster."

The result of an extensive collaborative development effort between Mitchell 1 and Snap-on, SureTrack is a comprehensive source of expert knowledge for professional technicians, combining diagnostic experience with repair timesavers and detailed parts replacement records, all wrapped in an interactive forum. Vehicle-specific data is generated from millions of successful fixes and consolidated from multiple sources — parts data, diagnostic troubleshooting procedures and repair experience — eliminating the need to access multiple databases and web-based forums to gather and analyze the information. SureTrack delivers it all from a single resource.

"With SureTrack, professional technicians can have more confidence in their diagnosis and gain tremendous savings in repair time and insights based on completed repairs from tens of thousands of shops and technicians across the country," said Bradley Lewis, vice-president of repair systems and information for Snap-on Inc. "Vehicle-specific repair results and timesaving tips are confirmed by expert technicians. SureTrack members also contribute fixes on vehicles they have successfully repaired."

With a subscription to Mitchell 1's ProDemand™ repair information, shopw owners now have access to a preview of SureTrack. In addition, SureTrack will be available as an optional module in ShopKey® Pro from Snap-on and as an integrated component of Snap-on's Windows based diagnostic platforms, VERUS and VERDICT.

Key benefits of SureTrack include:

- Access to multiple resources of real-world results through a single intelligent lookup.
- Direct path to the most likely fix, based on vehicle-specific model, mileage and symptoms.
- Faster diagnosis and repair based on real-life experience from millions of successful repairs.
- Expertise and support from a community of thousands of repair shops and SureTrack expert technicians.
- Millions of expert diagnostic tips, tests and timesavers that go way beyond OEM information.
- Extends the capabilities of technicians of all skill levels due to its intuitive interface and wide range of expert resources.
- Real-time, up-to-the-minute intelligence based on vehicles currently in service bays across the U.S.
- Definitive, reliable answers validated by SureTrack expert technician.

What do you think your highly experienced and skilled technician thinks about this? We only have so many ways and opportunities to stand out from the crowd and beat the completion, and being a great diagnostic shop is just about as good as it gets. I promise that if you get the reputation as a great diagnostic shop, your customers will see the value and gladly pay for your services. Competence and technical ability are of a far greater value than that $15 oil change, and your customers know and appreciate this, even if you don't.

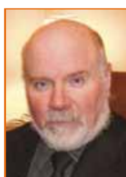
Customers want to associate themselves with quality and shops that bring value to the relationship. Several years ago when I was getting ready to undergo open heart surgery, I felt pretty darn good after doing a Google search and finding that my surgeon was among the best in the business with a national reputation.

Rather than apologizing for diagnostics, I am going to suggest you start bragging about it. Rather than discounting it, I am going to tell you to institute an elevated diagnostic rate that is at least 25 percent higher than your floor rate. Rather than tip toeing around it and selling a single hour, I am going to tell you to have a consult with your customer and let him or her know that major surgery may be required, that we won't know until we get in there but we have our best man on it and we will let them know what we find.

Most customers will appreciate this approach, a few will not. If we cannot do diagnostics profitably, we should not do it. The bottom line is that the very second we start talking about diagnostics; we are talking about something out of the ordinary. Our customers know this and though they are worried because we are asking for their permission to dive in on something that might or might not be expensive, they need their car, they understand the urgency and you are (or should be) the expert.

A great diagnostic tech is a huge asset to your business. He or she is a very different beast than a motivated B tech, with a different approach and a very different perspective. Make them a valued member of our team. Pay him for excellence. Market them and market their services but be profitable in that effort.

Everybody changes oil and does brakes. Only a few among us can perform open heart surgery and I promise you, it aint cheap. Rather than being a losing afterthought, diagnostics needs to be central to our marketing and broad strategic plan. Price is what you pay. Value is what you get. Diagnostics and a great diag tech can bring great value to our operation. MA



BRIAN CANNING
CONTRIBUTOR

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

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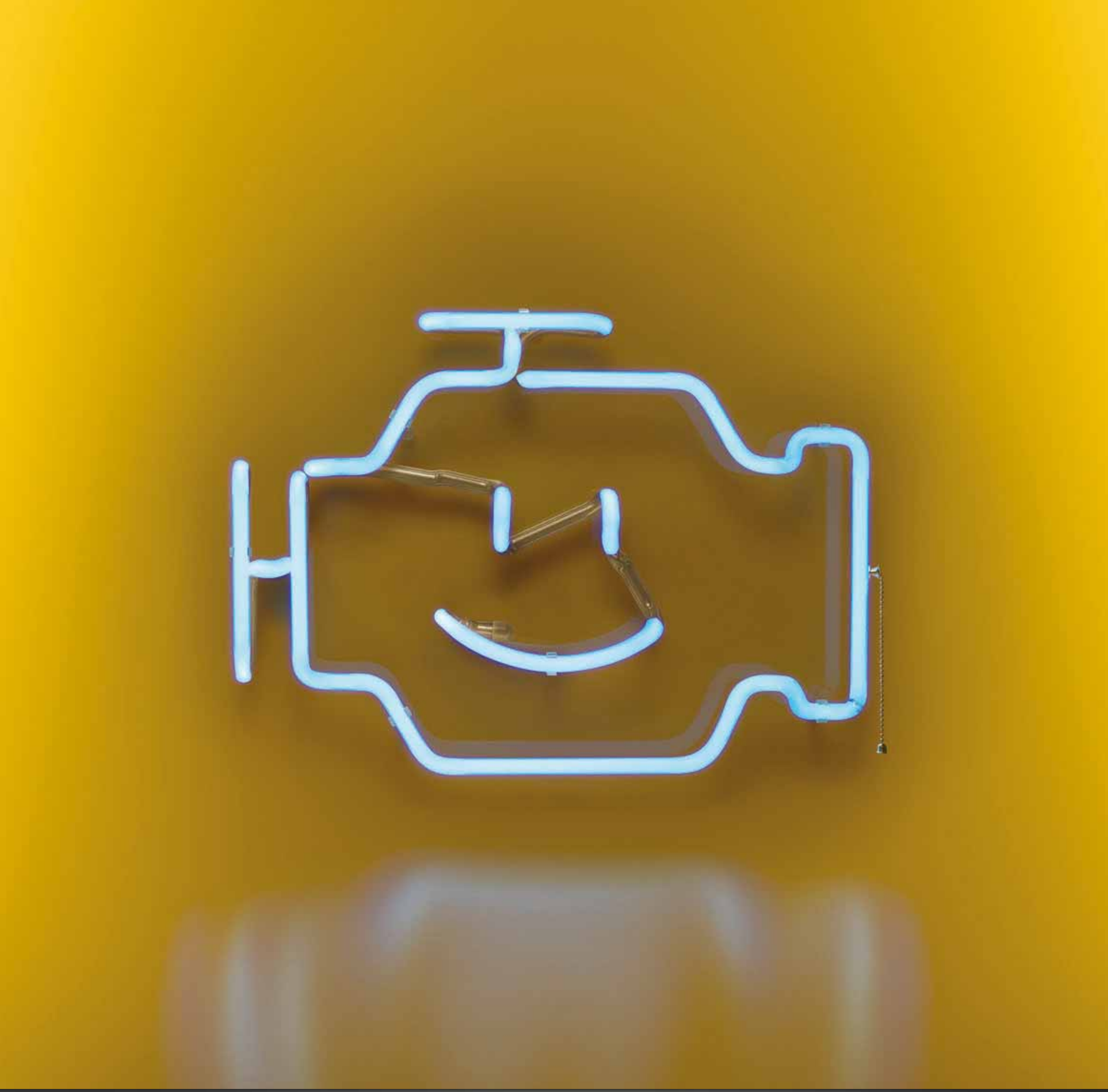

ARE YOU LYING TO YOUR STAFF?

YOU MIGHT NOT EVEN REALIZE YOU'RE DOING IT, SO HERE IS WHAT TO LOOK FOR.

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

HAVE YOU ever been blasted by your significant other when you thought you were doing nothing wrong? Odds are, you did do something wrong days ago, but they didn't share it with you, and it built up inside them. I was listening to coach Geoff Berman help a shop owner avoid the same mistake with their staff, and I'd like to share his advice with you.

How many times has something that bothered you happened in the shop, but you chose to ignore it rather than confront the employee? This happens several times until finally you lose your temper and your control. The employee is bewildered by your reaction and doesn't know its cause. To you, your reaction seems to make perfect sense, because you have been dealing with the issue internally. To the employee, your response seems to come out of nowhere.

Did you expect this person to read your mind? A better approach would have been to tell the truth from the beginning. If you had, you would have avoided this messy conflict and could have dealt with the situation in a more professional manner. Here are the three most important steps to follow to avoid this costly mistake.

Make It Clear

Unfortunately, shop owners react this way all the time. Things that seemingly go unnoticed just go unsaid. Worse than that, you never made it clear what you expected in the first place.

If you happen to be one of the few that have set clear expectations, was it done in writing? This is where most of us fail. People tend to find out what you expect when it is too late, when you tell them (or yell it to them) after the fact. Start off your relationship with your staff on the right foot. Give them the leash to either hang themselves or to be successful. It is not enough to say to me as an employee, "This is how we do it here," and expect that I get it. Maybe I will, maybe not.

The point is, I probably won't remember everything you tell me. The best thing you can do is assume I won't. That's why you put it in writing. The written expectation is used to help train and counsel the employee. Ever hear an employee say, "You never told me that." Put it in writing, and that won't happen anymore.

Measure It

It isn't enough to set a clear expectation. You also need to pay attention to how it is being carried out. How can you ever know whether what you want is being done, if you don't pay attention to it? Why do you think just because you told me to do it, that's how it will happen forever more? Things will get missed, forgotten and just plain fouled up. A month later, you happen to notice I'm not doing something correctly and that is when you lose your temper. You can avoid these situations if you measure the process and work on course corrections as you go. If you cannot measure it, you cannot expect it.

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"HOW DO YOU KNOW IF YOU ARE A GOOD LEADER? LEAVE THE SHOP FOR SEVERAL WEEKS. IF EVERYONE FOLLOWS YOUR BELIEFS, BEHAVES LIKE YOU TAUGHT THEM, THEN YOU'RE A GOOD LEADER."

CHRIS "CHUBBY" FREDERICK [ATI CEO]

Stop Holding Me Accountable

You might have heard that you must hold your staff accountable. I agree with that statement. All human beings need to be held accountable. I would ask you to consider something slightly different, though. If you say you're going to hold me accountable, it sounds negative. It sounds that way both to the person saying it and to the one being told. That is why you tend to shy away from confrontation, and things go unsaid that should have been said.

Instead of thinking of it as accountability, look at it as providing regular feedback. Sometimes this is good feedback, sometimes it is not. My hope is that you find more good in your feedback, and over time you learn how to look for that good. The bad things tend to easily find their way to the surface. It takes a bit more effort to find the good and inspire me to press on. This is how an effective leader keeps people focused and motivated. You can, too. The more you practice, the better you'll get.

What is regular feedback and why is it important? I'm sure you have heard the saying that it takes 21 days to create a habit. You can't do that without regular feedback. Each day, this new expectation is discussed. If you start with the feedback immediately, it will be easy to find the good and encourage that positive change. The message you will be sending the staff is twofold. First, that this expectation is very important to

you, and because it is clear you are paying attention, it will become important to me as well. Second, I will want to do it because you're making me feel good with all of the positive feedback.

As you do this daily, you will get a sense that it is starting to work on its own. When that happens, congratulations, you have helped me change my habit. At this point, you still need to measure performance and provide regular feedback, but you do not have to do it as often. Now, as you scale back the frequency of regular feedback for this situation, you are free to introduce a new process and make that the top priority.

Another Way You Lie

We have been taught as leaders that we need to find the good in people. That's true. I think too many times, though, we manufacture things to say that are not true, because we want to say something positive. We might say, "Great job today" to an employee, knowing very well that they did not have a great day. Leaving something unsaid and ignoring it is bad enough, but to tell me I did well when I did not, is clearly not true. What is the message we are sending here? How will you ever expect me to grow and change if you do not provide me the truth about my performance?

A simple way to improve this with a new employee is to take my temperature weekly. See how I am feeling about my new position and your company. Point out the things you like about what I bring to the organization and what I need to work on. Make sure that I have goals and that your conversations are about achieving those goals each week.

It is important for you to always have weekly one-on-one meetings with your management staff; but for the rest of the established employees, a weekly one-on-one meeting may be a bit much. You will find a meeting once a month to be adequate. This shows your commitment to them and to their success, and helps foster the positive outlook you're striving for. If they know you have their best interests at heart, they will do whatever you ask.

Whether you are training a new employee or changing the habits of one you currently have, it is important for you to recognize that your job as leader is to inspire your staff. If you follow the steps of setting a clear expectation, measuring it and providing regular feedback, your staff, customers and you will be happier.

If you would like a simple checklist to fill out before you meet with your employees, go to www.ationline-training.com/2013-6. It is a new ATI coaching form called "How to Help an Employee Change Their Behavior," and we will include a short video to show you how easy it is to do. MA

CHRIS "CHUBBY" FREDERICK
CONTRIBUTOR

Chris "Chubby" Frederick is CEO and founder of Automotive Training Institute, founded in 1974. ATI's 99 associates train more than 1,150 shops every week across North America to drive profits and dreams home. This article was written with the help of Coach Eric Twiggs.

E-mail him at cfrederick@autotraining.net

SORTING THE MAIL

YOU CAN'T JUST THROW A POSTCARD IN SOMEONE'S MAIL AND EXPECT THEM TO COME INTO YOUR SHOP. THERE IS MORE SCIENCE BEHIND IT.

BY **TIM ROSS** | CONTRIBUTOR

DIRECT mail has been around seemingly as long as the Great Pyramids. Since before the days of television, radio, billboards or even newspaper advertisements, business owners were mailing flyers and cards to potential customers to drive sales.

Because it's been around for so long, direct mail doesn't always rise to the top of the list when shop owners are looking for marketing vehicles for their businesses. But like most everything in the past 10 years, direct mail marketing has changed dramatically with the advent of new technologies, making it an even more effective marketing tool for repair shops.

You probably are hearing a lot about the growth and accessibility of social media platforms such as Facebook, Twitter and Foursquare and how they've stolen the marketing focus from direct mail. While those new technologies allow you to communicate to your potential customers, they aren't as multi-faceted as direct mail.

You can do more with direct mail today than you ever could before. But the question is how can simple postcards, flyers and mailed collateral trump the power of the Internet?

Know Your Audience

The ability to target quite strategically is one key benefit of direct mail. In the past, you might have directed campaigns to specific neighborhoods. Today, direct mail marketers can target specific households within neighborhoods.

The first step is to review your immediate market area to identify middle- to high-income neighborhoods. If you're a suburban shop, you goal is to typically target those middle- to high-income households located within a two- to three-mile radius of your shop. If you're based in a rural locale, the target stretches to five to 10 miles away from your store.

So, how do we figure out where those "ideal" customers are? Well, advances in technology have made it possible to mine a wide range of data. The information we can access to help clients develop a target strat-

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egy includes: household size, income levels, home values, spending habits and length of residency.

It also is possible to analyze a shop's current database of customers to determine who their customers are (demographic-wise) and where they are coming from. Once you have that information, we suggest mailing to the "best" areas, which will include both your current customers and new targets who have similar demographic profiles. That approach will allow you to grow new customers and to blunt the impact of competitors who are out there targeting your current customers. And remember, even your loyal customers will forget about you if you fail to mail consistently.

The combination of mailing to the highest caliber customers around your store consistently and creating a compelling message that drives customers to action is what makes direct mail effective in the auto repair industry. Too many shop owners try to exclude existing customers because they feel that offering a discount to existing customers is a waste of money.

What they fail to realize is that most existing customers need a postcard reminder or reason to come back in — they don't decide to come in on their own unless they need a repair. But it is way too risky to let good customers flounder out there when they are getting flooded with advertising from competitors trying to woo them with new customer discounts.

Your reluctance to provide discounts to current customers (which might save you $20 to $50), could cost you a customer that will spend $900 over a year's time, and will serve as a constant flow of referrals.

It is important to continue to mail into your best carrier routes or neighborhoods monthly because even the most well-established stores that have been marketing for years only see a 20 percent to 25 percent penetration rate in their markets. There is always room to grow in these areas. In addition, you have an influx of families moving in and out of these great neighborhoods, so you want to introduce your business through mailings so that your shop is top of mind for these new potential customers.

The Return

Once a direct mail campaign has been mailed, the real work begins. Shop owners need to measure the results of their compaigns to see if they were successful. What was the return on investment?

There are various tools to help gather this kind of information. One such example is utilizing an ROI data extraction program to judge the impact of our direct mail efforts. This program helps determine who specifically responded to the monthly campaign by matching the addresses where postcards where mailed that month against addresses in the customers point-of-sale system within a specific period of time. In addition, each campaign is sent out with a specific tracking number that is used by clients to not only determine when a customer is responding to the direct mail, but also allows them to find out how much a customer spent during the recent visit.

Call tracking is also a big part of the success of a direct mail marketing campaign. The typical call tracking number is a local phone number that is created to log and record all the calls that are generated from the direct mail postcard. The calls are routed through a call tracking company that ultimately redirects the customer to the business.

While originally created to help advertisers figure out where leads were coming from, call tracking has evolved to the point where the information this tool provides is too valuable to pass up.

Call tracking allows businesses to realistically evaluate the success of a campaign by calculating response rates. But it's more than a simple tally of phone calls. Analytics can show which campaigns perform better in certain areas, during certain times of the year and even which households respond better to one campaign versus another. Call tracking can also record phone calls to determine if extra training is needed to increase customer response. For instance, if you send out 1,000 pieces and get 500 responses, but only a few actually show up and spend money with the business, the problem might not be with the campaign or the direct mail targeting, but in the way your staff handles new customer calls.

With today's direct mail technology, info can be gathered and evaluated so that changes can constantly be made to ensure the highest possible ROI.

It is mind boggling how owners spend good money to drive business through advertising, but do not train and inspect how the front line employees answer the phone. While I could write an entire article on the topic of how to make the most of prospect calls, I'll briefly say that the goal is to make life convenient for the customers and not the shop. Basically, move heaven and earth to fix the problem and you'll be rewarded with a new customer.

Some companies will even evaluate your staff's performance, based on the factors you consider important.

Knowledge is power. The more you know about your customers and potential customers, the better your direct mail campaign is going to be. More than that, you should be fully aware of how your employees and sales staff handle customers. A direct mail campaign might generate calls from hundreds of people, but your staff has to be able to convert those responses into sales.

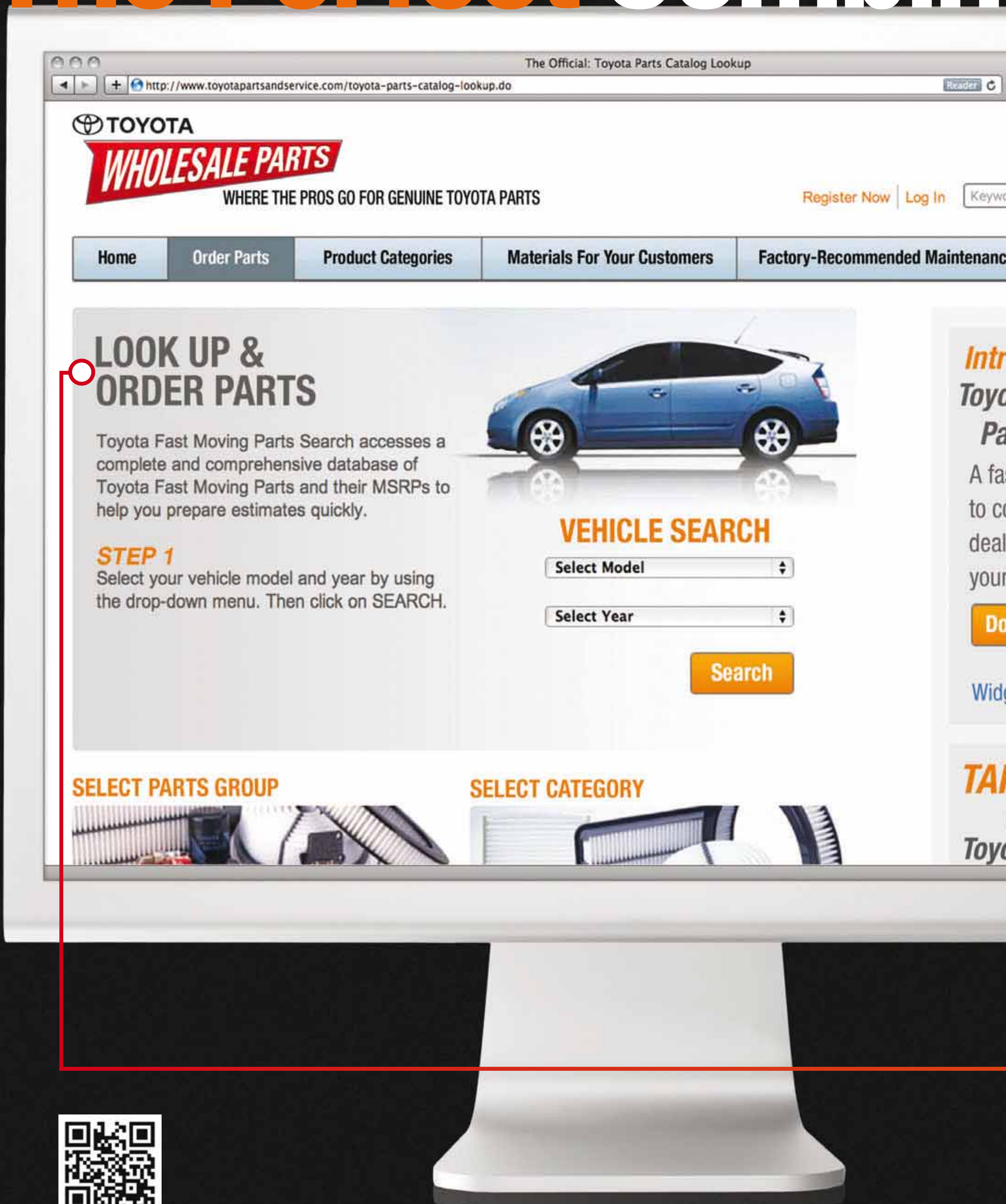
With today's direct mail technology, that kind of information can easily be gathered and evaluated so that changes can constantly be made to ensure the highest possible return on the direct mail investment.

TIM ROSS
CONTRIBUTOR

Tim Ross is president of Mudlick Mail, a provider of direct mail services for the automotive service industry. He has been with Mudlick Mail since 2008.

Contact Tim in our Workshop at Mudlick Mail

The Perfect Combin



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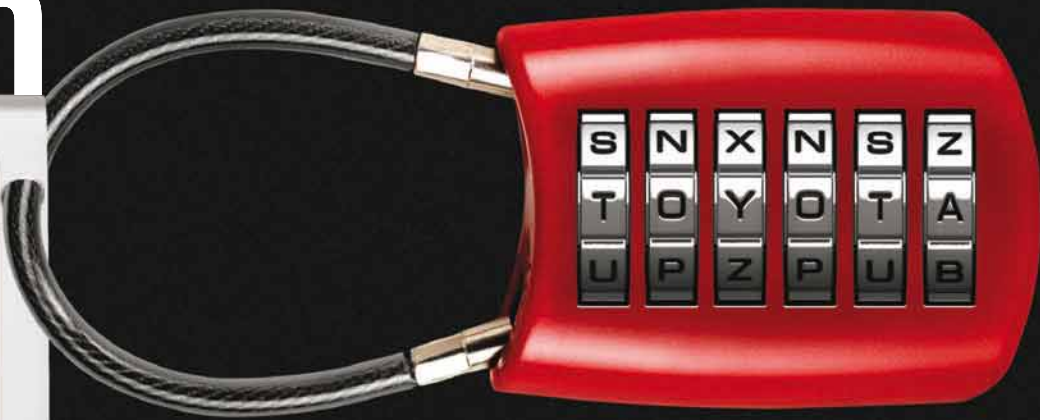

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OPERATIONS

SHOP PROFILE

A snapshot of one of the industry's leading shops

GRAHAM TIRE / WORTHINGTON, MINN.

Brave new world

More than just tires and more than just history.

BY **ROBERT BRAVENDER** | CONTRIBUTING EDITOR

Rich in history, Graham Tire succeeds most at not becoming a part of it. Started nearly 60 years ago, this particular Goodyear franchise has spread its stores throughout Iowa and along the Minnesota border until it now has 11 locations, even a retread factory.

Naturally the store is tops in the service industry, having built an outstanding reputation with both its customers and the franchiser.

But the owners are more concerned with the future than the past, hence their hiring of Jen McCann as marketing coordinator, a new title slowly taking hold in the industry. Utilized by a growing number of shops big and small, this position, sometimes billed as marketing director, has long existed with larger companies selling goods and services. But with the advent of the internet, specialized personnel are now needed to sort out a shop's online presence.

"Unless you have a lot of time to devote (to the Internet), I think it's very vital," McCann comments. "I certainly keep myself busy, so I don't know what they did before me."

McCann is the first person to have this job at Graham, hired right out of college where she was majoring in business marketing. Her responsibilities include maintaining Graham Tire's website, which is more complicated than it sounds. The site itself was designed "to deliver an easy customer journey for the visitor; anyone that visits our site should be able to find what they are looking for in a matter of minutes," says McCann. "This includes an easy to use navigation bar, a 'smart' search option and all of our deals and promotions prominently displayed on the homepage."

But you can't just set up a website and let it go at that. While the site itself might be easy to use, how easy is it to find? "Every couple of years Google comes up with an algorithm that says in order to surface organically in a search, meaning at the top of the list when somebody searches something like 'service in Worthington,' your website has to have new content, it has to be updated at pretty regular intervals." McCann explains. "Having a mobile site helps, so basically we try and add new coupons, new banners, rotate our tires, highlight our service as often as we can so we can be on top of Google's searches."

AT A GLANCE

Graham Tire Company
Shop name

Bob Graham
Owner

Worthington, Minn.
Main shop location

11
Number of locations

58
Years in business

200
Total number of employees

24
Number of technicians

Varies by location
Shop size

6-12 per location
Number of bays

187 (main location)
Average vehicles per week

$113 (main location)
Average weekly repair ticket

$12 million (main location)
Annual gross revenue

Goodyear, Mighty, Titan Farm
Shop affiliations

THE 2013 CONTEST STARTS NEXT MONTH. EMAIL FOR INFO TBRANDYBERRY@ADVANSTAR.COM

Photos: Graham Tire

Master Technician Jack Byers repairs a coolant leak on a 2003 Buick Park Avenue.

ASE Technician Evan Cummings raises a Ford F-150 to examine the chassis.

A brand new automotive detail shop features full-time detailer with more than 20 years of experience.

Rather than a catch-as-you-can-catch effort from random staff members, McCann's time is devoted solely to making the website and all of Graham Tire's marketing efforts work together and drive business. "With that time I can research what we need to be doing, why something is not working rather than try and throw something at it, because I'd found a couple of minutes during the day," she reports. "(Advertising) is very expensive, so it needs to be a coordinated effort."

For this, McCann utilizes a variety of marketing modes: social media like Facebook and Twitter, direct mail, email marketing, billboards, local radio and newspaper, and local events within each store's community. And Graham Tire has plenty to advertise.

Founded in 1951 by Bill Graham, in 1965 his son Bob began developing the eastern half of the company (the western half run by his brother Tom in Nebraska and South Dakota), which is now run by General Manager Kelly Monthei (pronounced "monty"). Under their collective auspices, the company has grown to 10 retail stores — seven in Iowa, three in Minnesota, with headquarters at their Worthington, Minn., branch — as well as one commercial store and the aforementioned retread plant.

And how does one get a retread plant? Short answer: volume. That volume derives from quality work. The lube techs alone are required to fill out a 37-point inspection sheet on each vehicle.

"Each of our locations has the ability to reprogram and reflash on-board computer systems," McCann reports. "We incorporate the use of scan tools from Snap-on, Ease and OTC, (and) have made large investments in not only equipment but countless hours of training."

At each of the stores, employees utilizes online training available through ASE and Goodyear; for the latter, this not only includes technicians but sales and management. "All of our mechanics are ASE certified at least to some degree, while probably over half are ASE Master certified," McCann cites. "All of our parts stores have their own training websites, and we try to utilize that into the program, making sure everybody is current."

During the past five years, technicians also have attended numerous training classes put on by Automotive Training Group, Inc., a company specializing in advanced technical information and training. "We attend lots of training shows," McCann affirms. "We just sent something like eight people down to VISION Hi-Tech Training & Expo in Kansas City, which is a big deal for the automotive industry."

Each store holds monthly meetings to track problems and chart progress; a district service manager visits each store to ensure quality is maintained and lines of communication are kept open. Factor in location, logistics and loyalty (Graham has been a Goodyear retailer for more than 50 years), and you are rewarded with a warehouse distribution network and a factory, which recaps tires for semi-tractors and agricultural equipment.

A lot of these recaps are distributed throughout Goodyear's regional network, while some supply Graham Tire's own commercial tire center, located in Des Moines, Iowa. Besides offering and installing these tires, they also service fleet accounts. "We do alignments, small engine work," says McCann. "It's specifically geared toward commercial applications like semis."

Recently McCann had posted on the website that the company had proudly sponsored a 150-mile K&N Pro Series race at the Iowa Speedway in Newton, as well as purchased a cup car with Graham Tire livery from Hendricks Motorsports for display purposes. Who says marketing has to be all work and no play?

ROBERT BRAVENDER
CONTRIBUTOR

Robert Bravender graduated from the University of Memphis with a bachelor's degree in film and video production. He has edited magazines and produced shows for numerous channels, including "Motorhead Garage" with longtime how-to guys Sam Memmolo and Dave Bowman.

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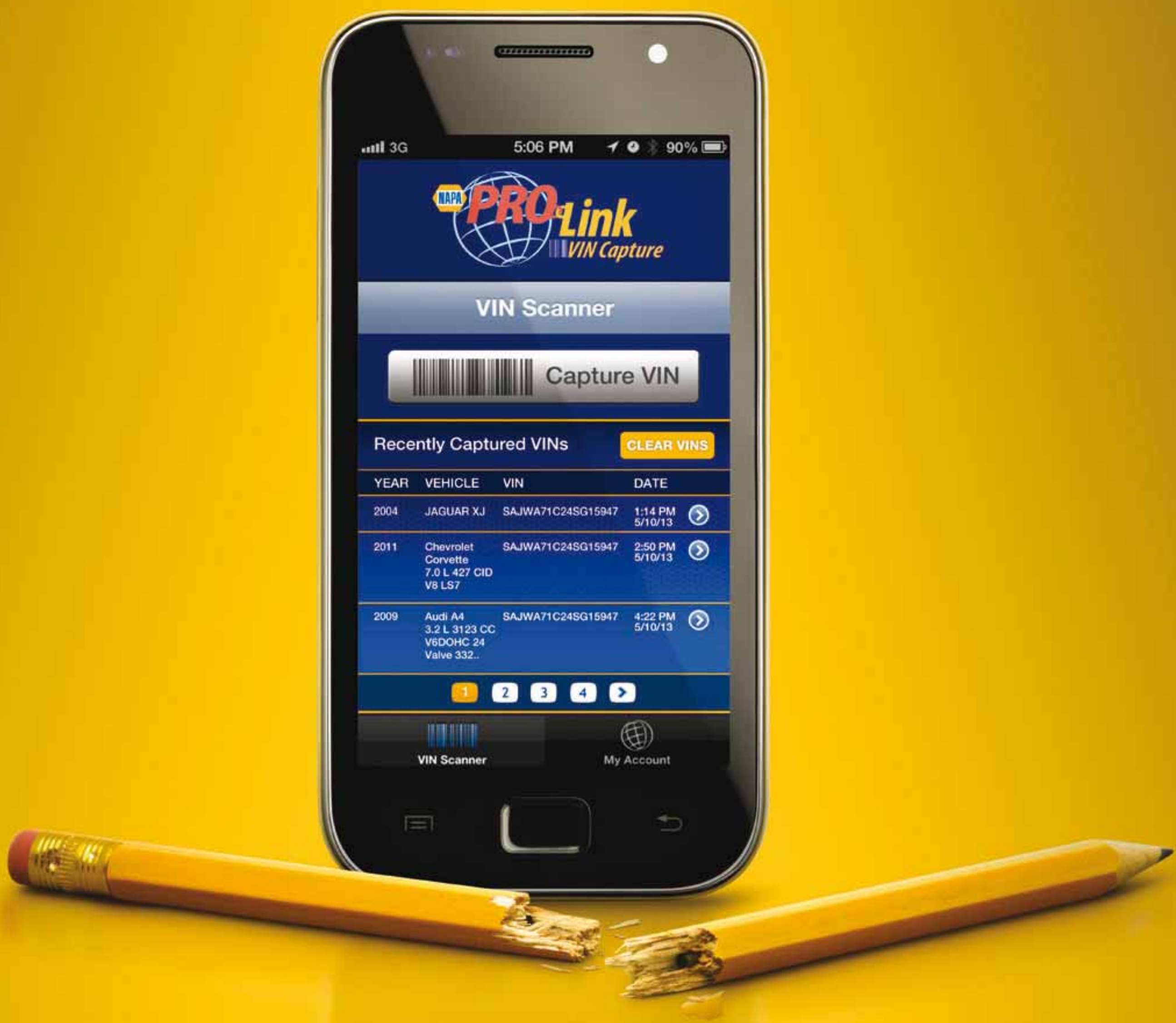
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DRIVABILITY

PUTTING FUEL TRIMS & DOWNSTREAM O2S UNDER A MICROSCOPE

HAVE YOU EVER HAD A VEHICLE IN YOUR SHOP WITH NO CODE OR A P0300 CODE INTERMITTENT MISFIRE AND WONDERED WHETHER TO CHECK FOR A FUEL OR IGNITION CAUSE FIRST?

BY **MARK DEKOSTER** | CONTRIBUTING EDITOR

Let me share with you a technique that will give you a quick and effective way to capture the concern and determine, with a high level of certainty, an analysis path. It uses your scan tool to watch the fuel trims and the downstream O_2 sensors. I began teaching this technique to Ford technicians in the Advanced Drivability courses starting in 2000 as a Service Training Instructor with Ford Motor Company.

To understand why this method works, let's lay the foundation by reviewing Powertrain Control Module (PCM) feedback fuel control. First, the conventional zirconia dioxide sensor is the feedback to the PCM reporting the exhaust stream as rich or lean with a stoichiometric switch point of 450mV. In operation, it is more accurate to say the sensor is a switch and that stoichiometric (the ideal air/fuel mix) is a range that goes from about 350mV to 650mV. A voltage above 650mV then represents a rich (low oxygen (O_2) and/or high hydrocarbon (HC) content) air/fuel mixture in the exhaust. A voltage below 350mV represents a lean (high oxygen and/or low hydrocarbon content) air/fuel mixture in the exhaust. A voltage reading between 350 and 650mV is a stoichiometric (14.7:1) air/fuel mixture in the exhaust.

When we monitor the conventional oxygen sensors' signals, we see that at a steady state operation the typical vehicle's upstream O_2 will be constantly switching rich-lean. With a working cat during steady state operation, the downstream oxygen sensors will be holding steady, usually somewhere in between 350 and 650mV.

Testing also has shown that as a rich-lean or stoichiometric switch,

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the operation of the sensor does not change based on combustion. In other words, if a stoichiometric air/fuel mix entered the combustion chamber, a stoichiometric air/fuel mix comes out.

If a cylinder does not fire due to an ignition concern, the effect on the upstream sensor will be minimal. If the cylinder does not fire due to a lack of fuel, the effect will be pronounced. Note: There is what is called the Characteristic Shift Down, which comes from a sensor being contaminated by an excess amount of HC in the exhaust stream if the over rich or misfire condition lasts long enough.

Check out a case study on misfiring Chevy using fuel trim as a diagnostic aid. MotorAge.com/casestudy

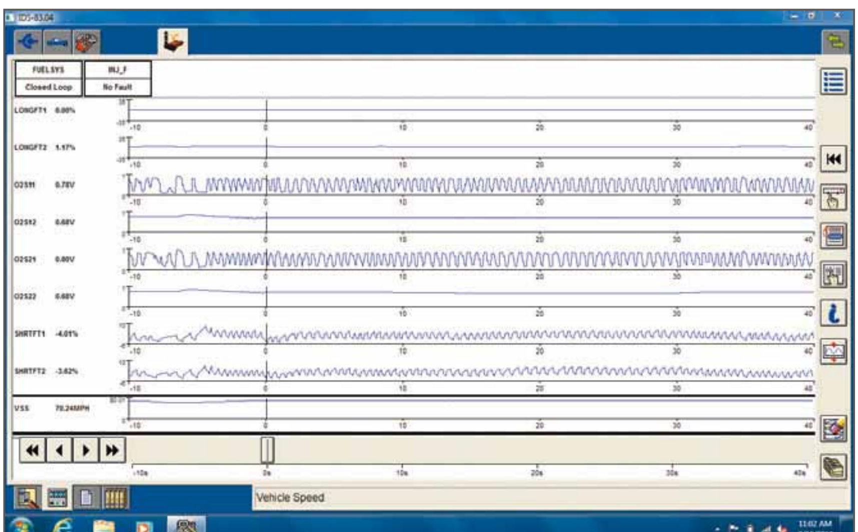
Getting the Switch to Switch

To get a conventional oxygen sensor to switch, the PCM drives the mixture rich to lean to rich. This can be seen with a scan-tool that will graph the Short Term Fuel Trims (STFTs). The pattern will be a saw tooth that is just opposite of the sensor voltage swing. By watching the STFT values, you also will see that they will be switching in a ±4 percent range (on a known good car, of course). If the fuel trims spend about an equal amount of time adding and subtracting, then the overall fuel mix is stoichiometric.

Long Term Fuel Trim (LTFT) is the adaptive strategy side of the system and those values will be used for baseline purposes in this analysis. Under normal operation, we expect these values to be within 10 percent of zero. While it takes LTFT in excess of ±25 percent to set a rich or lean Diagnostic Trouble Code (DTC) and illuminate the Malfunction Indicator Lamp (MIL), I consider anything in excess of ±10 percent to be a concern that requires investigation. Possibilities include contaminated oil, slight vacuum leaks or a contaminated Mass Airflow sensor (MAF), and are all things that should be looked into.

Add in the Converter

To finish the foundation, let's review engine and catalytic converter operation. When STFT is switching in a ±4 percent range, a stoichiometric air/fuel mix is entering and leaving the cylinder. That is critical to understanding operation and using this technique to analyze intermittent misfire concerns. It is the combination of STFT and LTFT that tells us what entered the cylinder.



You can see the downstream O_2s are floating at about .68V and the STFT is switching in a ±3 percent range.

Photos: Mark DeKoster

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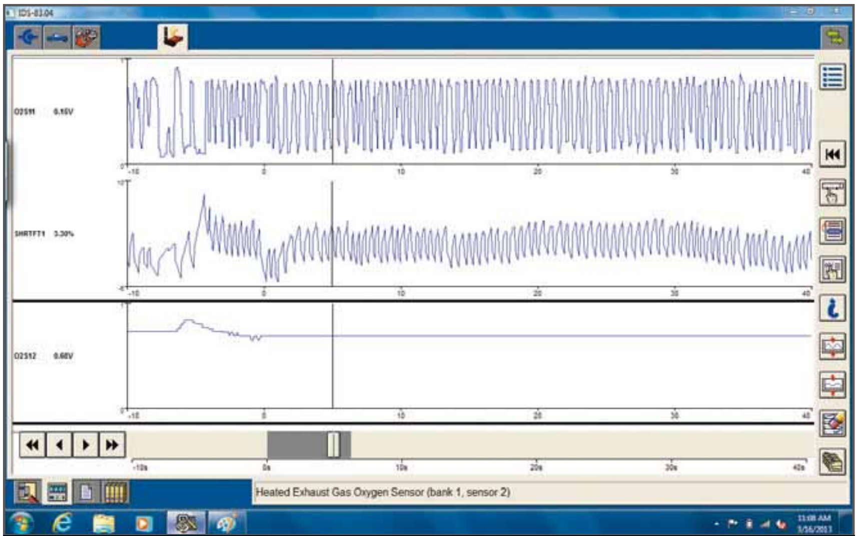


In this image, you can clearly see the STFT and upstream O_2 in a rich/lean dance.

If the air/fuel ratio coming out of the cylinder is lean, the sensor will stay at a low voltage. Keep in mind that lean can be too much air or not enough fuel; rich is just the opposite.

Conversely, the voltage will stay high if the air/fuel mix is rich. The PCM will decrease or increase fuel pulse width until it gets the sensor to once again switch. Once the sensor is switching, the STFT goes back to switching in a ±4 percent range again. Adaptive strategy will start, and the PCM will learn what the new normal is and LTFT will change so that the STFT switch range is above and below zero.

The last part of the system to consider is the operation of the catalytic converter and the downstream oxygen sensors. A normally functioning cat will take excess O_2 that is in the exhaust stream and store it. It will also capture the HC and CO and store it. (NO_x emissions and cat operation does not effect this diagnostic.) During catalytic operation; the O_2, HC, and CO are used and we have H_2O (water) and CO_2 (carbon dioxide) coming out. There is a balance during steady state operation and the downstream sensor will also indicate whether or not a stoichiometric A/F left the cylinder(s).

It is typical to see the downstream sensor voltage floating in the 350 to 650mV range when the cat is lit off, the system is in closed loop and there are no misfires or other concerns. In fact, most manufacturers monitor the downstream oxygen sensors and will tweak LTFT to improve fuel economy and reduce emissions. That is one reason your car's fuel economy improves during steady-state highway driving.

Using This Info To Fix A Car

Now that we have set the foundation, let's use this information to figure out what causes an intermittent misfire.

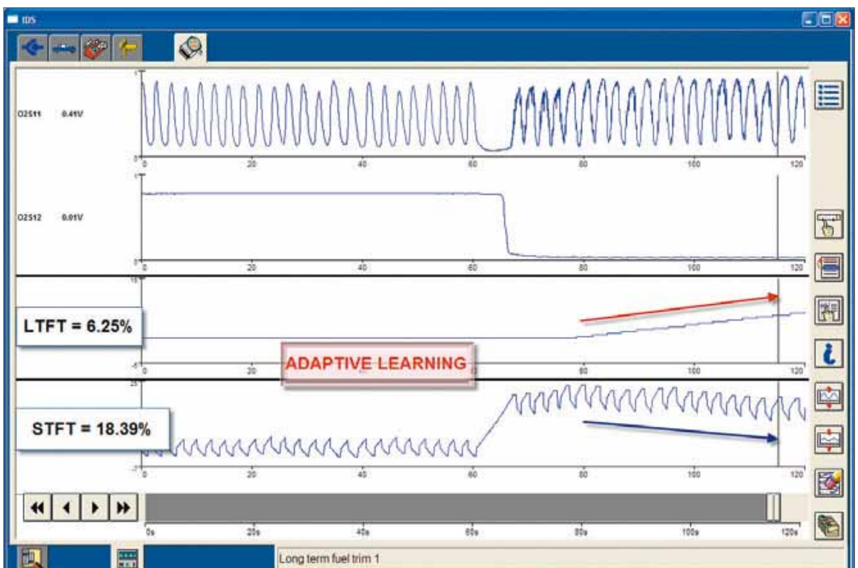
If your vehicle has a P03xx code, then follow the pinpoint test related to the code. If not, then we will start by getting a baseline on the vehicle. Baseline the vehicle means to note what the LTFT and STFT values are without the misfire present and note where the downstream oxygen sensor voltage is.

The car needs to be running in closed loop as most vehicles limit datastream in open loop operation. Of course, if the car has gone into open loop, there should also be a MIL code or at least a pending MIL code.

Another piece of data to review is the misfire data. Ford does not list misfire counts in their data stream but useful misfire information can be found in Mode $06. This information will give you a sense for which cylinder(s) have a concern. They may not give a direction, such as fuel or ignition but it will at least point you towards a specific cylinder.

Let's consider what happens in a "good" cylinder in closed loop. A near stoichiometric A/F ratio enters the cylinder. The plug fires, the mixture burns, and the exhaust is expelled out and into the exhaust system on its way to the catalytic converter.

The cat absorbs any excess O_2, HC and CO and then processes that into H_2O and CO_2. This exhaust stream then passes by the downstream O_2 and out the tailpipe. As this happens, the upstream O_2 switches and outputs a varying voltage between 100



You can see the concern at the 60 second mark. STFT shot up to about +20 percent and got the O_2 switching again. Within about 10 seconds the LTFT begin ramping up and STFT starting going back towards a ±3 percent range as the LTFT learned the new normal and adapted.

and 900mV. The downstream O_2 will stay fairly steady and float between 350 to 650mV. Now let's take a look at what happens when things don't go as planned.

Scenario 1 – Ignition misfire. In closed loop operation, the PCM has created a near stoichiometric A/F ratio in the cylinder. When the sparkplug doesn't fire that A/F mix enters the exhaust stream. Some fuel condenses out in the cylinder and goes into the oil. This is why the O_2 sensor gives an initial lean reading. However, most of that stoichiometric air/fuel mix enters the exhaust stream, goes past the upstream sensor and into the cat.

Anytime there is a change in the A/F ratio sensed by the O_2s, the STFT will react and begin to add or subtract fuel to get the O_2 to switch. With an ignition misfire the STFT typically will only need to add up to 15 percent to get the O_2 to return to switching.

The downstream O_2 will show an increase in voltage and go into the 900mV to even 1,000mV range. This happens because the cat has to try and clean the exhaust and so it uses all of the stored O_2 entering from the misfiring cylinder. It is unable to oxidize all of the HC and uses most to all of the excess O_2 that came with the HC from the cylinder that had the misfire.

The cat is trying to clean the exhaust and therefore the downstream O_2 sees a rich exhaust stream, low O_2. It will output a voltage above 650mV and usually above 900mV during the event. The one above is at 980mV.

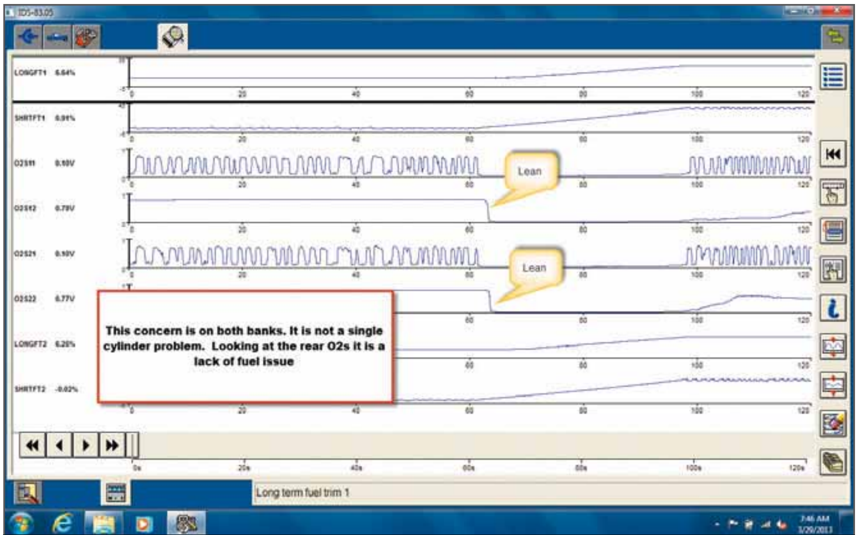
This happens so consistently that you can look at the datastream during the misfire event and if STFT has changed less than 15 percent positive and the downstream oxygen sensor has voltage higher than 650mV that you can with confidence look for an ignition related concern to be the cause of the misfire.

To prove this to students and myself, I have intentionally created this concern on many cars over the years to assess the reliability of the test. I have yet to find a vehicle in which this was not seen. Even vehicles with upstream wide band air fuel sensors react the same way.

My observations do show, however, that sensor placement in the exhaust system has an effect on this method. When the manufacturer places the upstream oxygen sensor farther down the exhaust system the effect of a misfire tends to be dampened. As the exhaust streams from the other cylinders mixes with the stream from the misfiring cylinder the change in fuel trims tends to be less.

One thing you may have to watch out for is when the OEM has built in some type of limp in mode that impacts the datastream. In this case of a Lincoln Towncar, the PCM determines a fault and goes into what Ford calls Failure Mode Effects Management. There will be a failure code in this case, the

Loop Status Parameter Identifier (PID) will show OL-FAULT (Open Loop-Fault) and the PCM stops sending most datastream to the scantool



A 2006 Ranger would lose power every so often and then continue. The failure event was captured with a scantool and it was obvious from fuel trims and the downstream O_2s that it was going lean. Additional testing found a loose ground connection for the fuel pump and was easily repaired.

Scenario 2 – A lack of fuel misfire. In the case of a misfire caused by an injector that does not spray fuel the reaction of STFT and the downstream O_2 is significantly different. If we have a miss caused by no fuel or little fuel due to a mostly plugged injector, then the mix in the cylinder is mostly air. Isn't that the same as a lean air/fuel mix? This cylinder full of air is then pushed out into the exhaust stream, past the upstream O_2s and into the cat.

In this case, the reaction of the STFT will go well beyond 15 percent. Because there is an excess of oxygen going into the cat, the cat has more than enough O_2 to oxidize what HC and CO enters and have O_2 left over. The reaction of the downstream O_2 is to produce voltages below 100mV. In this example, the voltage produced is 8mV.

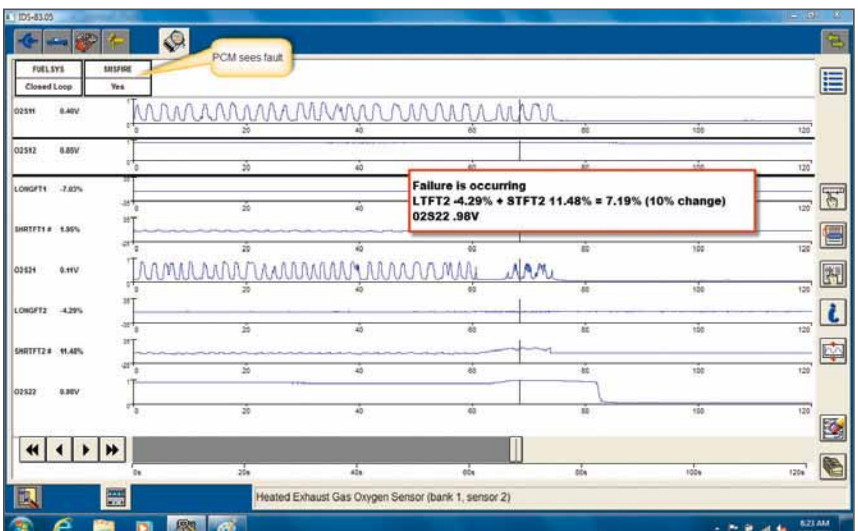
The rule of thumb for a fuel-related misfire concern is STFT going more than 15 percent positive, often into the mid 20 percent range or more and the downstream O_2 voltage below 350mV.

The downstream oxygen sensors also can be used in a similar fashion to analyze concerns such as a fuel pump losing pressure or volume. As the volume drops off and the system goes lean the downstream sensors will go lean as well. Because both banks will be similarly affected you can rule out a single cylinder concern as the cause of the lean running condition.

Keep this tool in your memory toolbox for the next intermittent misfire you're faced with:

- A 15 percent or less change in trim and a downstream O_2 above 650mV points to an ignition concern
- A 15 percent or more change in trim and a downstream O_2 under 350mV points to a lack of fuel concern

These scenarios are fairly easy for you to recreate in your shop to see the results and prove to yourself that this method is repeatable to the point of being a realistic method for analysis.



The cursor shows the fault occurring and the changes are minimal. STFT has only gone positive by about 10 percent. The O_2S22 has gone to .98V. In this case, the PCM has recognized the fault and is showing a misfire. If the PCM sets a distinct code, then you will have that additional information to go on.

MARK DEKOSTER
CONTRIBUTING EDITOROR

Mark DeKoster has been fixing or teaching people how to fix cars for over 30 years. He has been a tech, trainer for Snap-on and Ford Motor Company, and currently is an associate professor at Ferris State University. He is the lead instructor in The Automotive Management Degree Program.

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WHEN YOU'RE TALKING POWER, MOST PEOPLE WANT MORE. PACKING AIR IN, MEANS THERE'S MORE FUEL TO BURN.

BY **DAVE HOBBS** | CONTRIBUTING EDITOR

EDITOR'S NOTE: The following article ran earlier in 2013, but was trimmed due to space. It follows in its entirety.

Forced induction – it's about numbers. Numbers matter. Ask your accountant. Ask your customer. Ask an engine builder. One number an engine builder loves is the one for an engine's volumetric efficiency, or VE.

VE is a measurement of how full an engine's cylinder is with air. The number assumes that the air contained in the cylinder is at ambient pressure at sea level (14.7 psi). Obviously, with an engine at rest each cylinder is 100 percent volumetric efficient, but we don't care about engines at rest. The trick is achieving high VE when it matters most: under acceleration and at higher rpms. Under typical high rpm conditions air is moving into a cylinder courtesy of a piston traveling close to 50 feet per second, and that's where the difficulty begins. Forced induction from superchargers and turbochargers lend a hand to increase engine VE.

More Air = More Power

Every tech knows more air means more power. That's always been the rule with engine performance whether you're grading performance on power or efficiency. Not that fuel and spark deserve less than honorable mentions. Air volume and density is the biggest factor when you want to go fast or go efficient or in the realm of today's automotive market – plenty of both.

Consider that the average catalytic converter equipped non-direct injection spark ignited engine has an optimal stoichiometric air:fuel (AF) ratio of 14.7 pounds of air to every 1 pound of fuel. Take into consideration the vast difference between an actual volume of 1 pound of fuel and 14.7 pounds of air. One pound of fuel would fill a 20 ounce empty plastic soda bottle from a vending machine. In order to really calculate how much air 14.7 pounds is (volume wise), we could do a bunch of complex math or just look it up for an assumed pressure of sea level and temperature of 70° F. Those numbers considered, 14.7 pounds of air is 2,894 gallons.

That's right — for every one 20-ounce soda bottle of gasoline an engine consumes it breathes enough air to fill a small gasoline delivery truck's tank. Now that everyone's head is around the mental picture of a soda bottle of fuel for every tanker truck tank of air, we can really appreciate the importance of volumetric efficiency and the role of a blower — a supercharger or turbocharger.

While VE can be improved with induction and exhaust manifold deigns, valve timing and a host of other design

Photos: Dave Hobbs

tricks, nothing beats the blower. A turbine drawing in ambient pressure air and compressing it to two or more atmospheres (30 PSI or greater) increases the VE and thus performance of an engine in an impressive manner.

Blower 101

In a general sense, there is nothing new about either style of VE boosting blowers. Superchargers utilize an engine driven turbine that compresses air (thereby increasing air pressure and density) via a chain, gear or belt. The result is low-end torque along with a horsepower boost at higher rpms. Trucks, muscle cars, dragsters, etc. have been traditional users of the supercharger for many, many decades. While saddling the crankshaft with another mission (turning a supercharger) does drop fuel economy ever so slightly, the supercharger shines with instant power that will make a believer out of anyone behind the wheel.

Turbochargers, on the other hand, use exhaust gas driven blowers to increase high-end horsepower. Trucks, performance cars,and longer duration racing vehicles (Formula 1, CART, etc.) all are traditional candidates for turbocharging. For these reasons, blowers are quite at home on diesel-equipped trucks and some non-performance oriented passenger cars. You will be hard pressed to find a light duty (LD) diesel truck today without a turbocharger.

Although turbo and superchargers have been around for more than 125 years, the turbo has been an exception to the rule on most domestic passenger cars and gas engine equipped LD trucks for most of those years. In recent years, trends resulting from stricter emission and environmental standards have resulted in the turbo's exposure into the economy car market.

Take for example the Chevrolet Cruze 1.4 liter 4 cylinder engine. The Cruze isn't exactly a minicar, nor is it stripped down to be ultra-light as are some imported economy cars, so 1.4 liters under the hood hardly sounds like enough power until its turbocharger is factored in. Performance is quite adequate while mileage nears the numbers that are typically only met with a hybrid electric vehicle.

Not to be outdone, Ford's approach to this increasingly popular technology is marketed as "EcoBoost" and, as is with the case of some of the GM applications, Ford utilizes a smaller engine with a turbocharger to do "more with less." Ford pairs their gasoline direct injection (GDI) with their turbo to reduce the delay inherent with most turbos commonly referred to as "turbo lag." The combination increases fuel economy by 20 percent, reduces emissions by 15 percent and still provides a noticeable improvement in power.

The Hardware (and Software)

Hardware for the supercharger varies with the design of the blower internally. Rotor superchargers, centrifugal superchargers and vane superchargers comprise the most popular variety within the passenger car market. The physically longer design used on vehicles like the Buick 3800 and on street rods/top fuel dragsters use a set of two rotors. Buick, Pontiac and Oldsmobile 3800 V6 models were popular cars to sport the option of the Eaton M62 and M90 blowers.

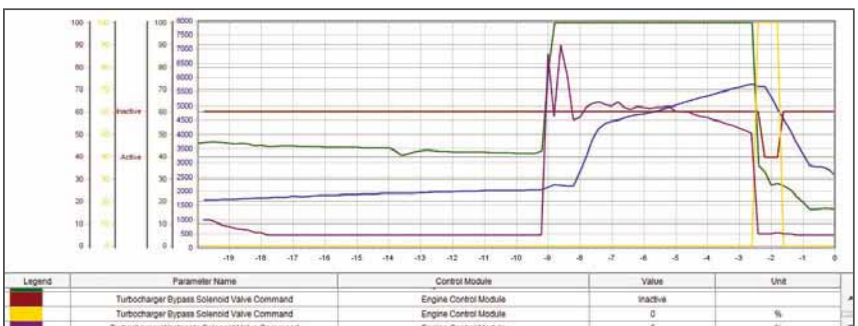
Find out just how important it really is to have a solid base engine before you decide to add more air at MotorAge.com/howfast

These units often are called Roots after the company/inventor name. Centrifugal superchargers are compact units utilizing a spinning turbine. These typically are used in tight spaces such as bolt on aftermarket units although some late model Ford Mustangs, Thunderbirds and limited edition F-150s did come from the factory supercharged. The common GM Roots-style blower's main components were the compressor housing, (part of the upper intake manifold on the GM V6 designs) the nose drive unit containing a drive pulley, coupler, bearings and a boost bypass shaft with associated bypass actuator and vacuum solenoid.

The job of the bypass shaft/plate is to allow normally aspirated air to enter the engine in a non-compressed state thereby eliminating or reducing boost. During periods of rapid decel or after engine management electronics have detected certain problems the boost bypass solenoid is activated to apply vacuum to the vacuum actuator. The actuator in turn moves a rod connected to the bypass shaft. The bypass shaft has a butterfly plate on it resembling a small throttle plate.

Hardware for the typical turbocharger contains the turbine wheel, (exhaust driven fan) turbine housing, turbo shaft bearing housing, compressor wheel, (compresses air) compressor housing, waste gate and waste gate actuator.

The wastegate is a valve that allows exhaust gas flow to bypass the exhaust driven turbo when conditions merit that boost be limited as in the case with the supercharger boost bypass valve. Wastegates can be mechanically controlled by the mechanical dynamics of boost pressure versus vacuum against a spring loaded diaphragm. The diaphragm, in turn, moves a rod, which is connected to the wastegate valve itself. The rod traditionally has had the appearance



On this chart of a 2012 Chevy Cruse with 1.4 Turbo, green is throttle, blue is rpms, red is turbo bypass and magenta is turbo wastegate. When scanning, make sure boost goes up with load and throttle increases and down with decel.

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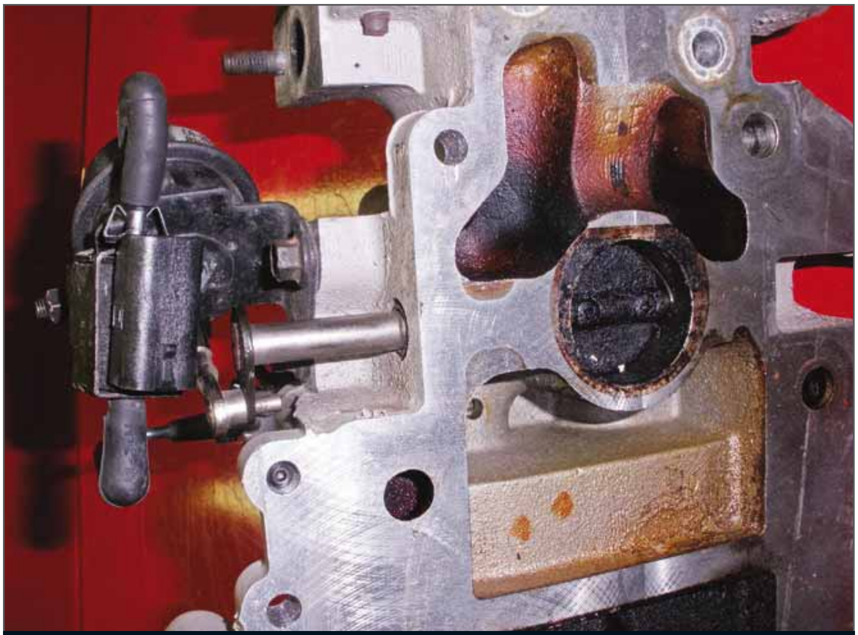

Here is a late 1990s GM 3800 V6 Supercharger. The small throttle plate looking bypass for boost opens when ECU controlled vacuum solenoid activates.

of being adjustable and is — by the factory only in most cases.

Now that I've made that disclaimer, some techs will have to fix the DIY or other "tech" who worked on it to adjust the boost up to (or down to) specs after the rod has been adjusted. Removal from the turbo is required in order to shorten (increase boost) or lengthen the rod (decrease boost). More recent turbos, like those on some modern common rail diesels, the wastegate actuator control is part mechanical (spring loaded diaphragm versus boost pressure / exhaust back pressure) and part electronic vacuum solenoid control courtesy of the engine management computer.

To add to further complexity (not that any OEM engineer ever does so on purpose) another advance in recent model years for turbo chargers is the variable geometry (displacement) turbocharger. They work off of the Bernoulli principle. A ring surrounds the exhaust turbine that contains a set of nine or so vanes shaped like an airplane wing. As the ring is rotated by an actuator, the position of the vanes change and like the flaps on an airplane wing, pressure is changed. This changes the turbine's speed (and engine boost) and along with that, exhaust backpressure.

Increasing exhaust back pressure is desirable for a diesel to assist with much needed EGR. Typical to newer diesels, the variable geometry turbo actuator is moved hydraulically via electronic controls. The actuator and associated controls are in the center of the turbo housing and include an actuator position sensor and a turbine shaft speed sensor. The actuator electronic control may be a full-blown ECU on the CAN communications bus. In these cases, the engine coolant may be used to keep the ECU alive in that hot environment.

Not wanting to be outdone by the diesel engineers, GM's gas engine powertrain engineers introduced a boosted air bypass valve into the cold air side of their small engine. The 1.4 liter Chevrolet Cruse is an example. Here is how it works. When the accelerator pedal is depressed this bypass valve is closed. The force in the return spring integrated in the valve presses the valve cone against its seat in the turbo housing. The valve is turned off when the accelerator pedal is released,

In order to avoid pressure spikes in the intake manifold and unloading or overrunning the turbo, the engine control module (ECM) sends a voltage signal to the bypass valve, which will then open. The compressed air on the pressure side of the turbo is led to the intake via the open valve.

When the pressure drops, the turbine speed can be kept relatively high and the turbocharger is prevented from exceeding the pump limit. This

On this Eaton supercharger (GM), if the pulley can be moved up and down or side to side, there is a bearing problem. If the pulley can be rotated several degrees before meeting the resistance of the Roots blower rotors, there are worn out couplers.

WE SPEAK TRANSMISSION.

The intercooler is built into top of Ford Powerstroke diesel engine.

is all done on the cold side (intake) of the system. There is still a wastegate for the vehicle's turbocharger.

Speaking of the cold side, last but not least in the world of hardware would be the heat exchanger referred to as an intercooler. You don't have to design in an intercooler to build a vehicle with a blower, but it sure helps. Back to the ideal gas law — if you compress a gas the temperature goes up with the pressure. We don't need to add more heat into a NO_X/Knock prone environment so we cool the air prior to the intake manifold. Intercoolers might be mounted in front of the radiator/condenser or on top of the engine.

They might be air-cooled or water-cooled. They are important. When they get restricted for airflow (internally or externally) the very technology that was used to increase VE is now decreasing it.

Oil Can, Please

Superchargers spinning at 50,000 rpms and their counterpart turbo spinning at 100,000 rpms require a sufficient amount of uncontaminated lubrication. Although not restricted to a stationary oil sump design, the Eaton Roots-style blower used in GM's passenger car line applications utilized a sump with its own oil.

Regardless how neglected the motor oil was in the crankcase, the supercharger still has a fighting chance. The oil should be changed whenever bearing failure has occurred or any other source of contamination or abusive service (racing, towing, etc.) is suspected. In the case of the popular GM V6 applications using Eaton blowers, the service procedure requires two bottles of Supercharger Oil (P/N 10953513) unless you opt to not flush the nose drive assembly.

You don't necessarily have to remove the unit from the engine to drain the oil once the ¼-inch drain plug is removed. Simply use a floor jack to raise the driver's side of the vehicle to push the oil towards the front of the unit. Using two large syringes (farm supply store) and some ¼-inch clear tubing, you can then suction out the oil from the unit. Lower the floor jack to bring the vehicle level again and use the syringes and clear tubing to add oil until it reaches just below the bottom of the threads of the drain hole. Using clear tubing will help you see when the oil reaches the bottom of the threads.

Turbocharger lubrication is supplied in most all cases from the engine's lubrication system, which leads to a bit of a dilemma these days. On one hand, we have the traditional 3,000-mile oil change for all but rough service (short trips or hot usage vehicles), while on the other hand we have longer-life oils, better filters and the ever so popular oil life monitor that tells the customer when to have the oil changed. Oil life monitors are based on engine Parameter Identifiers (PIDs) like the vehicle speed sensor (VSS) for distance and the engine coolant temperature sensor (ECT) sensor for time at operating temperature to produce a software model that allows for some of the factors in oil breakdown but what about other factors like dusty roads and cheap air filters?

According to one OEM dealer service manager in my hometown, the hype about the waste of money and cost to the environment due to the myth of the 3,000-mile oil change has resulted in the opposite extreme: oil that doesn't get changed often enough. Drivers are waiting the 7,800 to 20,000 miles of driving with their synthetic oil waiting for that oil life monitor to clock down to zero percent and according to my service manager friend's experience with a rash of engine problems like premature valve guide wear that's too late.

When we are talking about a hot, high-revving turbocharger a return to slightly more conservative oil change intervals is in order to prevent premature turbo wear out. Oil is cheap. Turbos are not.

Diagnosing Blower Problems

Noise is the big complaint with both turbochargers and superchargers due to wear out. Keep in mind some noise is normal. Some turbo or supercharger whine is the nature of the beast. If a pulley has been changed out on a GM supercharger (smaller one for more blower speed/boost) there will be more natural noise from the supercharger.

When noise exceeds the norm, it's time to diagnose why. If you can get to either side of the turbine on a turbocharger (cold side will be easier) simply use your fingertip to check for play up and down. There should not be any noticeable bearing movement with upward and downward motion. When a shaft bearing is loose or worn out on a turbo, it often is the oil issue previously mentioned. Bearing noises are of course expected but on some of the diesels due to design and location worn out bearings can make a noise you might swear is an exhaust leak but actually is a worn turbocharger bearing.

With a high mileage older supercharger (i.e. a 1990s something Buick) it might just be wear out with something in the nose drive unit. Those noises come in two varieties: bearing wear and coupler wear. If the noise is grinding or whining the bearings are the likely sources. If there is a noise like something rattling or loose, look for a bad coupler. The coupler's job is to connect the pulley driven input shaft to the rotors internal to the supercharger.

As the engine's drive belt fluctuates in speed, couplers dampen those variations to protect the supercharger from damage. A quick test to determine which issue the supercharger has is to remove the drive belt and rotate the pulley back and forth. If there is a clunking sound — it's most likely a coupler problem.

Next, grab the pulley and check end play up and down and side to side. If there is excessive movement, bearings are the problem. Numerous resources are available on the aftermarket for everything from supercharger coupler kits to rebuilt turbochargers. When selecting a reman blower, consider the time tested adage "you get what you pay for." Murphy's Law also applies in these cases when you consider the money you saved on a cheap reman turbo or supercharger is directly relational to the complexity of the R&R when the job comes back.

Engine management failures to look for would be over boost (detonation/engine damage) and under boost. In the under boost situation, the symptom can be slight to a full blown "won't hardly move down the road." Almost everything is a PID these days, so if you have a decent scan tool look for things like turbine shaft speed errors or actuator position sensor diagnostic trouble codes (DTCs) that would indicate that something is physically broke (won't move to the correct position) or the sensor has failed.

As with any new technology, the combination of the boost bypass and wastegate control on the GM economy engines will be a steep learning curve to determine on a road test that something is a little off. When they are vastly out of specs DTCs typically set but in the real world we often have to battle the no code drivability problems due to worn mechanical components or slightly skewed sensors. Start scanning those new engines with complex forced induction systems as they come in for routine service so you'll have your sea legs when a real problem comes into the bay.

As progress marches on, we'll be seeing series turbos become more popular. These systems compress, intercool, then compress and intercool some more with dual turbos that are designed to have one handle low-end rpm duties and the other handle the higher rpm duties. In the months and years to come as fuel prices continue to rise, we'll be glad to see our fuel costs decrease as our motor's VE numbers increase. MA

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THE DVOM VS. THE DSO

MAKING THE RIGHT CHOICE CAN SAVE YOU TIME AND HEADACHES.

BY **JAIME LAZARUS** | CONTRIBUTING EDITOR

Almost every automotive or truck technician has worked in a flat rate pay environment at one time or another. I am no exception. The idea behind a flat rate pay plan incites us to be the fastest we can be. On that plan, the faster we get the job done, the more money we stand to make. It is this type of remuneration that prompts us to constantly think ahead to what our next move is (while still performing in the present) or suffer the consequences of lower pay for production that's less than optimal. Increasing our income is one good incentive for us to constantly improve our skills so that there is a minimal amount of time wasted when we perform repairs.

Over time, smart technicians learn lots of ways how to save time. For example, we might choose one tool over another, like using an air ratchet instead of a non-powered tool, to decrease the time it takes us to do the job. It is for the very same reason that I'll reach for a Digital Storage Oscilloscope (DSO) instead of a Digital Volt & Ohm Meter (DVOM) when I have to perform certain electrical diagnostic routines. In those cases, the DSO delivers more information to me in a shorter period of time than a DVOM will, thereby enabling me to decrease my diagnostic time and to increase my diagnostic accuracy and productivity.

Now, I won't argue there are times when a DVOM is all I need, and that using a scope during those instances would be more time consuming, be more cumbersome, etc. I admit, there are tasks where employing the use of a scope would be like trying to kill mosquitoes with a cannon. What I will insist though is that I save time when I use a DSO if, for example, I need to use more than just one part of Ohm's law to find a problem, analyze a particular part of a circuit in detail or compare multiple signals at the same time. Let's explore some examples of how a DSO might save us some time.

First, consider a simple one-speed radiator cooling fan circuit that's comprised of a PCM-controlled relay, the fan itself and of course all the wiring that connects the components. The relay has four electrical connections: two for the control side and two for the load side. When the relay is activated, what tests can we perform?

If we were to choose a DVOM, we could read the average of both the control-side voltages (supply and ground) and both of the load-side voltages (supply and feed) on each leg of the relay and we could read the average amperage flowing through each side of the relay if we plug in a current probe. Notice I said the average of those readings; that is important to remem-

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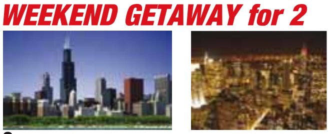

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ber. We also can perform voltage drop tests on all four circuits one at a time. If instead, we chose to use a scope on that radiator fan circuit, we could do all of the same tests. Naturally, the time it would take to perform those tests, whether we used a DVOM or a DSO, would depend on many factors but would be fairly equal.

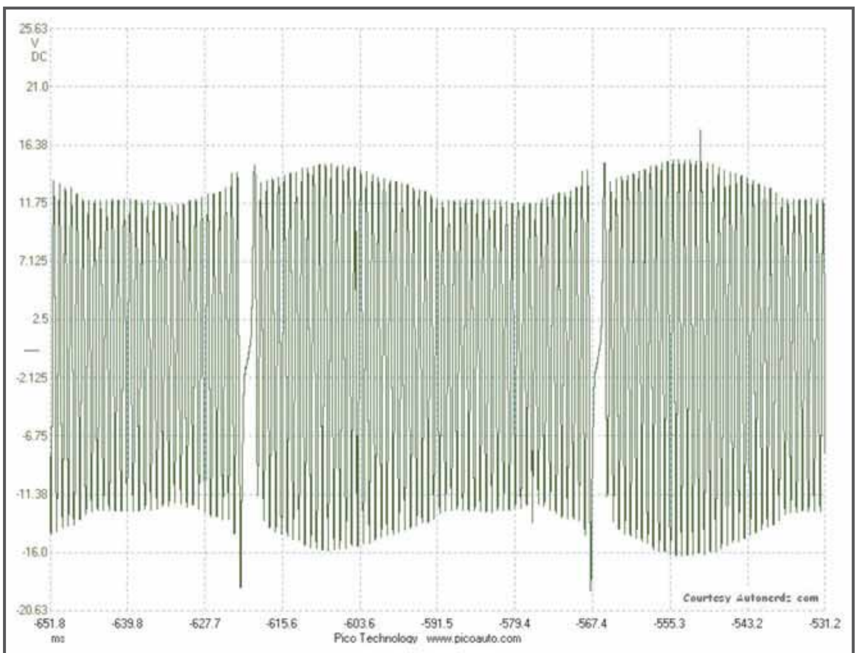
Now here's the exciting part (at least to me it is). If we did decide to use a DSO, we could perform even more tests and not take much more time to do them. For example, if while we are looking at the average amperage of the cooling fan motor and then changed some settings, we could zoom in to inspect the integrity of the armature windings in the motor itself.

If one or more of the armature windings was shorted to ground, shorted to itself or if it had an open circuit, we would be able to see that on the display. But any of those situations could be averaged into the DVOM readout, and you might never know they existed. We can say averaging the readings will mask the problem.

Technical Editor Pete Meier shares basic voltage drop testing procedure using the DMM in this blog.
MotorAge.com/dmmtesting

What can we learn from the in-rush amperage reading of a motor? In-rush amperage can be described as the amount of amperage needed to get an armature rotating. This measurement is an important part of the calculations used to determine the state of health for an electric motor. There are lots of rule-of-thumb specifications I've heard over the years for what is considered acceptable, but the actual specification will differ depending on the application for the motor (radiator cooling fan, starter, whatever) and might vary according to what it is installed on.

In any case, it is nearly impossible to accurately measure the in-rush amperage when we use a DVOM, even when it's set to its most sensitive measuring capability. The inaccuracy is attributed in part to limitations in the sampling rate of the tool, such as at what point the tool takes its samples when compared to when the peak amperage occurred. The way a DVOM averages its samples most likely will result in its maximum reading to display differently each time you try to measure the inrush amperage. By the way, you do know the fastest sampling occurs when selecting the Min/Max function on your DVOM, right? That's just a reminder for those of you who might have forgotten.



A DVOM can tell you if a WSS is outputting a signal, but it would never catch this defective signal (tone ring is damaged). This defect can be the cause of unwanted ABS activation.

Anyway, other tests on this circuit the DSO can do are the load-side relay contact integrity test and the control-side suppression diode test. When the fan relay contacts close, we can measure the time it takes to reach the maximum in-rush of current flow. This time span might be extended, indicating high resistance between the relay contacts. That might be caused by relay contacts that are burned, have carbon deposits or even (and I've seen this) ants between them.

At the time the relay's turned off, a spike is usually seen in the control-side oscilloscope voltage waveform. This spike is induced by the relay's collapsing magnetic field that's created by the energizing of the relay winding. If the suppression diode is faulty or the spikes are severe enough, they can wreak havoc on the computer that controls the relay and sometimes cause anomalies in other systems as well. The symptoms might include stalling, stuttering performance complaints, instrumentation flickering and more. Because the spikes typically last for just a split second, they are elusive to the technician attempting to address those strange customer complaint(s) when using a DVOM. It is almost a certainty that the cause is impossible to find without a DSO.

More Opportunity

There are many more tests a scope can do on this circuit that a DVOM cannot, but you get the idea.

Here's another situation you might be familiar with. Let's consider a simple two-wire permanent magnet generator (PMG) sensor, like a wheel speed sensor. If we're addressing an Antilock Braking System (ABS) complaint, we've been taught to use our DVOM to test the resistance of the windings and if within specifications, measure the AC voltage produced when the wheel is spinning. We can even measure the frequency generated if our meter allows. Lastly, we can compare these readings to the other

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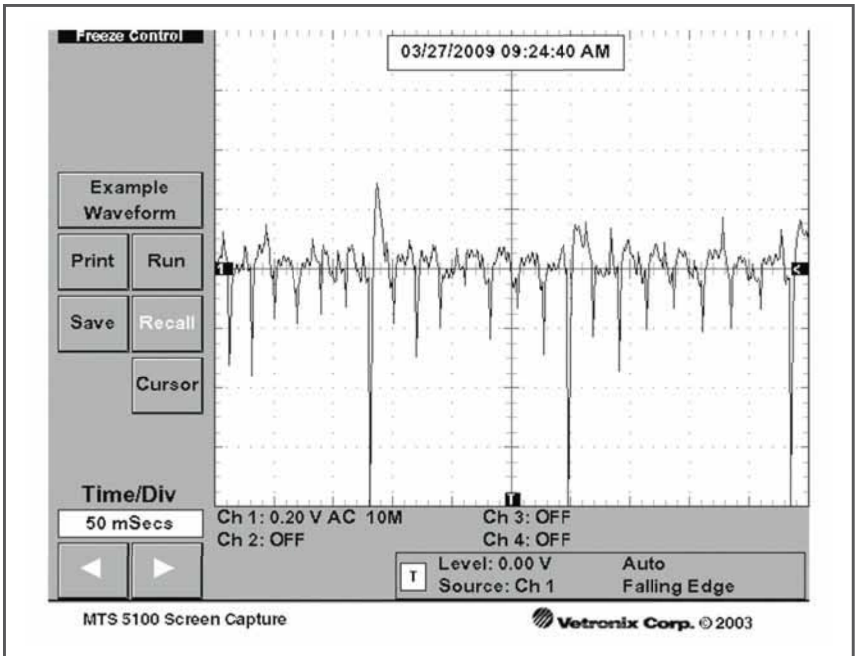
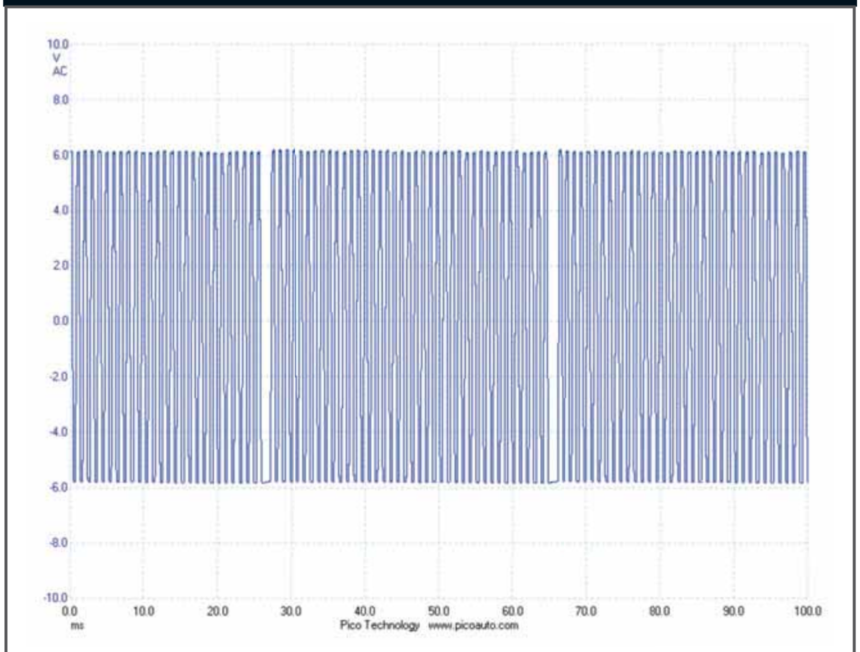


Only a scope allows you to check the electrical health of a fuel pump's windings and catch a problem before the pump actually fails.



Even glitches in magneto-resistive wheel speed sensors can be found using the scope. This sensor's tone ring has a broken tooth.

sensors on the vehicle one at a time, and hope to find a difference. In theory, if all these tests pass then we are to assume the sensor is good (don't we just love to assume?).

Alternatively, we can perform those same tests using almost any DSO (some might require a certain creativity to do so) and get identical test results, but the DSO can give us so much more information. On top of what the DVOM presents, we can see if there are any reluctor teeth missing while we measure the AC voltage simply by adjusting our settings to closely examine each pulse that gets generated by a reluctor tooth passing near the pick-up. Once a full 360-degree tire revolution is displayed on the screen, it becomes obvious where one or more pulses have not been generated as expected (missing tooth). A missing tooth can be interpreted by the ABS as a skid or wheel lock.

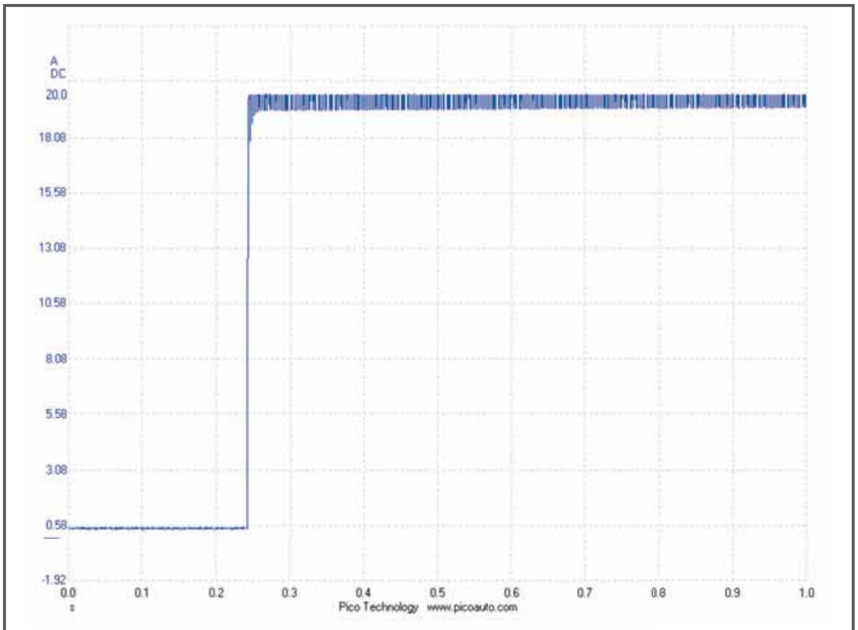
We also can see if the sensor is close enough to the reluctor. In most instances where permanent magnet generators are used as sensors, the proximity to the reluctor is important. It becomes obvious when rust build-up on the sensor mounting surface has distorted how the sensor is positioned in relation to the reluctor when using a DSO. When positioned further away from the reluctor (or off-center), it won't produce as much AC voltage as the other sensors. If so, it may be too low a voltage at slower speeds, meaning too weak a signal, to rely on for ABS decision making. Therefore, the weaker signal may not meet the ABS electronic control unit's acceptable threshold value when comparing it to the other sensors and set a code. This might also result in an unintended ABS activation at slower speeds complaint. It's not because the particular wheel speed sensor's signal has been dramatically affected by the change, but when comparing its signal to the others on that vehicle, the amplitude generated is far less than all the rest.

If we were to drive the vehicle in a straight direction while displaying all of the wheel speed sensors on our scope screen, we could compare them to one another. Theoretically, because all our wheel and tire combinations are the same then all four will rotate at the same speed and our wheel speed sensors should all produce the same signal.

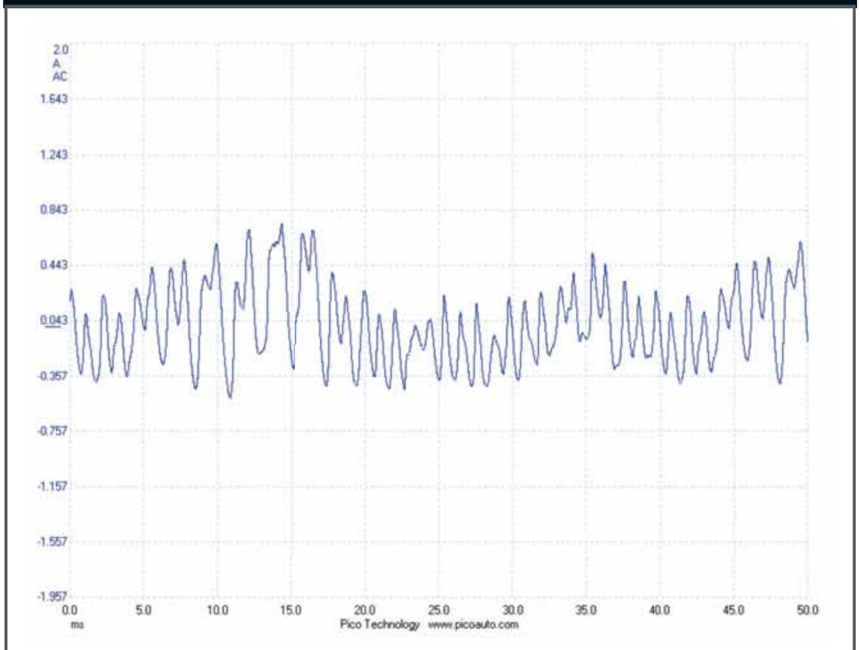
If for some reason one is not like the others (like the replacement CV axle having a different number of reluctor teeth) it will be readily evident by its pattern not matching the others. This situation usually results in an ABS Diagnostic Trouble Code (DTC) that when following the chart, most likely will lead to unnecessarily replacing components (read: wasted time). The fact is, we can compare this sensor to the others on the vehicle – at the same time – to see if its signal is the same or not when we use an oscilloscope, but can't if we're using a DVOM.

Here I have described many tests that can be done on two very simple and very common circuits. Can you imagine what can be done on more complex systems?

Do you ever do repairs on vehicles that came from other shops? I do and some of them are body shops. It's common for me to diagnose damaged sensors that look perfectly fine on the outside. Sometimes they will pass all the criteria when tested using a DVOM, but their signal will be faulty when examined with an oscilloscope. The damage that isn't obvious can be observed when driven. Like, we can see if a tone ring (reluctor) is bent or misshaped by the pattern increasing and decreasing as the wheel spins. It's the not-so-obvious stuff that becomes obvious when we use a scope.



Like graphing scan data to see anomalies, a scope can be used to "graph" an electrical input to do the same thing.



Sometimes cooling fans don't come on when they are supposed to. Checking the health of the motor using a scope may provide the clues you need to determine why.

I promised not to present any exotic examples, so I won't take this opportunity to delve into the two-wire Digital Wheel Speed Sensors (Magneto-Resistive) and how a bad wheel bearing may affect its signal. I'm sure though, that I just planted a seed.

What about the wiring repairs you've seen? Sometimes folks can get pretty creative when it comes to their definition of wiring repair. When it comes to PMG sensors, it becomes much more important to follow proper repair procedures and proper routing. I remember being called into a shop for a "stalls over 20 mph" complaint after an "off-road experience" (that's how it was described to me). This Buick LeSabre's Vehicle Speed Sensor harness had been repaired and re-routed in such a way the ignition system influenced the signal (even while sitting still). By the time the vehicle reached 20 mph, the scanner showed vehicle speeds of 123 mph. When that happened the PCM then governed the engine down just as its programming told it to.

Could a DVOM have found the cause? Yes, I believe in this case it could have. After what's been written in this article and if approached with this scenario, would you have grabbed your oscilloscope or your DVOM first?

I feel the DVOM can't give us many of the test results that a DSO can, doesn't report complete system integrity without performing time-consuming component-level tests and sometimes masks its results leading us to waste our time. Remember, having worked flat rate during most of my career, I want to get the most information in the shortest period of time so that the job gets done quicker; so that I get the car out, get the next one in and make a living.

So what if a few mosquitoes get harmed in the meantime? MA

JAMIE LAZARUS
CONTRIBUTING EDITOR

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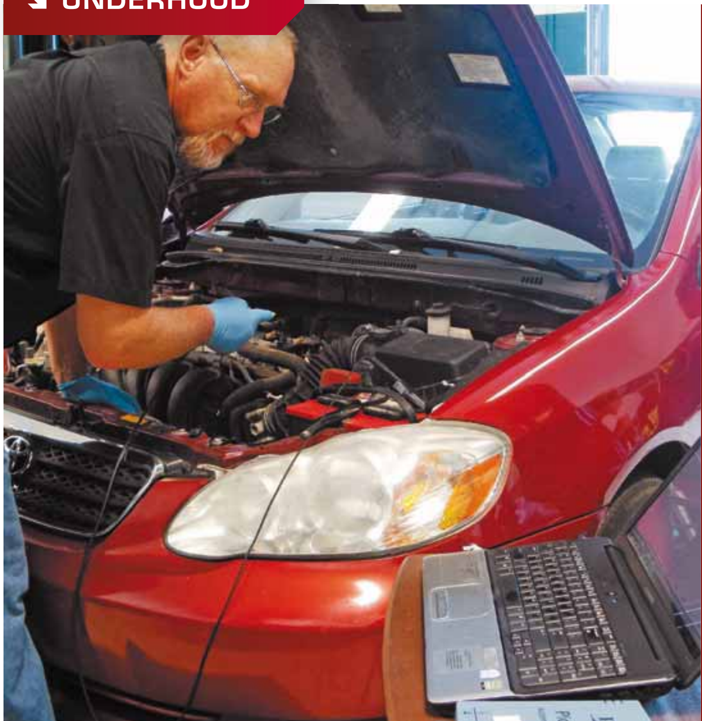

INTRODUCTION TO IN-CYLINDER PRESSURE TESTING

Ever wish you could see inside a running cylinder? Now you can with this testing method.

THIS EXCITING DIAGNOSTIC METHOD OPENS NEW POSSIBILITIES IN DRIVABILITY TROUBLESHOOTING.

BY **BERNIE THOMPSON** | CONTRIBUTING EDITOR

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Every decade or so, a new automotive technology is discovered that is game-changing. The use of pressure transducers in automotive service bays is one of the most exciting discoveries of the 21st century.

They can check engines, transmissions, power steering, brake systems, EVAP systems and A/C systems. These transducers measure physical pressure changes and convert these changes to an electrical output signal. Pressure transducers need a power source and ground source, and they will produce a voltage signal that is proportional to the physical quantity applied. An oscilloscope is used to display and analyze the signal output produced from the pressure transducer by graphing the pressure changes over time, thereby identifying changes that occur within the system.

Pressure transducers allow the tech to see the inner workings of the internal combustion engine without disassembly. In order to check the spark ignition internal combustion engine, three pressure transducers are used: one in the cylinder, one in the intake and one in the exhaust. To place the one in the cylinder, remove the spark plug from the cylinder head (ground the spark), then install a compression test hose with the one-way check valve removed. Place a 300 psi transducer on the compression hose. The -30 Hg vacuum transducer on the intake manifold will be centrally located on the vacuum port close to the throttle body.

Place the exhaust 25 inch/H_20 transducer hose in the end of the tailpipe. With these transducers in place, the engine will be operated in three modes: crank no start, idle, snap throttle and each of these engine operating conditions will produce different pressure waveforms on the oscilloscope and will use different techniques to diagnose them with.

The engine under these three operating conditions can be checked for camshaft to crankshaft timing problems, variable camshaft timing problems, intake and exhaust valve sealing problems (both consistent or intermittent), valve spring problems, piston ring sealing problems, worn camshaft lobes, restricted exhaust problems, ignition timing problems or cylinder misfire identification.

Let us analyze the idle compression waveform as seen in Figures 1 and 2 on subsequent pages. Figure 1 is a camshaft chart with the compression waveform overlaid on the cam card. Figure 2 is a basic compression waveform produced at closed throttle at low rpm. The large pink lines divide the compression waveform into 180-degree divisions of crankshaft rotation or the strokes (intake, compression, power, exhaust) of the engine, and the small pink lines divide the crankshaft rotation into 30-degree divisions as seen in Figure 2.

Photo: Pete Meier

The large pink line in the middle of Figure 2 represents when the piston is at 360 degrees of crankshaft rotation at Top Dead Center (TDC). The intake valve opens just before this point. The crankshaft is in rotation, so the piston is in motion; the piston moving away from the cylinder head increasing the volume within the cylinder. This, in turn, creates a low-pressure area contained within the cylinder, which pulls a negative pressure (vacuum) against the closed throttle plate. This reduction in pressure can be seen from G, which is atmospheric pressure to I, which is negative pressure.

This drop in pressure should start at the TDC point and fall rapidly to I, and this pressure change should occur before the two small pink markers after TDC or 60 degree after TDC. I indicates the lowest pressure obtained during the intake stroke, whereas J indicates the average pressure during the intake stroke. The intake duration is from G to K, but note that K occurs after the intake stroke ends at the Bottom Dead Center (BDC) mark. The intake pressure stays low after the BDC mark occurs even through the piston is in an upward movement.

Because the intake manifold has volume under low pressure, the intake manifold acts as an accumulator storing negative pressure. As long as the intake valve is open, it is exposed to this low-pressure area contained within the intake manifold. This accumulator effect stabilizes the low pressure area in the cylinder,which keeps the low pressure in the cylinder even with the upward rising piston. When the intake valve closes, the pressure will start to rise, which occurs at K. The intake valve should close at 40 to 60 degrees after the BDC mark.

The piston is now in an upward movement in the cylinder and both valves, intake and exhaust, are closed. The volume contained within the cylinder is now trapped. The crankshaft is rotating and thus is moving the piston toward the cylinder head. As the piston comes closer to the cylinder head, the area within the cylinder is diminished. This reduction in cylinder area creates less space for the volume contained within the cylinder; this in turn increases the pressure within the cylinder.

Peak pressure occurs where the piston comes as close to the cylinder head as mechanically possible. This is the compression TDC point (A). Peak pressure at A can identify the TDC position for such things as checking the ignition timing or injector timing, and checking the crankshaft or camshaft position sensor.

Sixty to 70 percent of the compression pressure within the cylinder is created within the last 30 degrees of crankshaft rotation before TDC (BTDC) during which time the piston slows down and stops, though momentarily, at the TDC point. Although the piston velocity is slow, the pressure is rising due to a decrease in the area contained above the piston crown.

Because the volume contained within the cylinder works against the area contained within the cylinder, any volume loss due to cylinder leakage during the compression stroke will affect the peak pressure within the cylinder. It is important to check the peak pressure points over multiple cylinder cycles as they should be the same. If one peak is high and the next peak is low by just a few pounds (PSI), and then the next peak is high again, the cylinder is leaking. The air flow into the cylinder cannot change fast enough to allow a high/low/high

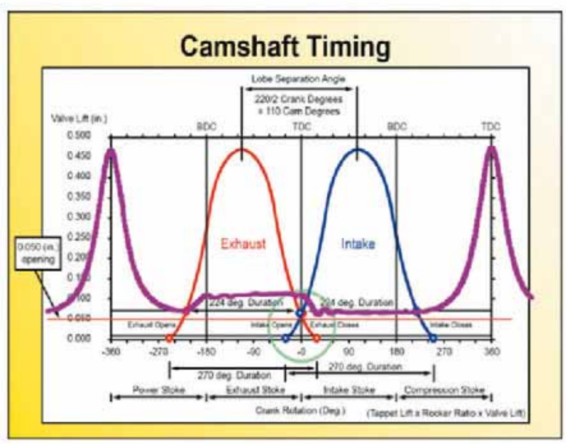

Figure 1 — Here, the in-cylinder pressure pattern is overlaid on a cam spec sheet to illustrate how the pattern changes through the 720° combustion cycle.

pressure change. This is due to a volume change or leakage problem within the cylinder.

Because the crankshaft is in rotational motion, the connecting rod pulls the piston downward. The downward movement of the piston allows the area between the cylinder head and piston to increase, thus the cylinder pressure decreases. Because there is no spark present within the cylinder (the spark plug is removed), this stroke is not the power stroke but instead is a decompression stroke. The compression tower has an upward ramp and a downward ramp, if the tower is measured from K to A and the pressure is divided in half there is a point on both sides of the tower that represent the point of half mast. Half mast is identified by B and M.

These points will be measured in crankshaft degrees to the TDC mark, and must be within 20 degrees of one another. If the compression tower has more than a 20-degree differential between the rising and falling ramps, there is a mechanical failure.

When this occurs, one side of the compression tower will have more space between the ramp and the TDC mark compared to the other ramp and the TDC mark. The piston continues its downward movement and at 90 degree after TDC the waveform has returned to a negative pressure state (point C). The piston continues downward increasing the area within the cylinder and the compression waveform also continues downward to a point D; this is the point where the exhaust valve opens. There should be a clear point of definition at point D that indicates the valve seal is intact.

The point at D should look like clones cycle to cycle with very little change occurring to the exhaust pocket. If point D is changing cycle to cycle, this is an indication that the valve has a seating problem. In Figure 3, it is clear that none of the exhaust pockets look alike and therefore indicates that there is a valve seating problem. It is important to understand that either valve, intake or exhaust can cause the exhaust pocket to change. Check the intake manifold pressure and

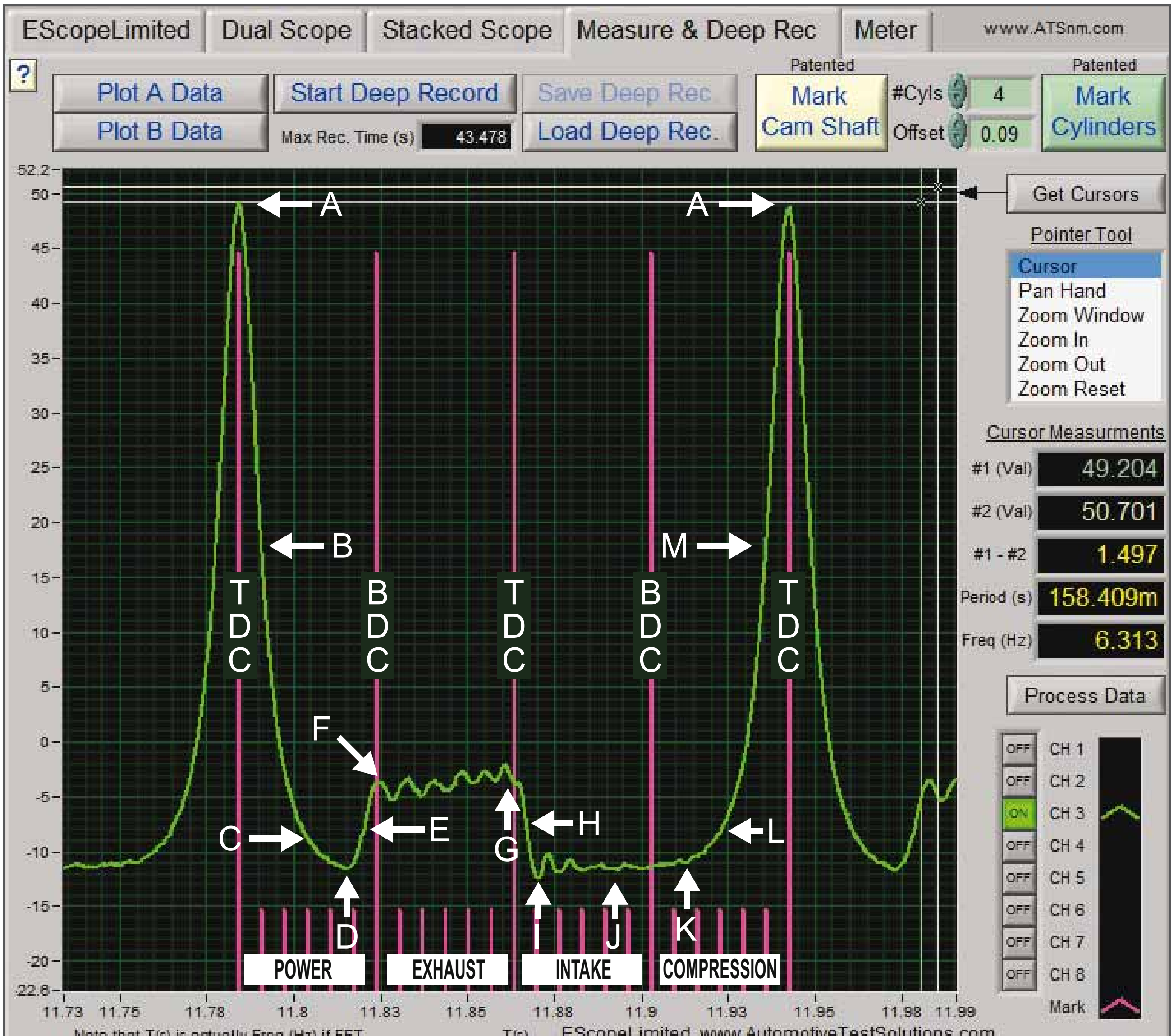

Figure 2 — Each element of this pattern has a story to tell.

Photos: Bernie Thompson

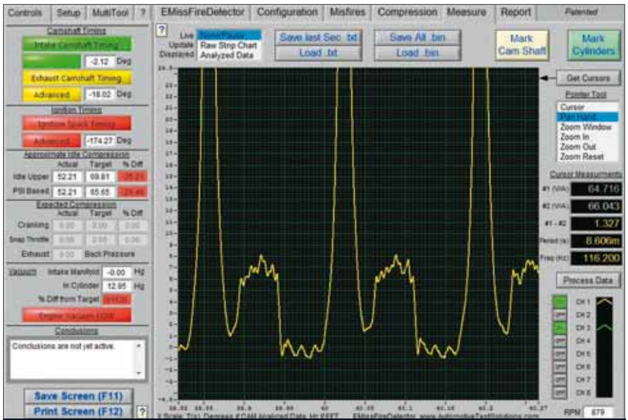

Figure 3 — Notice the changing exhaust pocket. This indicates a valve (either exhaust or intake) sealing issue.

exhaust pressure to determine which valve is not seating properly.

The pressure in the cylinder starts to rise at point D; however, the piston is still moving downward. It would seem that because the piston is moving downward and increasing the area within the cylinder that there would be a corresponding decrease in pressure. The exhaust pressure is near atmospheric pressure and the pressure in the cylinder is in a negative state. A high-pressure area moves to a low-pressure area, so the exhaust pressure rushes into the cylinder as soon as the exhaust valves opens.

This pressure rise within the cylinder from D to F is the pressure equalizing to the atmospheric pressure within the exhaust system. Point D is where the exhaust valve opens. This valve opening event should occur at 30 to 50 degrees before BDC (BBDC) and it is used to check camshaft timing. The exhaust ramp from D to F will also be used to check the exhaust camshaft timing.

If the pressure is measured at D and then at F, and this pressure ramp is divided in half (point E), this point should fall on the BDC mark. If the BDC mark falls between E and F, the exhaust cam timing is correct. If the BDC mark falls below E, then the camshaft timing is retarded. If the BDC mark falls to the right of F, the exhaust camshaft timing is advanced.

The BDC mark on newer engines may fall several degrees to the right of F and be timed correctly. It is important to measure the exhaust ramp and find point E and mark it with a vertical cursor. This cursor will now cross the pink grid that represents the crankshaft degrees. On older engines, this cursor should fall between the 15-degree BBDC and the BDC marks. On newer engines, this cursor should fall between the 23-degree BBDC and the 12 degree BBDC marks.

The piston will rise from the BDC mark to the TDC mark. During this time the exhaust valve will be open. As the piston moves upward, the area within the cylinder decreases, creating a higher pressure than the slightly elevated atmospheric pressure within the exhaust. This forces the volume in the cylinder into the exhaust system. The ripples between F and G represent the exhaust pressure resonance within the exhaust system.

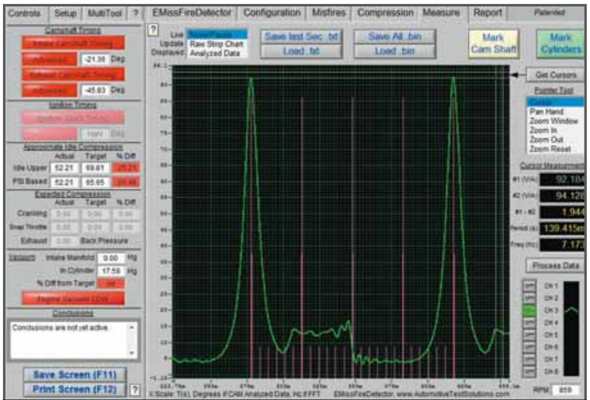

Figure 4 — In this waveform, cam timing is obviously off. Is this cam too far advanced or retarded?

Because the exhaust valve is open, the pressure within the exhaust system can be seen within the cylinder. The area between points D and I is referred to as the exhaust plateau. This plateau is created by the intake manifold vacuum. The intake stroke pulls the cylinder into a negative pressure area and the intake valve is then closed, trapping the negative pressure within the cylinder. The piston then moves up compressing the volume within the cylinder to its peak pressure, and then moves down decompressing the volume within the cylinder.

At the point the piston returns to the same position within the cylinder as it was when the intake valve closed, the pressure within the cylinder will return to the same pressure as it was when the intake valve closed, which is negative (vacuum). Because the intake stroke changed the cylinder pressure to a vacuum relative to the exhaust pressure and the exhaust valve opened when the cylinder returned to the same point and then rises back to the exhaust pressure, the exhaust plateau is created by vacuum. The points D and I should be the same. If D is lower than I, the cylinder is leaking volume. If D is slightly higher than I at about 2 psi or less, the cylinder leakage is OK. If this is greater than 2 psi the cylinder is leaking volume.

The intake ramp will be used to check the intake camshaft timing. Because the intake valve will need to open in order for the intake pressure to drop rapidly, the intake valve opening can be calculated using the intake ramp, which is G to I. If the pressure is measured at G and then at I and this pressure ramp is divided in half (this point shown at point H), this point should fall 20 degrees after the TDC mark. The intake camshaft timing is correct if the 20 degrees after the TDC mark falls within ±5 degrees of H. If the 20 degrees after the TDC mark falls below the H mark, the camshaft timing is advanced. If the 20 degrees after the TDC mark falls to the right of the H mark, the exhaust camshaft timing is retarded.

On newer engines with variable camshaft timing (VVT) on the intake cam, the 20 degrees after the TDC mark will be adjusted to 30 degrees after the TDC mark. It will be important to measure the intake ramp and find point H, then mark point H with a vertical cursor. This cursor will now cross the pink grid that represents the crankshaft degrees. On older engines this cursor should fall between 10 and 20 degrees after TDC. On newer engines this cursor should fall between 20 and 30 degrees ATDC. The point at which the intake valve closes can also be used to check intake camshaft timing. This point is marked as K, and should occur between 40 and 60 degrees after BDC.

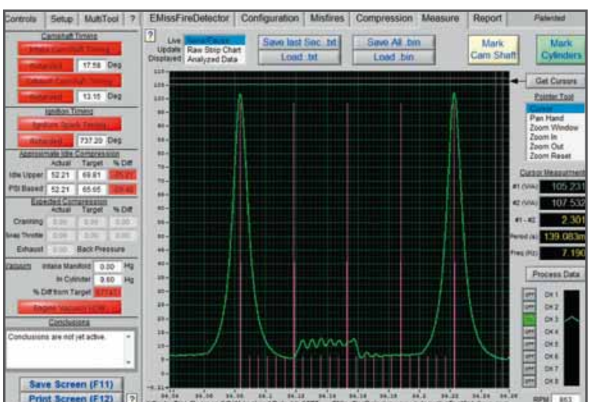

Figure 5 — This waveform also shows a cam that Is timed improperly. Can you think of how you could use this method to check the operation of a VVT system?

Now let's look at Figures 4 and 5, which are camshaft to crankshaft timing problems. We will first analyze Figure 4 in which it is quite easy to see that the compression waveform is not like Figure 2. Let's start with the location of the exhaust pocket. In Figure 2, the exhaust pocket is located at 35 degrees before BDC whereas in Figure 4, the exhaust pocket is at 65 degrees before BDC. Next the exhaust ramp at E in Figure 2 is at 12 degrees before BDC, and in Figure 4 the exhaust ramp at what would be E is located at 45 degrees before BDC. On the intake ramp in Figure 2, H is located at 18 degrees after TDC, and in Figure 4 the intake ramp at what would be H is located at TDC. The intake valve closes in Figure 2 at 45 degrees after BDC, in Figure 4 the intake valve closes at 30 degrees after BDC. Whether you look at the exhaust cam or intake cam, it is quite apparent that this camshaft is advanced.

In Figure 5 again you can see the compression waveform is not like Figure 2. In Figure 2, the exhaust pocket is at 35 degrees before BDC and in Figure 5, the exhaust pocket is at 0 degrees TDC. Next, the exhaust ramp at E in Figure 2 is at 12 degrees before BDC, in Figure 5 the exhaust ramp at what would be E is located at 13 degrees after BDC.

On the intake ramp in Figure 2, the point at H is at 18 degrees after TDC, in Figure 5 the intake ramp at what would be H is located at 35 degrees after TDC. In Figure 2, the point at G is located just before the TDC mark whereas in Figure 5 this point is at 25 degrees after TDC. The intake valve closes in Figure 2 at 45 degrees after BDC; however, in Figure 5 the intake valve closes at 70 degrees after BDC. Whether you look at the exhaust cam or intake cam, it is quite apparent that this camshaft is retarded. MA

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THANKING THE TURBOCHARGER

The pickup version of the Ford 6.7 liter Power Stroke diesel uses the Honeywell VNT DualBoost turbocharger. This view shows the main air inlet (bottom), the high speed air inlet (top) and the turbo outlet (at right).

DIESEL ENGINES ARE PERFORMING BETTER THAN EVER, AND ONLY LOOK TO GET EVEN BETTER.

BY **TONY MARTIN** | CONTRIBUTING EDITOR

EDITOR'S NOTE: The following article ran earlier in 2013, but was trimmed due to space. It follows in its entirety.

The diesel engine would be a shadow of its current self if it weren't for the turbocharger. Having said that, when was the last time you saw a new diesel that didn't have a turbocharger? Aside from small tractor engines and the like, the naturally-aspirated (non turbo) diesel has pretty much gone the way of the dodo.

This makes sense, because the turbocharger has made the diesel engine better in virtually every respect. Diesels are now more efficient, produce more torque and horsepower, and have much cleaner emissions than ever before. While a host of technologies have been utilized to make this happen, a good deal of the credit has to go to the turbocharger.

Diesel engines have gotten better over time, and an evolution in turbocharger technology has enabled this. Early turbos were limited in their capabilities, and these shortcomings had a proportional negative effect on diesel engine performance. The diesel turbocharger of today is capable of performing across a much broader engine speed and load range, yielding tremendous efficiency and emissions benefits. And we can expect even more from our diesel powertrains as new generations of turbocharger technology are introduced.

Turbochargers are relatively simple machines and are very reliable overall. But like everything else, things can and do go wrong, and automotive service professionals are called on to make them right again. Even if you only work on gasoline engines, turbochargers are becoming more common and you will need to become familiar with them. Let's start by looking at basic turbocharger operation.

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Laws of Physics

A turbocharger is constructed by attaching a turbine to the end of a shaft with a compressor wheel at the opposite end. The turbine is located in the engine exhaust stream, so it sees very high temperatures. This requires the use of materials such as ductile iron for the housing and nickel or titanium alloys for the turbine wheel.

The compressor, on the other hand, operates much cooler because it handles filtered air at ambient temperatures. Thus, the compressor end of the turbocharger typically uses aluminum for both the housing and the compressor wheel. The turbocharger also might incorporate a wastegate, which would allow exhaust gases to bypass the

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Modern diesels rely heavily on turbocharging to increase engine output, reduce emissions and improve overall efficiency.

turbine wheel if boost pressure rises above a certain threshold.

The basic operation of the turbocharger is both simple and elegant. Start by using waste exhaust gases to spin the turbine (at speeds that can exceed 250,000 rpm). This recovered energy is utilized to drive the compressor wheel, which forces fresh air through a charge air cooler (CAC) and into the diesel engine's intake manifold. More air in the combustion chamber means more fuel can be burned, thus producing increased power and torque. Turbocharging benefits diesel engines by:

- Increasing engine power density
- Increasing engine torque at low and medium RPMs
- Increasing fuel economy
- Reducing emissions
- Enhancing DPF regeneration
- Maintaining power at high altitudes.

Of course, it can't be quite that simple. If a turbocharger is sized large enough to work best at peak engine output, it won't work nearly as well at lighter loads where lower exhaust flows are produced. In contrast, a single small turbocharger would respond well at low loads, but would lack capacity for high engine output.

This dynamic doesn't affect engines such as generator sets that run at a steady load and speed. However, automotive diesels operate over a broad range of engine rpms and loads, so a single fixed geometry turbocharger can't meet these requirements.

Another critical issue regarding turbocharger performance is a phenomenon known as "turbocharger lag." When the driver pushes down on the throttle, more fuel is injected into the engine's combustion chamber.

However, turbocharger boost will not increase until the extra fuel creates greater exhaust gas flow. This results in a flat spot (hesitation) as the turbocharger takes time to spool up, and also can cause an increase in black smoke as an overrich mixture occurs. Turbocharger lag gets worse with larger turbo units, which require that much greater exhaust flow to build boost. Clearly, what is needed is a turbocharger package that will provide adequate boost under all engine operating conditions.

There are a number of possible approaches that can be taken to maximize turbocharger performance. However, the real challenge is to do it at the lowest possible cost without increasing vehicle weight, or the space required. This is a tall order, but automotive engineers have come up with some creative ideas to meet these objectives.

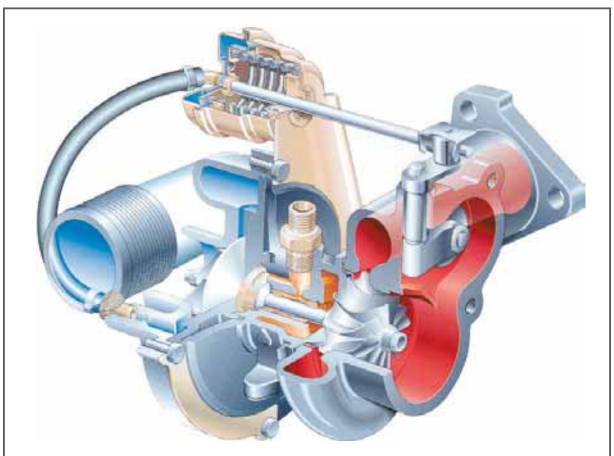
Two-Stage Turbocharging

In terms of pure performance, the best solution is to use multiple (two or three) turbochargers. One such approach that is being used in light-duty diesel engines is two-stage regulated turbocharging, also known as series sequential turbocharging. "Series" means that the output of one turbocharger feeds directly into another; "sequential" is the shifting of work from one turbo to the other depending on the mode of engine operation.

This system is designed to rely on a small turbocharger to provide rapid boost response at lower engine speeds, and then press the large turbo into service as the engine approaches peak output. A familiar example of two-stage regulated turbocharging is the Ford 6.4 liter PowerStroke diesel. This design also is used extensively in late model BMW passenger car diesels.

In two-stage regulated turbocharging, a large turbocharger (known as the low pressure or LP turbo) is used as the first stage of compression. The LP turbo feeds boost air into a smaller turbocharger (known as the high pressure or HP turbo) and then on to the engine intake manifold. Ideally, there also would be CACs located after each turbo to increase air density and maximize boost performance. However, it is more common for a single CAC to be used after the HP turbo.

Exhaust gas flows in the opposite direction from the boost air, flowing first through the smaller HP turbine, and then continuing through the LP turbine. A valve is used to progressively bypass the HP turbine and send exhaust gases directly to the larger LP


Conventional turbochargers use a wastegate to control boost pressure. When boost rises above a specified limit, the wastegate opens and allows exhaust gases to bypass the turbine.

Photos: (TOP) GM; (BOTTOM) Borg Warner

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The Ford 6.4 liter Power Stroke diesel uses series sequential turbocharging. The HP turbo is on the right, and feeds boost air into the variable geometry LP turbo.

turbine as engine output increases. A compressor bypass valve also might be used to short circuit the HP compressor on the air intake side, effectively eliminating the smaller HP turbo at high engine outputs.

The performance advantages of two-stage regulated turbocharging are clear. However, the downsides also are significant, as this approach adds more weight and uses more space under the hood. What about designing a single turbocharger that can adapt to the various engine operating conditions?

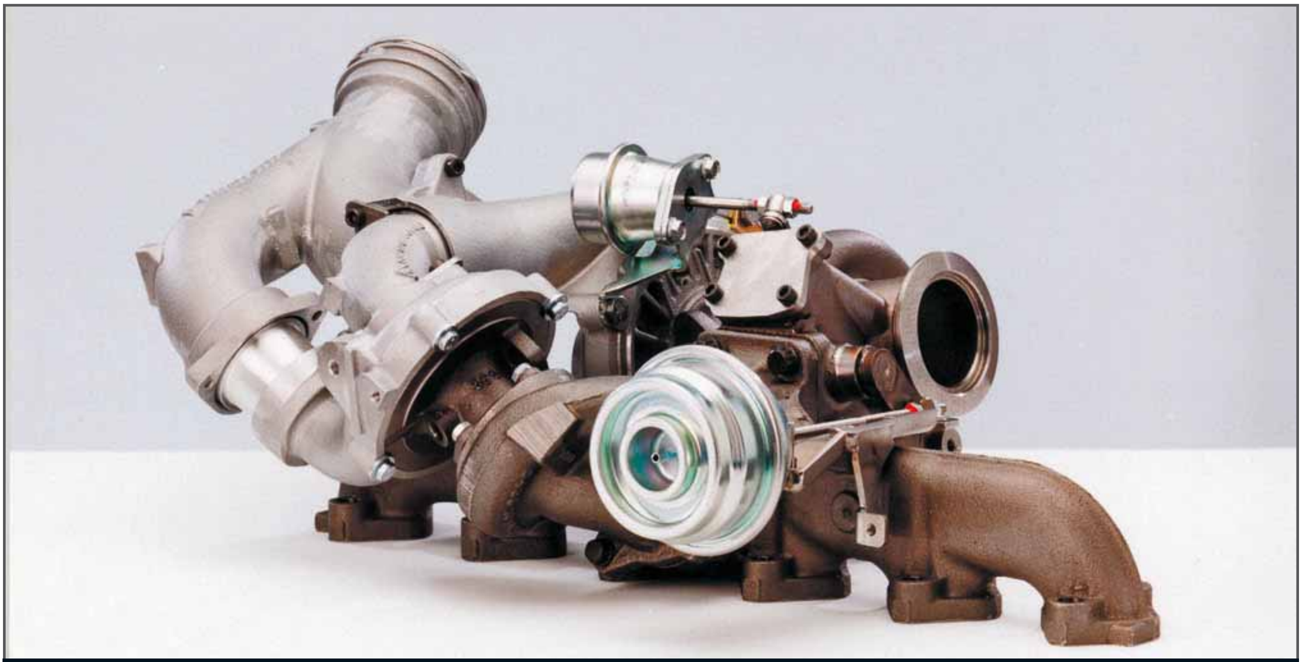
Variable Geometry Turbochargers

Because it isn't always practical to use two turbochargers, another turbocharger design has become mainstream technology. The Variable Geometry Turbocharger (VGT), also known as Variable Turbine Geometry (VTG), has been in use in light-duty diesels for more than 20 years. The basic idea is to modify the turbine section of a large turbocharger so its flow characteristics can be adjusted during engine operation. With this approach, a large turbocharger can operate like a small turbo when a diesel engine is at lower engine speeds and loads.

The most common VGT design uses variable pitch vanes that guide exhaust gases on to the turbine wheel. The vanes, which have a similar profile to an aircraft wing, are located around the circumference of the turbine. The vanes are all connected by a unison ring, which rotates to adjust vane pitch (angle). The PCM is responsible for the operation of the unison ring, and can control it using either a hydraulic or electromechanical actuator.

At light engine loads, there is limited exhaust gas energy to generate boost. When more boost is required, the vanes are rotated to a closed position. This creates a nozzle effect, where high velocity exhaust gas is directed on to the turbine wheel and increases its speed. This generates boost very rapidly, reducing turbo lag.

As engine load rises, exhaust gas flow also increases. If the turbocharger compressor is already running at high speed, this could cause an overboost condition if left unchecked. The turbine vanes are opened progressively, allowing exhaust gases to flow more freely through the turbine section. This reduces the nozzle effect at the vanes, which helps limit turbocharger speed



Two-stage regulated turbocharging uses a small turbo for low-speed response, and a large turbo for high output operation.

Photos: Borg Warner

This is a cutaway of a variable geometry turbocharger showing the unison ring and its connection to the variable vanes around the turbine assembly.

and peak boost pressures. Most VGT turbochargers do not use a wastegate and instead use the variable vanes alone for controlling boost.

VGT turbochargers play a major role in diesel emission control. This plays out in a number of ways, including simple efficiency gains that result in lower fuel consumption. A bigger factor, however, is the enabling of diesel exhaust gas recirculation (EGR) systems. With boost pressure in the engine intake, EGR gases don't flow very well because of a reduced pressure difference between the intake and exhaust manifolds. To overcome this, diesel engine management systems will close the vanes in the VGT turbocharger, which increases exhaust backpressure. Combining this action with closing of an air intake throttle helps increase the pressure difference between the manifolds and EGR gas flow increases.

Another benefit of using a VGT with a diesel engine is the ability to close the vanes to create exhaust backpressure when starting in cold ambient temperatures. This helps warm up the engine more quickly, and retains heat better during engine idling.

Best of Both Worlds

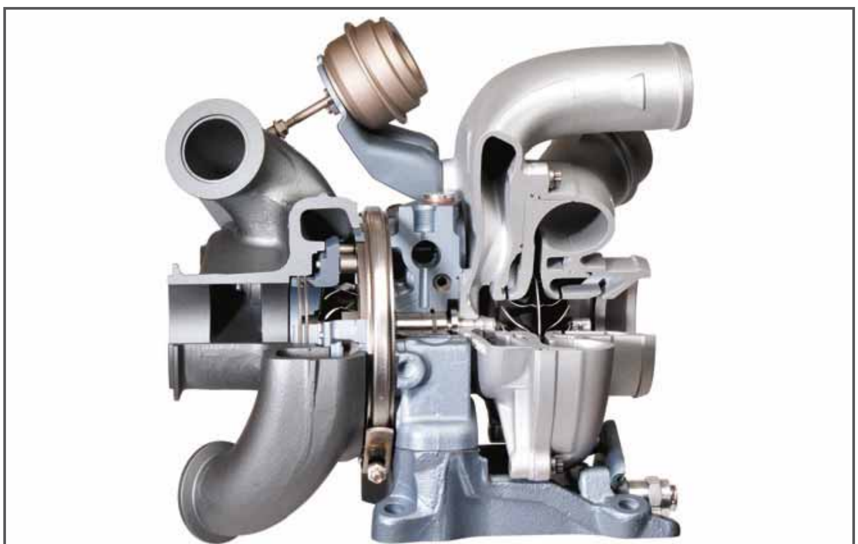
VGT turbochargers cost less and have a smaller footprint than multiple turbocharger systems. However, they do not perform as well either, so (like everything) a compromise is made. This is the job of the engineer, who has to decide what is most important and strike a balance between these competing factors.

It is fun to watch what is happening with the latest turbocharger system designs, because every trick in the book (and some new ones) are being used to push VGT technology closer to multiple turbo performance levels. One area with room for improvement is the mass of the turbocharger rotating element. With a conventional VGT, a large turbocharger with relatively heavy components is built to perform like a small turbocharger when needed. If the mass of the rotating components could be reduced, the VGT would be able to build boost even faster and therefore respond more quickly to changes in engine load. The key is to make it lighter, but still be able to maintain the airflow potential of a large turbocharger.

Honeywell has taken this path in the design of its VNT DualBoost turbocharger, found in the pickup version of the Ford 6.7 liter Powerstroke diesel. VNT stands for Variable Nozzle Turbine, which is Honeywell's version of the VGT. The VNT DualBoost's primary claim to fame is low inertia, meaning that the turbocharger's rotating components have a reduced mass and can accelerate and decelerate much more quickly than a standard VGT.

This was accomplished through the use of a unique compressor wheel with two small impellers mounted back to back. Each impeller has its own separate air inlet, and discharges into a common outlet. The VNT DualBoost is described as a two-stage sequential variable geometry turbocharger, despite the fact that both compressor wheels are driven by a common shaft and operate effectively in parallel.

"This (design) gives the Dualboost its inherent advantage in allowing a lower inertia rotor group while delivering the same air flow capacity of a



Note the VNT DualBoost's unique compressor design and the separate air inlets for each side of the impeller. Both impellers discharge to a common outlet.

Photos: (TOP) Alain Ernoult; (BOTTOM) Honeywell

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13-6

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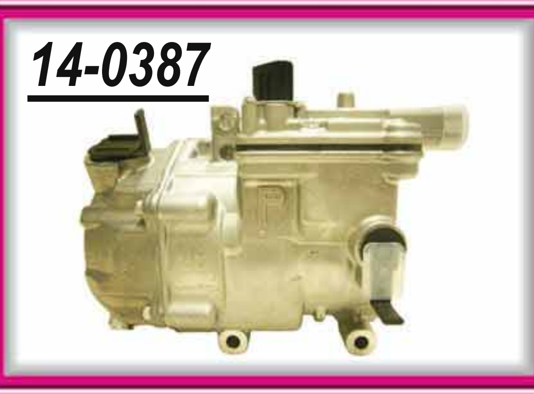

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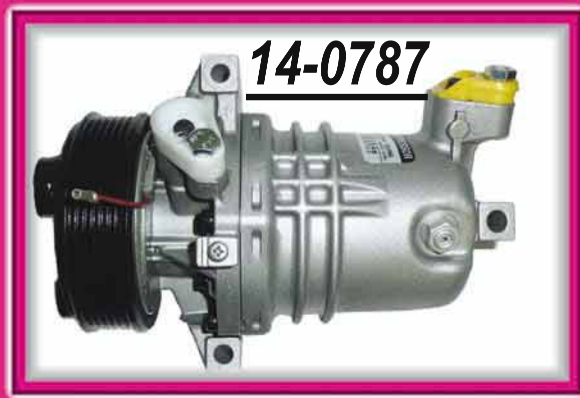

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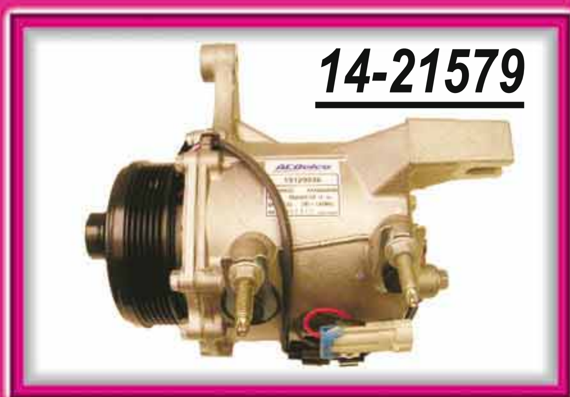

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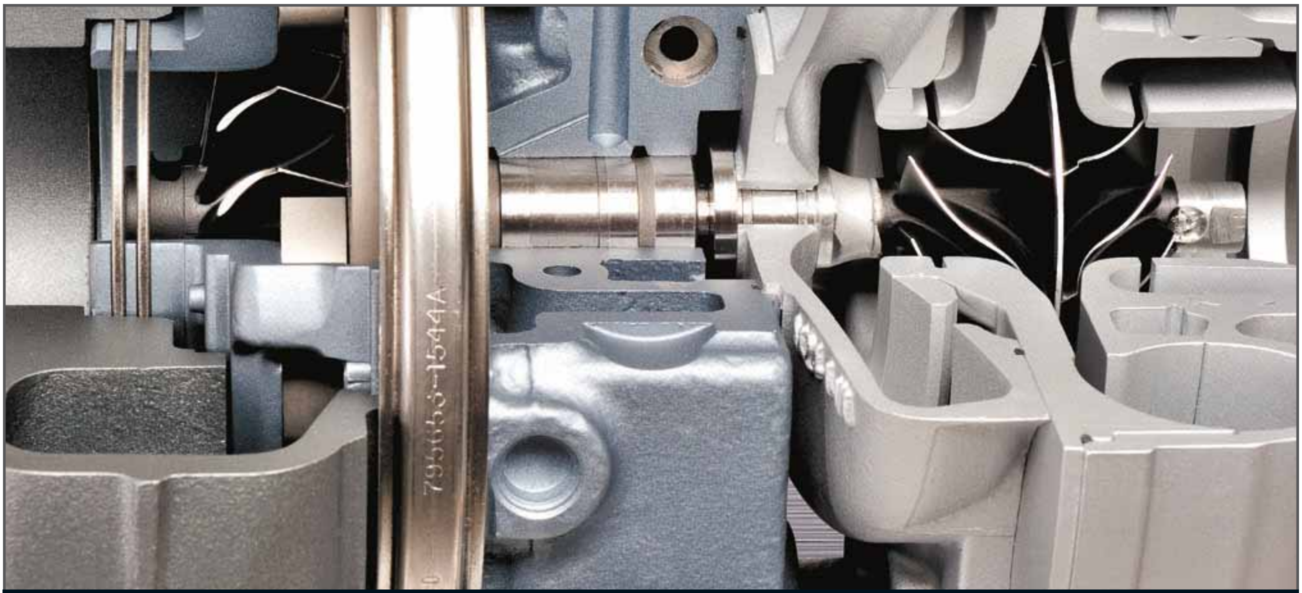

The turbine section of the VNT DualBoost looks like a conventional VGT, except that it also uses a wastegate for more precise boost control.

larger turbocharger," says Geoff Duff, Honeywell Regional Applications Engineering Leader – Americas.

The VNT DualBoost also uses ball bearings instead of conventional sleeve-type bearings to support the rotating element. This reduces mechanical losses and further improves turbocharger response.

The turbine section of the VNT DualBoost looks more like a conventional VGT, but includes a wastegate. The unison ring is hydraulically-actuated, and the vehicle PCM operates a spool valve that controls engine oil pressure on both sides of the actuating piston. When the engine is operating at high boost and rpms are rising rapidly, opening the variable vanes may not be enough to control boost pressure. In these situations, the vacuum-operated wastegate is opened to prevent overboost and possible engine damage. Overall, the wastegate allows for more precise control of turbocharger boost and a high power point.

During engine operation, the outboard impeller receives air through the main air inlet in the compressor housing, much like a conventional turbocharger. The inboard impeller is fed by an alternate passage known as the high speed air inlet. While there are select conditions when airflow will stall on one side of the wheel or the other, the impellers operate in parallel with little difference in their performance. Using two impeller wheels instead of one changes the work/speed relationship of the compressor, which increases the performance of the turbine. This improves on conventional VGT performance and comes close to matching that of two-stage regulated turbocharging.

What Goes Wrong

While turbochargers are designed to last the life of the vehicle, things can and do go wrong. Like the engine itself, a turbocharger can live a long and prosperous life only if it has clean air and clean oil. Make sure to inspect the air inlet system regularly, and repair any problems you encounter right away. Changing oil at the correct intervals and using the best oil and filter you can afford is also good policy.

An illuminated Check Engine (MIL) light will often be your first clue that something is wrong with the turbocharger and/or associated systems. Turbochargers are designed as an integral part of any diesel engine, and are monitored closely by the vehicle onboard diagnostic system. OBD monitors related to the turbocharger include the boost pressure monitor, which is responsible for determining if turbo output is correct for any given engine operating condition. The vehicle's PCM runs regular tests on all emissions-related systems, and will generate diagnostic trouble codes (DTCs) when tests fail. DTCs often will be the starting point for your diagnosis, which also might involve searching TSBs and service information databases such as Identifix or iATN.

In regard to scan tools, it definitely pays to have the most capable unit you can afford. In light-duty diesel repair, the litmus test is what sort of bi-directional testing the scan tool is capable of. As you can imagine, more is better, and generally the best option is the factory scan tool. Better scan tools are also capable of performing air management tests that do a comprehensive check on the turbo, EGR system, etc.

Turbocharger technology continues to evolve, so watch for new designs and know that diesel powertrains will only get better as turbocharger performance improves.

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Photos: Alain Ernoult

CHASING DOWN CAT CODES

This cat has obviously been abused, as witnessed by the molten hunks of substrate inside. Unless the killer is found and repaired, the new cat will soon suffer the same fate.

THE NUMBER ONE CODE TECHS DEAL WITH IS ALSO ONE OF THE MOST MISDIAGNOSED.

BY "G" JERRY TRUGLIA | CONTRIBUTING EDITOR

JUST SCAN IT

Scan this QR Code to watch on your smartphone a presentation on converter do's and don'ts. Or visit MotorAge.com/easternvideo

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The No. 1 codes in the country are the P0420 and P0430 (Catalyst Efficiency Below Threshhold) diagnostic trouble codes. They cover the same problem, with the only difference being to which side of the engine they are referring. But there is more to be considered than the catalytic converters alone. Other key components involved are the O_2 sensor heaters, the O_2 sensors themselves and the Powertrain Control Module (PCM) software that performs the catalytic efficiency testing.

What is catalyst efficiency? The catalytic converter is the last step in cleaning up any dirty gasses left over after combustion. Simply stated, its efficiency is a measure of just how well it can do its job.

Most vehicles (those certified to OBDII) have both a pre-catalytic (upstream) oxygen sensor (or air fuel sensor) and another oxygen sensor located after at least one of the catalytic converters (downstream). Conventional oxygen sensors respond to the amount of oxygen in the exhaust stream and provide feedback to the PCM for fuel control. But the downstream sensor should sense a relatively stable voltage signal.

When this rear sensor voltage zigzags up and down at a steady RPM, it is an indication of a decrease in catalytic efficiency. The PCM programming determines how much zigzagging is acceptable. If the PCM interprets the readings to indicate a catalytic converter failure, a P0420 – P0430 pending Diagnostic Trouble Code (DTC) is first set. If the decreased efficiency still occurs on the next consecutive test, a hard DTC is set and Freeze Frame data Parameter Identifiers (PIDs) are recorded and stored.

Remember, Not Just the Cat

As with any other diagnostic challenge, you must go after the root cause of these codes using a systematic approach. Even if you do determine that the converter has failed, there often is an underlying reason for that failure. Miss that, and the new converter quickly will suffer the same fate as the old one.

An often overlooked, but extremely valuable, source of information is the code's Freeze Frame recording. Even if you own the OE scan tool, you should first make use of the Generic/Global mode of the tool. The reason? Generic/Global does not substitute engine values (PIDS). It also provides access to Freeze Frame data and Mode $06 test

Photos: "G" Jerry Truglia

A borescope can be used to inspect the condition of the substrate. Damaged substrate (broken, clogged, melted) means something killed the cat before its time.

results if needed. The Freeze Frame data is going to be especially helpful to you in diagnosing these DTCs. Be sure you do not erase/clear DTCs, because that also will erase/clear Freeze Frame. Freeze Frame data might help you uncover a sensor value that is out of normal range only under the conditions that were present when the DTC was set.

Remember that Freeze Frame data does not record at the exact moment the fault occurred. It can be in a 15-degree-frame window, meaning what you see in the Freeze Frame might have happened 15 degrees-frame before or 15 degrees-frame after the store screen. It can still be very helpful in duplicating the problem by providing some idea of the conditions the vehicle was under when the problem was discovered.

The next step in diagnosing any problem is in understanding how and why the PCM detected the fault. In most cases, the PCM is comparing the input signal from the upstream oxygen sensor to the input of the downstream sensor. As discussed earlier, the downstream sensor should remain relatively stable. And while an aged cat can cause the rear sensor to swing in synch with the upstream one, it is not the only reason why. And, as mentioned earlier but absolutely worth repeating, if the cat is indeed failed, it is imperative to know why to avoid sealing the fate of the replacement.

Read more on OBDII monitors and how they work in this blog by Pete Meier MotorAge.com/obdiimonitors

After you have read and understood the conditions and criterion of the DTC(s) and before you touch your toolbox, check your service information for any related Technical Service Bulletins (TSBs). In some cases, a software glitch has a reprogramming procedure available or a part has been upgraded. You'll never know unless you look.

Begin your work on the car by performing a good visual inspection. Are there signs the car has been maintained or neglected? Are there any obvious issues that could affect the PCM's testing of the cat?

These are the top 10 causes of catalytic converter efficiency codes and cat failures:

1. Engine mechanical problem
2. Cylinder misfire
3. Exhaust leaks or damage
4. HO_2S / WR (oxygen sensors)
5. Fuel pressure
6. Injector problems
7. Oil contamination
8. Engine coolant temperature (ECT) problems
9. Intake leaks
10. Ignition timing

Photos: Pete Meier

A hose held to the ear is one way to seek exhaust leaks that can cause sensor readings to be off.

General Testing

Every input and output on the vehicle depends on a stable power source and dependable grounds. The first step in your diagnostic strategy, then, is to make sure the battery itself is healthy.

I suggest the first place you start your code-specific diagnosis after the battery's condition is verified is to check the overall engine health. This is accomplished by performing a relative compression test. This is performed easily by using a scan tool (if this option is available) or by using a labscope and high amp clamp. The scan tools perform this test in the 20-second range while the labscope test is completed in two minutes or so. You can see this performed by reviewing a few webcasts that are available on the *Motor Age* or the TST YouTube channels.

Another important piece of information to review very carefully is, both Short Term Fuel Trim (STFT) and Long Term Fuel Trim (LTFT). Fuel trim affects how much fuel the PCM commands the injector to fire. If the upstream oxygen sensor reports that the engine has a lean condition, the PCM increases pulse width to add additional fuel.

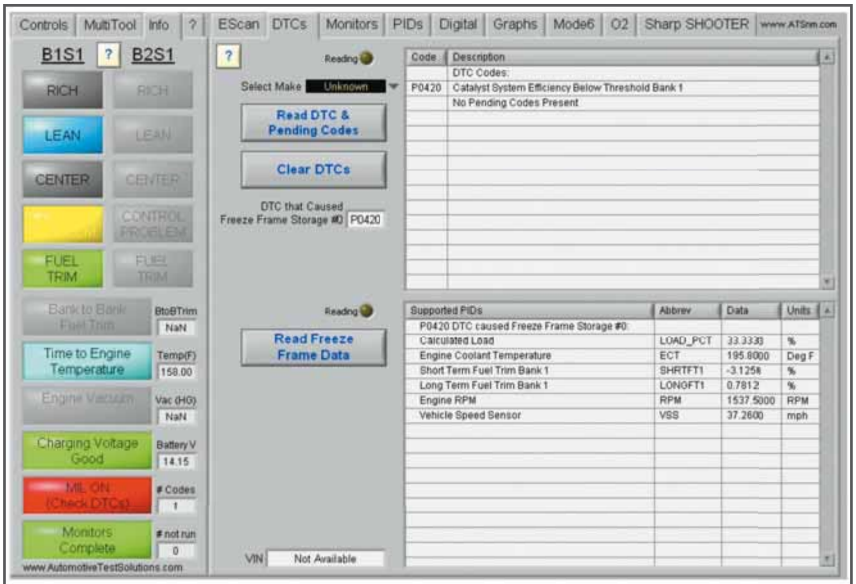
To the contrary, if the sensor reports a rich condition, the PCM shortens the pulse width to reduce the amount of fuel injected. The STFT and LTFT numbers represent the amount of pulse width change, typically as a percentage. Zero is perfect fuel trim. Fuel trim that is positive means that the PCM command is trying to add fuel, and fuel trim that is negative means that the PCM command is trying to remove fuel.

STFT is an immediate response to the air/fuel mix being reported by the oxygen sensors and will move ideally across zero no more than ±10 percent. Personally I prefer to use +6/-6 when I diagnosis a problem vehicle. More shift than that indicates there is a problem somewhere. LTFT is an adaptive response to excesses in the STFT. It doesn't swing across zero on your scan tool data stream like STFT does. Even so, excesses of over ± 10 percent indicates a problem and depending on make, a more than ±15 percent variance will set a System Lean/Rich DTC on most vehicles.

Understanding fuel trims and what they are trying to tell you is a learned skill that will save you time and effort on many drivability problems. For example, a Ford diagnostic flow chart for this code says that after confirming there are no other DTCs (an important step, to be sure), you should look at the O_2 sensor wiring and then check fuel pressure. However, if we use a little common sense, if we are getting good O_2 sensor and fuel trim readings on our scan tool, why would we perform these tests?

Air leaking upstream of or at the upstream sensor can cause the sensor to read a false lean condition.

Photos: Pete Meier



Checking Global OBDII for data and Freeze Frame is an important step in any drivability diagnosis.

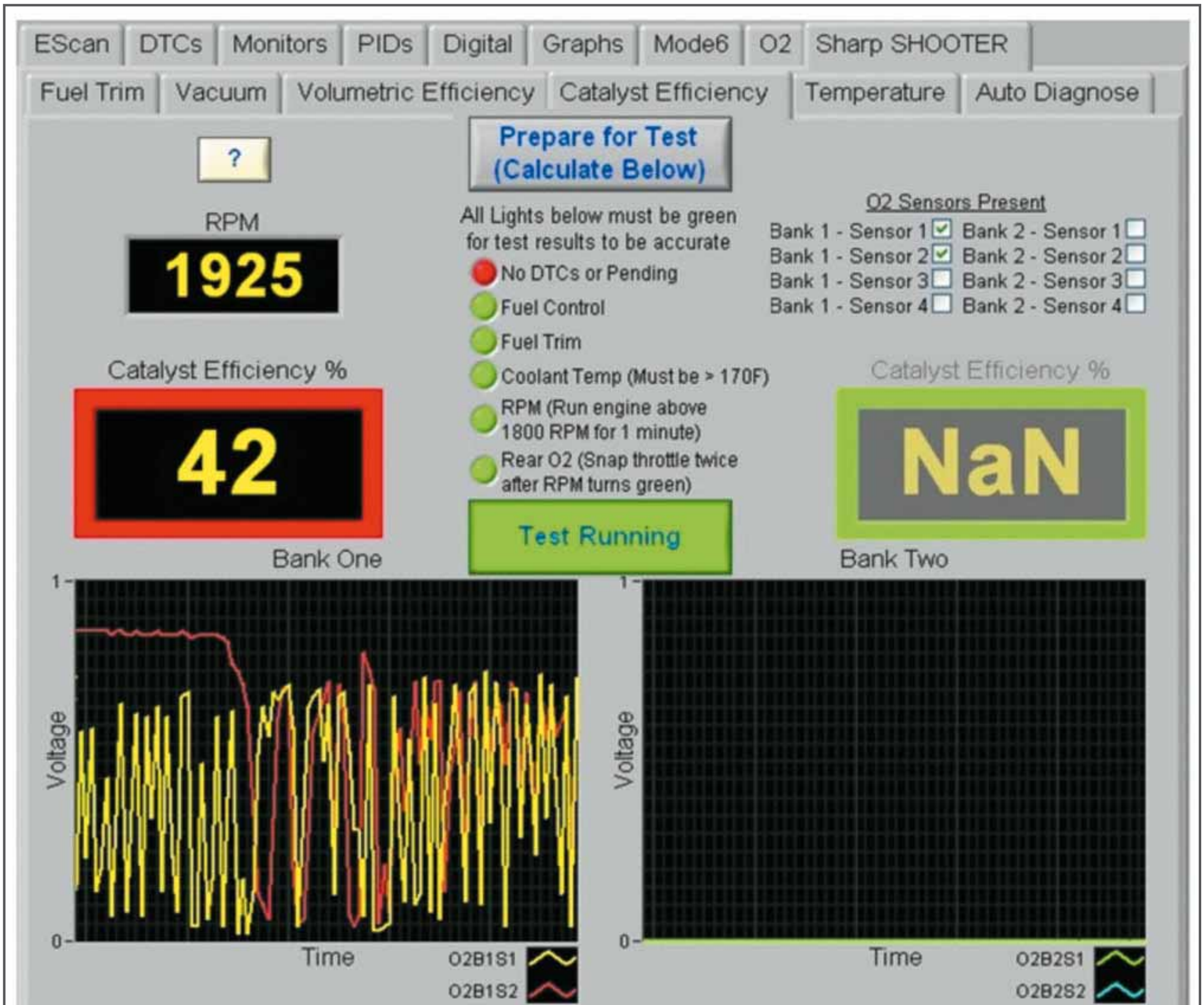
Don't work hard, work smart. Remember that the most important tools are what God gave us: the brain, eyes, ears, nose and hands. So take a good visual look at the vehicle, look up TSBs and check out PID data carefully before ever following a trouble tree.

Some Case Study Examples

This one was a quick fix. Using the search function on our service information system, we looked up the specifics on the P0420 DTC on a 2001 Nissan Frontier. The search also provided us a TSB that informed us that when the catalytic converter was verified as OK, the repair was something other than replacing parts. This is not uncommon. I have seen plenty of vehicles where a new converter was installed blindly but the P0420 problem still was present or the onboard monitor responsible for keeping an eye on the cat would not complete its testing. These techs could have avoided a lot of frustration had they taken the time to look up the TSB

This Mode $06 screen shows questionable results. Aging oxygen sensors can provide slow feedback that may impact cat testing results.

Photos: Pete Meier; "G" Jerry Truglia



The ATS EScan allows a bay test that mimics the ECM's own catalytic efficiency monitor.

advising that a reflash was required for false codes.

The next case study brings together all the basic knowledge of conventional oxygen sensors and Air-Fuel Sensors (AFS) that any tech should already know. This 2004 Nissan Altima 2.5L had a P0420 after some unrelated work had been done to it. The car was kept up with well and had only about 90,000 miles on the odometer. At this relatively low mileage, I suspected something more than just a faulty cat.

I looked up TSBs after performing the basic checks and found that the PCM might need to be reprogrammed. However, after checking the calibration codes of the car's PCM, I determined that the PCM had the most up-to-date software already installed.

I used an exhaust gas analyzer to check the emission readings at the tailpipe. Interesting! They looked clean and correct. But that was in direct opposition to what the onboard test results were. I began to suspect a bad sensor, exhaust leak, worn converter or a bad PCM. After all, the onboard emissions analyzer on this car is the AFS and the downstream oxygen sensor, and they found that something was amiss with the converter.

The PIDs reflected that what the sensors were sensing was bad. Also, using bi-directional controls to make the fuel mixture richer and leaner, the sensors acted normally. So, how was it that the sensors were good, the emission analyzer measurements were good, but the PCM thinks the cat is bad? Perhaps an exhaust leak was throwing off the sensors, but a smoke machine found none.

I now performed a simple test that should have been performed after my initial test. I took a look at Enhanced OBDII data on my scan tool and looked up the proper voltage for AFS sensors on Nissans. Nissan AFS sensors should be at 1.47 volts. I measured the vehicle at 1.50 volts. So, the AFS sensor was not the problem, since it was in the proper range.

Graphing the sensors told me the story and led me to the repair. There are two catalytic converters on this car. The downstream oxygen sensor on this vehicle was located after the first cat, but before the second cat. An exhaust gas analyzer would not find

Photos: Pete Meier; "G" Jerry Truglia

the problem while a functional HO_2S would. That's why the post-cat HO_2S sensor is zigzagging when it should be straight — the front catalytic converter needs to be replaced. Nissan recommends replacing both should one fail, and they are sold only as a pair.

On to a 2004 Toyota Camry. On this car, I took advantage of the Catalyst Efficient test incorporated into the ATS EScan scan tool. The first one, tested at idle, passed with 99 percent efficiency. The second test was performed at cruising rpm and failed with a 42 percent efficiency. The lesson here is using Freeze Frame data to see when the fail occurred. I have repaired vehicles where the test failed at idle and passed at a higher rpm. Always take a look at the Freeze Frame data. In the case of this Toyota, Freeze Frame definitely revealed that the problem was off idle with recorded PIDs showing a 50 percent load on a warm engine running at 72 mph at 2,709 rpms.

The fix for this vehicle was to reprogram the PCM (per TSB, see how looking this stuff up pays off) and run a couple of cans of Run Rite fuel system cleaner through the system. Yes, I have had success restoring some life into catalytic converters using this method. The cleaner helped clean up the converter and got this vehicle back on the road. A word of caution, though. Sometimes, engines that are severely carboned will spew chunks of carbon out during the cleaning process, especially when done improperly. This actually can lead to blockage of the cat's substrate and/or damage to it.

Our next and last vehicle came in with another P0420 DTC that was caused by a vehicle that was in desperate need of maintenance. As previously stated, there are 10 top causes for this DTC, and this one could have been avoided if the owner had maintained the vehicle. The problem with this 2000 Honda Civic was that the ignition system was in very poor shape and caused the converter to load up with fuel causing it to deteriorate. After running a Catalytic Efficiency test and Mode 6 data it confirmed that this converter was really bad and most likely could not be saved by just performing a tune up and fuel system cleaning.

After the tune up was performed the engine was running good, I tested again but the results from both the efficiency and Mode 6 test were still bad. I appreciated being called in to check this vehicle out as it makes a good case study. I had the tech remove both the front and rear O_2 sensors so I could install my video scope to take a look at the converter. The picture from the upstream O_2 sensor revealed the substrate was in poor shape but the back O_2 sensor revealed that it was over for this converter. This converter had to be replaced.

A Few Words Of Note

In many cases, repairing a catalytic efficiency code will require cat replacement. Before you do, though, take the time to inspect the condition of the old cat's substrate. Blocked, broken, or melted substrate is a sure sign the cat didn't fail of old age alone. It is vitally important that you check that "top 10" list and find the culprit responsible for its early demise.

Another common mistake is choosing a cheap replacement cat. The problem is that when a poor quality converter is installed, the Malfunction Indicator Lamp (MIL) might return. That's because the quality of the substrate might not be sufficient to meet the normal requirements of the engine and soon are unable to meet the PCM's standards. Be sure to use a replacement from a quality aftermarket manufacturer or the OE part itself.

One last note on repairing P0420 and P0430 DTCs. Make sure you do all the paperwork. It's an EPA law that you must keep, hold and tag the converter for 15 days, provide the vehicle owner with the converter paperwork and keep your own copy of that paperwork on hand for at least six months.

Diagnosing this common problem involves more than swapping converters. It takes the dedication of a professional tech to find out why the cat failed in the first place and a correction of that root cause to avoid a reoccurrence of the same complaint. Do your homework, research the service information, and verify that all other systems are working properly to ensure that MIL stays off. MA

Photos: "G" Jerry Truglia

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.

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REMEMBER WHERE YOU STARTED

A FEW GENERAL TIPS CAN KEEP YOU ON TRACK IN YOUR DIAGNOSTIC WORK.

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

Anyone who has ever tackled this job knows it isn't the easiest to perform. Read over the OEM service procedure anytime you're taking on something new.

Between attending events around the country and my continued work educating techs in the U.S. and Canada, the first months of 2013 have been a whirlwind of travel with little time to breathe in between. And of all the duties I carry, writing this column for all the *Motor Age* readers is one of my most enjoyable.

Let's start off this month with a few general tips before diving into a case study involving a 2007 Ford F150 Variable Cam Timing (VCT) problem I hope you'll find both entertaining and informative.

Adding Air Creates a Rich Mix?

The purpose of the Air Injection Reaction (AIR) system is to reduce hydrocarbon (HC) and carbon monoxide (CO) emissions left after the combustion process. AIR system failures often involve pumps damaged by moisture, vacuum hoses damaged by heat or check valves sticking open or closed from carbon buildup. Faulty AIR systems tend to make engines run rich. This will occur if the air from the pump enters the exhaust manifold before the upstream O_2 sensor or does not switch to underhood when the engine is warm.

Atmospheric air is injected under pressure into the exhaust manifold upstream by the air pump. Air pumped directly into the exhaust helps to further oxidize exhaust gases before they enter the catalyst.

Some older vehicles switch air injection between the exhaust and the catalyst itself. Air is sent upstream right after the engine is started cold, but switches downstream when the catalyst warms up and starts to work. It is important to remember to disable air injection when you evaluate exhaust gas O_2 levels, since air injection can elevate O_2 levels and lead to false conclusions.

Disabling air injection does not mean clamping off any air injection hoses and tubes. This might lead to permanent damage of hoses and valves. Instead, before taking tailpipe exhaust samples, follow the recommended OEM service procedure to disable the air pump electrically or to divert air injection to the vent port.

Keeping Your Balance

When you need to confirm and zone in on a fuel injector problem, the best test to perform without a bunch of expensive tools is a fuel injector balance test. Follow these steps to perform this simple test on most engines without breaking your tool budget.

With the ignition off, remove the injector plug/wire connectors of the injector to be tested. Next, install an accurate fuel pressure gauge and fuel injector tester. The fuel injector tester is a special tool that allows you to operate the injector independently of the Engine Control Module (ECM). If you have a scan tool capable of performing this task, this step is not necessary.

Photos: "G" Jerry Truglia

All of this expense caused by the use of the wrong oil.

The F150 had misfire codes stored for cylinders No. 1 and No. 6.

Turn the ignition on/off as needed to get the maximum reading on your fuel pressure gauge. Write that number down. If you are using a manual tester, select the "1 Pulse/500ms" option and press the "Activate Injector" button once. Record the reading on the fuel pressure gauge. The difference between what you started with and what you ended up with is the amount of pressure drop. Do this twice for each injector. Be sure to start the engine between tests on each cylinder to prevent hydrostatic lock, and to start each new test with the same peak pressure reading.

Once you have completed your testing on all injectors and have figured out the pressure drop for each one, it is time to compare. Determine the average pressure drop by adding them all up and then dividing by the number of cylinders tested. Suspect a problem with any injector whose drop exceeds the average by ±1.5 psi. An injector with a lower drop probably is restricted and passing less fuel, while one with a larger drop probably is worn or sticking and passing too much fuel.

Confirm your diagnosis and repair by using fuel trim. Fuel trim is information that is sent to the ECM and stored in memory as Short Term Fuel Trim (STFT) and Long Term Fuel Trim (LTFT) values.

2007 Ford F150 5.4L VCT Problem

This Ford came in with the MIL illuminated and a poor performance problem. A common problem on these engines is due to a problem with the VCT system. So the first thing we checked was the oil, noticing it was new and filled. Our next step was connecting our EScan, checking for DTCs (Diagnostic Trouble Codes). We found the following DTCs stored in the computer: P0300 (random misfire detected), P0301 (cylinder No. 1 misfire detected) and P0306 (cylinder No. 6 misfire detected). These misfires DTCs can be caused by ignition, fuel or mechanical problems. We ruled out both ignition and fuel, leaving us with most likely a mechanical problem. To confirm the mechanical problem, we performed a relative compression test using the OTC Genisys EVO® scan tool. The results of the test confirmed that we had a mechanical problem that was causing the misfires.

Because this was the first time that we had seen this vehicle and customer, we had to ask what maintenance had been performed. The owner informed us that he was having the vehicle serviced at a local tire shop that offered a $19.95 oil and filter change. The oil that the tire shop used was 10W30 along with a cheap import oil filter.

Because the proper oil and filter are critical to proper operation of the VCT system, we suspected that the system was damaged along with other problems. Ford requires 5W20 synthetic blend oil along with a Motorcraft (or service equivalent) oil filter every 5,000 miles or 3,000 miles if the vehicle is used in severe conditions, load and driving. The owner of this vehicle was in the construction business using the vehicle to haul a bunch of heavy supplies and a trailer. Remember that when using other than the recommended oil and filter, engine damage can occur prematurely. The correct oil is critical in this and every other variable timing system.

When we took the valve cover off we noticed that the phaser and solenoid was gummed up with burned oil.

This OTC tool is used to manually fire the injectors in order to perform an injector balance test. Some makes support scan tool bi-directional control to do the same thing.

It's always a good idea to know how a system works before tearing anything apart. A quick overview of the system is that the VCT is connected to the camshaft, controlled by the PCM via the oil control solenoid. The solenoid, by allowing or restricting oil flow (applying or releasing the cam phaser) controls the VCT system.

The VCT phaser has four modes: idle, part throttle, wide open throttle and default mode. Adjustments are based on airflow, engine and coolant temperature, part and wide-open throttle, RPM, load and throttle position. The purpose of the VCT system is to help reduce emissions, increase engine output, improve idle quality and of course increase fuel mileage.

Because of the improper maintenance, the fix for this 5.4L was pretty involved. With the customer's approval, we replaced the phasers, timing chains and solenoids. We also cleaned the oil passages and removed the oil pan to access and clean the oil screen and pump. At least now this engine once again was able to pull the load and run smoothly. 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.

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MYSTERIES, METHODS AND FRUSTRATION

UNDERSTANDING THE HOW, THE WHY AND THE TIMING OF A FAILURE.

BY **RICHARD MCCUISTIAN** | CONTRIBUTING EDITOR

One of the college's instructors purchased this Crossfire, and it's a sexy yellow with an adjustable spoiler. We have changed the oil in it a time or two, which costs $100 because it calls for nine quarts of full synthetic every 10,000 miles. We hadn't seen the car in more than a year when she called me one day.

CAUGHT IN THE CROSSFIRE

2005 CHRYSLER CROSSFIRE
Vehicle Year/Make/Model

3.2L NATURALLY ASPIRATED V6
Engine

NAG1 5 SPEED AUTOMATIC
Transmission

158,871 MILES
Mileage

UNIT SOMETIMES WON'T CRANK AND CUTS OFF WHILE DRIVING
Vehicle complaint

She said the Crossfire needed an engine and was at the Chrysler dealership 15 miles away. They wanted some giant price to replace the engine, and she was looking for a less expensive alternative. I called LKQ and found her a used mill for $1,700. It was delivered to the Chrysler dealership, which had a Crossfire expert, and he seemed to have done a good job replacing the engine. He did, however, leave the dealership not long after doing the job.

She paid their fee with glee, happy to get the Crossfire back, but almost immediately she discovered a new problem. There were times without warning when the car wouldn't crank (no starter operation) and when it took one of those spells, nobody could get it started. Then, just as suddenly, it would decide to crank. At other times the Crossfire would just die going down the road. Further, she said she might drive it a month with no issues and then have a lot of trouble in a single week.

Were both of these problems related? A problem in the antitheft system might cause the no-crank, but it wouldn't cause the stalls while driving issue. And because the Crossfire expert who installed the engine no longer was in-house at the first dealer, she decided to take it to another Chrysler dealer about 50 miles away. There she was charged a lot of money for repairs that left the problem untouched. So it wound up sitting in her garage for a while, because she just didn't trust it.

The Crossfire came to us on a rollback as a no-hurry troubleshooting job, and it was dead when it got

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Max. tire width: 31.5"

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R23AT / Tilt-Back Tire Changer
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Max. tire diameter: 41"

$1,855

R980XR / Swing-Arm Tire Changer
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Max. tire diameter: 50"

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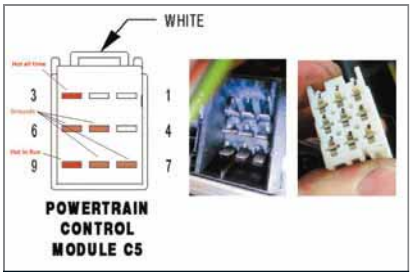
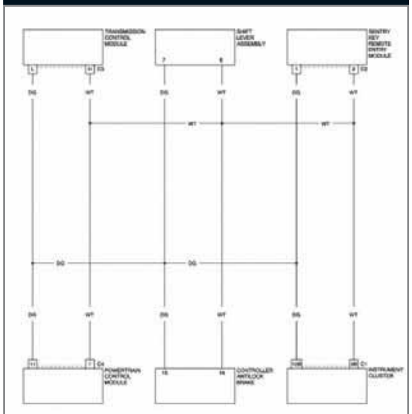


This is the 9 pin connector that feeds power and ground to the PCM, and it is very odd that Chrysler posts the pinout of the PCM side rather than the connector side. The white connector shell is a mirror of this shop manual image, and it'll throw you if you don't catch that early.



These modules are all on the same network, yet they communicate with the PCM over different pins at the DCL. One of them might be causing this problem, but if so, it's extremely intermittent.

I just loved getting the shipping box back with this label on it after they plainly indicated over the phone that they could rebuild the Crossfire's PCM. As it turned out, rebuilding the PCM would have been a waste of money.

here. Perfect situation, if the problem would remain long enough.

On this platform, the Powertrain Control Module (PCM) triggers a Pulse Module to control starter engagement. When the engine starts, the pulse module interrupts starter operation — German designs are big on that point. But that module couldn't make it quit going down the road, could it?

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An Identifix search revealed 11 failures of the pulse module causing no-cranks (and one PCM), but my problem was that even if the starter was engaged artificially with the key on, the engine would spin but wouldn't start. Further, the PCM wouldn't talk during this time. Could the pulse module cause no-com? Maybe. There are five other modules sharing the Controller Area Network (CAN) B network on this car, but we decided to check powers and grounds first, and that was probably a mistake.

A diligent check of the PCMs powers and grounds at the C5 nine pin connector revealed that the PCM had everything it needed (as far as we could tell; the only decent wiring information we could find was in Identifix), but the PCM was still asleep. I had my parts guy call a remanufacturer to see if it could rebuild the PCM. They answered in the affirmative, but when we sent them the unit, they immediately sent it back and said they couldn't rebuild it. I also found that you can't just get a used PCM for this one from a salvage yard and reprogram it. You have to buy a new one, which burns through $2,000 in the blink of an eye. We didn't need to snag a new PCM on a whim for this Crossfire, at least, not without further testing.

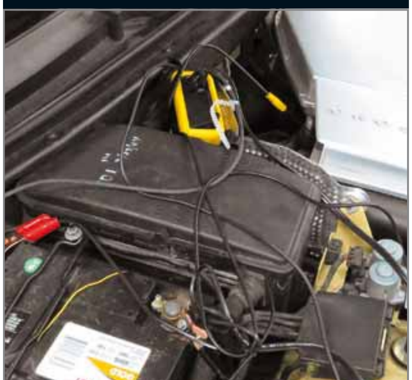
Reconnecting the PCM for the additional testing after receiving it back from the remanufacturer, we found that the Crossfire fired right up, and we couldn't get it to stall or fail to start any more. Of course, by the owner's testimony, it might take a month. We kept it for about a month, checking it periodically with no reoccurrence. We could plug in a Diagnostic Link Connector (DLC) recorder (I have two), but if the network goes down or the PCM stops talking, the DLC recorder is pretty much worthless anyway. I needed something that could be hard-wired to record some channels independently of the vehicle network.

I installed the four-channel Hickok Flight Recorder. It checks the battery, one auxiliary input (I connected this to the "hot at key on" feed wire), senses spark with an antenna strapped to or near a plug wire and hard wired it to the pulse side of one injector. We might get useful data from these four, or we might not. Snaking the long trigger cable into the car, I mounted the yellow pod with its red button and gave the owner instructions: If and when the car failed to start or stalled while driving, she was to press the button and capture a recording, which I could upload to the computer and hopefully analyze the data. I put her back in the driver's seat, and two days later she told me it had failed to start and she had made two recordings. She would let it sit and try it again the next day.

"In another instance, having parked the truck outside, we went to start it just to make sure it was fixed, and found that it wouldn't start at all – and there was no spark."

It started that next time around, and she made a snapshot of the normal start. I had the Auxiliary channel sampling pin 9 on connector C5. That one gets hot when the Engine Control Relay energizes, but that relay is hardwired into the Relay Control Module, which is a $400 item that rides right next to the PCM in the isolation box behind the passenger side shock tower. She greenlighted the repair and all was well. Did this failure have anything to do with the engine swap? I can't see how.

Here's the Pulse Module, which, according to Identifix posts, is usually the cause of no-crank issues (11 out of 13 posts). But I can't for the life of me figure out how it could cause the Crossfire to quit while driving.



This is the Hickok Flight Recorder. This Crossfire had been doing so well for so long that I figured I'd monitor battery, feed to PCM connector C5 pin 9 from the Engine Control Relay, fuel injection and spark. If and when it happened again, she pressed the red button on the little yellow pod I clipped on the ashtray; it recorded 15 seconds before and one minute after the button press. I wish it had more than four channels, but we only needed one this time.

The Ones That Make Us Look Bad

Ever had one of those jobs that made you look incompetent when you were absolutely sure you weren't? When I worked at the Ford dealer, an LTD came in for a transmission service. The car was clean and in good shape, and a seasoned transmission guy did the service. In those days, we always test-drove every car before performing a requested transmission service; some customers brought in a car with transmission problems, had it serviced and then claimed the service caused the problems.

Well, this one wasn't one of those. It belonged to a close relative of mine, and it was a straight-up deal. The bill was paid and the car left, but before it was 500 yards from the dealership driveway, it was pouring transmission fluid like an inverted crimson fountain. She limped the car back to the dealership for what seemed certain to be a record-breaking comeback.

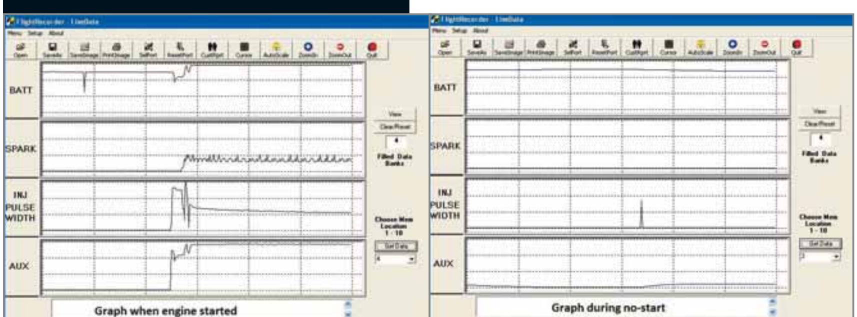
Because she was my relative and the transmission guy was swamped, I raised the car up on the lift and found that one of the steel transmission cooler lines had split at its roll crimp (the one on the line that snaps past the retainer).

My conclusion was that there was absolutely no way on earth the transmission service could have caused that – those lines were six inches north of the transmission oil pan. I repaired the line by cutting and double flaring it and installing a different fitting in the transmission and refilled it with fluid. Even though the failure wasn't our fault, there were no additional charges to the customer.

Another one of those face smackers was a 1994 Chevy pickup with TBI and HEI that would start, run a few seconds and then die virtually every time it was started cold. After a few of those start and die cycles, it would manage to survive and drive, and our diagnosis led us to check fuel pressure after an all night cold soak. The fuel pressure would kick up to 13 psi on startup, but then would drop all the way back to zero and the engine would die. We saw it do this about three times before it finally survived and the pressure stayed.

Further checking showed that the power to the pump was constant during these maneuvers – the pump never lost power, it just shut down after running for a few seconds. I had never seen a fuel pump do this before, especially not this consistently and never on a cold truck, but our diagnosis was solid. This one needed a pump, and we put one in it with the customer's approval.

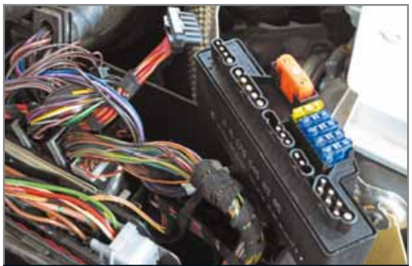
The next morning, having parked the truck outside, we went to start it just to make sure it was fixed, and found that it wouldn't start at all – and this time there was no spark. What the heck? Five minutes later our DVOM revealed that the pickup coil in the distributor was wide open – no continuity at all. Seriously? When you call a customer and explain that he now needs yet another part and more work after having told him he needed a different part the previous day for almost the same concern, well… You find out how much that person trusts your troubleshooting and your judgment. This guy didn't blink an eye, and we had the Chevy back on the road before 9.



The recording on the left is a normal start. The Crossfire owner actually made this one a day later than the one on the right. Notice that the auxiliary channel stays low on the right hand recording and that the spark and fuel injection were also offline. She told me the Chrysler dealer had already replaced the ignition switch, and the wires checked out. The root cause turned out to be the Relay Control Module.

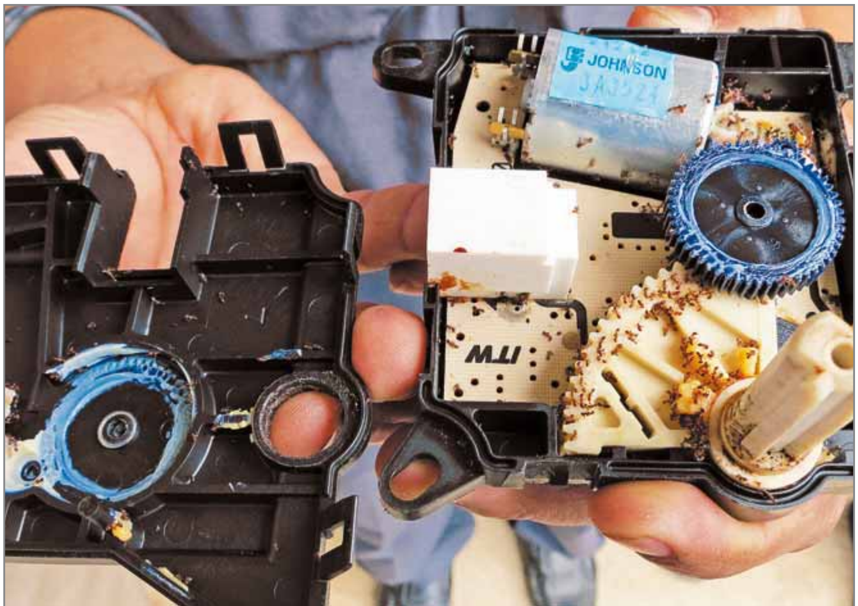
This Stuff Doesn't Make Any Sense

Another mysterious situation was one I wrote about a while back. A 2003 Explorer had a lot of bearing noise in the rear. This one has an aluminum differential housing mounted to the body and CV axles carrying the torque out through stand-alone two-race bearings to the hubs. We applied the Chassis Ear® to the differential and hubs, found the preponderance of the noise coming from the pumpkin and tore it down to find pitted bearings.



This is the relay box we replaced. It is a bit more elaborate but is reminiscent of the IRCM Ford used in the 1990s, with a wad of relays all in a neat package. They are just as prone to fail and a lot more expensive when it happens. In this case we spent more than $300.

This is a mystery I've yet to solve – how this Geo Tracker could ever have had operational air conditioning just blows me away (no pun intended). Virtually every other part of the A/C system was in place and had been ever since this vehicle had been assembled new. The connector that should have plugged into this switch was stiffly pointing in a different direction like the wires had never been bent to plug into the omitted switch.



Finally, we all like to disassemble failed parts to see what caused them to fail. We learn things that way. Usually the plastic gears loose teeth, but in this case, a tribe of ants had set up housekeeping in this Ford Expedition blend door actuator. Not a single ant survived – and neither did the actuator. There were no visible ants anywhere else in or on the vehicle. They all seemed drawn to this cavity. These little critters tend to foul up relays, too.

We replaced the bearings, got the rear end set up and reassembled, and had less noise but still too much, and further listening pinpointed noise in the hub areas. When we removed those bearings and found that they were pitted too, we found ourselves wondering how all the bearings in the rear end could fail even if they're not swimming in the same oil. Well, that one has been running quietly ever since.

Then there was the Camry Air Conditioner anomaly. Even with the right refrigerant charge, that one wasn't cooling, and with the compressor pumping, pressures on both sides were low, which points to an expansion valve problem. We replaced the expansion valve, which didn't change a thing. The next logical step was to determine whether the evaporator was clogged, but it seemed to flow freely when we put air through its piping. Not knowing what else to do, we replaced the evaporator, and this time we saw normal pressures and a frosty cold register.

Speaking of HVAC, some folks might remember the really mysterious situation I encountered about 10 years ago on a Geo Tracker where the girl told me her air conditioner had been working fine at the end of the previous hot season, but winter had come and gone and now her air conditioner wasn't blowing cold. We went through a lot of circuit testing on that one and finally discovered that there was no button on the dash to engage the A/C.

The instrument panel was set up as if that vehicle never had air conditioning – ever. There was a blind plug (one of those you have to break out to install the switch), and the wires leading to that blind plug were stiff and straight and had never been plugged in to anything. The Tracker had factory air – everything else was in place except that switch.

How the A/C had worked previously was totally outside my realm of understanding. I even asked her if any of the dash panel parts had been replaced, and she shook her head. I asked her about the button – had it ever had one? She couldn't remember anything except that the air had worked fine the previous hot season, which was equally odd. At any rate, the switch was $70, and she didn't want to spend the money, so we simply jumpered the two wires that would engage the A/C, and any time she turned on the fan in any air mode position, the compressor was running, which doesn't hurt a thing. It wasn't a factory-approved fix, but the customer was satisfied. MA

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

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SERVICING HYBRID A/C SYSTEMS

By Jim Bates

Hybrid vehicle air-conditioning systems are almost identical to their non-hybrid counterparts, but there are a couple of important distinctions that make servicing these systems very different.

The first thing to consider is that many later-model systems have electric A/C compressors capable of operating continuously, even during periods when the engine is not running. This enables the system to provide for uninterrupted cooling during frequent idle stops, deceleration, or other times when the engine cannot normally power a belt-driven compressor.

These electric compressors operate on the higher voltages provided by the hybrid vehicle's traction battery. Knowing how to shut down the high-voltage system and do a zero-voltage check is the first – and most important – step in servicing these systems.

You must also consider that even though R134A is still the refrigerant, PAG oil must not be used in these systems because it is electrically conductive. Should a problem develop in the compressor's electric motor, a high-voltage leak could cause the hybrid's "fail safe" system to shut down the entire electrical system (resulting in a no-start and no-run situation).

Most electric compressors are equipped with a dry ester type of oil that does a sufficient job providing system lubrication and protection from any high-voltage shorts that may occur within the compressor. Interdynamics HYB-1 and Supercool 24940 are two of the leading aftermarket products available for this type of job.

Servicing these systems requires equipment that flushes the hoses between the evacuation and recharge cycle (and turns off the oiler) to prevent contamination of the oil. No more than one tenth of one percent PAG contamination is allowed. Newer types of A/C service equipment that are rated as "hybrid safe" will have features that support these requirements, but if you are using older equipment, small changes to your routine are likely necessary to complete the job.

For example, while the evacuation procedure would remain the same as with a traditional vehicle, when working with a hybrid, you could recharge the system with a separate gauge and hose set that you have designated for hybrid use only. Adding oil could be done with a stand-alone oiler – such as the type attached between the gauge set and low side service port.

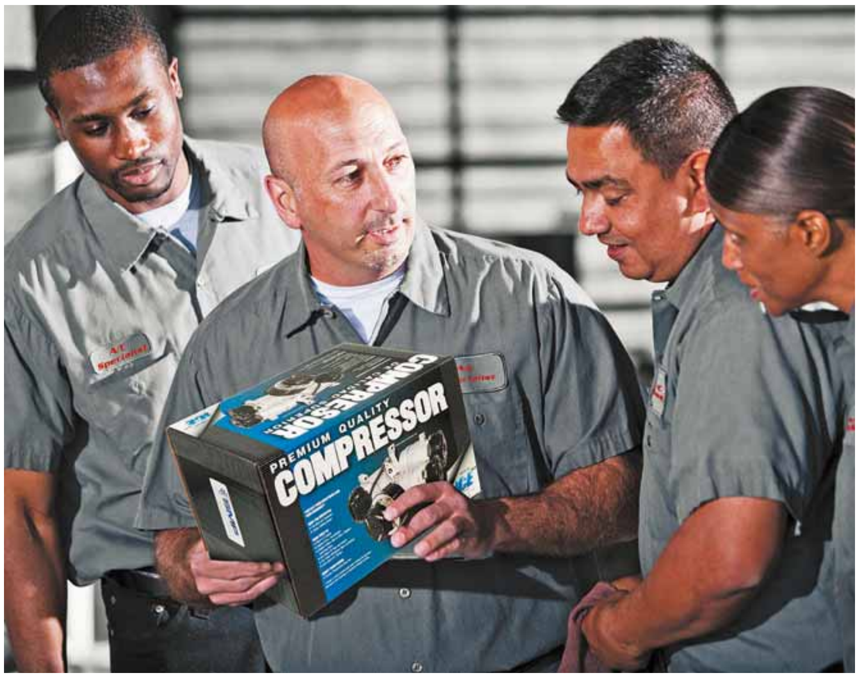
Don't let these high-profit A/C jobs pass you by. While there are certainly differences in hybrid A/C systems, fundamental diagnostics and service procedures are still key to a successful job.

If you are unfamiliar with any of the necessary procedures, Advance Auto Parts Professional offers Advance Shop eLearning with video tutorials at video.advancecommercial.com.

Advance Auto Parts Professional technical training specialists also host regional workshops on servicing hybrid and electric vehicles.

Jim Bates started solving automotive problems as a technician and racing enthusiast over 40 years ago. He spent eight years with Echlin Manufacturing and 23 years with Wells Manufacturing Company before coming to Advance Auto Parts upon his retirement. ASE-certified, Jim is a 25-year-plus member of SAE International, developing and conducting a wide range of training programs throughout the nation for both jobbers and technicians.

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.

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As vehicles and vehicle issues become increasingly more complex, so, too, are the challenges facing auto repair professionals. What if you had a source of expert knowledge combining diagnostic experience with repair timesavers and detailed parts replacement records available just a click away in your repair information software? Mitchell 1's SureTrack™ puts these tools right at your fingertips. Let's walk through a real-world example. In our scenario, a customer brings in her 2001 Chevy Tahoe (125,000 miles) with the check engine light on. Upon reading the code, we find that P0101 was tripped.

TSBs and Recalls

The first thing we do in SureTrack is look through the list of TSBs and Recalls to see if the OEM has issued any information related to this code. In this particular case, the OEM didn't provide any TSB information, but it is always a good idea to check here first.

Simple Search

Our next step is to perform a search for the P0101 code. SureTrack makes it easy by providing a "simple search" function where we type in a code or symptom. As we type, SureTrack returns any results back in a "type-ahead" feature. We are presented with a number of options for P0101.

Common Replaced Parts

Now we want to find the root cause of the problem. With the exclusive Common Replaced Parts feature in SureTrack (Figure 1), we see which parts are most frequently replaced at various mileages. In our example, SureTrack has data from 131 repair orders suggesting three most likely components to investigate: Air Intake Duct/Boot, Airflow Sensor and PCV Valve.

Real Fixes and Related Tips

Next, we can check to see what has worked for other technicians who had the same code. SureTrack brings together vehicle-specific data generated from millions of successful real fixes across the country. The data has been analyzed and confirmed by expert technicians, so we can feel confident in our diagnosis.

For our Chevy Tahoe, we see that another technician in the field has had a similar code and confirmed the mass airflow (MAF) sensor as the source of the problem (Figure 1). If we want additional information, we can just scroll down the page to find other real fixes and tips related to the exact issue we're dealing with in our Tahoe.

Guided Component Tests

Next up in our process is the Guided Component Test specific for each component and each vehicle. To deliver quick results, SureTrack's guided component tests include component operational descriptions, best test locations and connection diagrams. For the Chevy Tahoe, SureTrack provides the exact information we need to identify the component location and test the vehicle.

Waveform and Graph Images

In our scenario, there is a waveform associated with our code. No simulations here – SureTrack's comprehensive collection of test results is gathered through actual on-vehicle tests, so we know exactly what to look for. Now we can compare the test that we've just run on the mass airflow sensor to the known good values from the waveform library and confirm our diagnosis.

SureTrack Community of Experts

By now we've probably got all the information we need to complete our repair with confidence. But, if we still need additional help, we simply post our question to the thousands of technicians in the SureTrack Community. Responses typically start arriving in just a few minutes.

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YOU WILL GROW YOUR BUSINESS AT AAPEX

When you attend the 2013 Automotive Aftermarket Products Expo (AAPEX), you will grow your business by seeing the newest products in the industry, meeting the right people and getting answers to your important questions. This year's event is set for Tuesday, Nov. 5 through Thursday, Nov. 7, at the Sands Expo Center in Las Vegas, Nev., and registration is open at **www.aapexshow.com/Register**.

The No.1 reason buyers attend AAPEX is to see, touch and compare what's new in the global automotive aftermarket industry. At the 2012 AAPEX, exhibitors displayed 5,174 parts and components, 1,048 chemicals and car care products, 1,309 tools and equipment, 245 business products and services, and 1,190 accessories and custom products. At AAPEX, you can definitely count on seeing new products to meet your customers' demands, as well as the products and suppliers you need to fill an existing line or expand into a new line to grow your business.

AAPEX also is the No. 1 place to meet the right people in the industry. If you need to talk in person with a current supplier or identify a new supplier, in all likelihood, they'll be exhibiting at AAPEX. If your interest is networking with people facing similar business issues and challenges, AAPEX is attended by the best in the industry. Last year, buyers at AAPEX included 8,737 retailers, 7,028 service and repair businesses and 11,130 warehouse distributors (WDs).

Another compelling reason buyers attend AAPEX is to get answers to their important business questions. They get their answers by seeing the thousands of products on the show floor, meeting with exhibitors and suppliers, and talking with other buyers throughout the event. In addition, the AAPEX Learning Forum, with its more than 30 educational sessions, provides many answers to your business questions and concerns. Several sessions are tailored to the needs of various aftermarket segments, including retailers, service and repair businesses, and WDs. In 2012, sessions for these segments included WD management, employee productivity, sales, marketing and branding, and technology and service readiness.

With the newest products, the right people and the best seminars, you will grow your business at AAPEX. To learn more about AAPEX, visit the event's newly redesigned website at: **www.aapexshow.com**. The website includes a Find Products & Exhibitors section where buyers can search by product, exhibitor or brand, and a Learning Forum area with details about sessions being offered at AAPEX 2013. The

AAPEX Mobile Compass App – for taking AAPEX with you on the go – also is available and may be downloaded at: **tiny.cc/aapex_apps**.

AAPEX represents the $395 billion global motor vehicle aftermarket and is jointly sponsored by the Automotive Aftermarket Industry Association (AAIA) and the Automotive Aftermarket Suppliers Association (AASA).

For more information, visit the AAPEX website, **www.aapexshow.com**, or e-mail: **info@aapexshow.com**. AAPEX also is on Facebook, www.facebook.com/AAPEXShow, Twitter, **www.twitter.com/AAPEXShow**, Pinterest, **www.pinterest.com/aapex**, and LinkedIn, the AAPEX Show Group, **tiny.cc/aapexlinkedin.**

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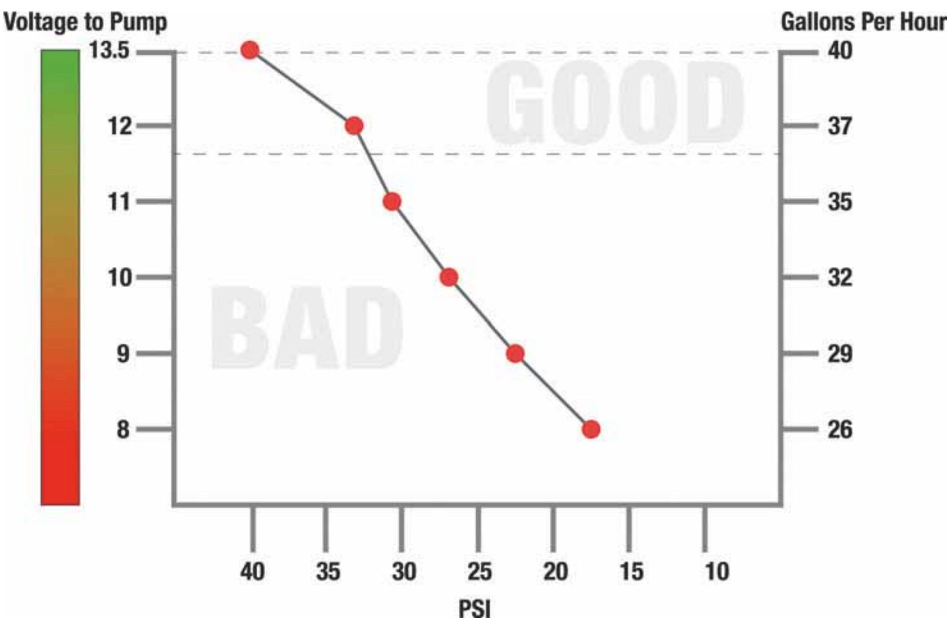
THE IMPORTANCE OF PROPER FUEL PUMP VOLTAGE

Have you ever heard this, "I checked the system pressure and it was below the vehicle spec. I know I have voltage at the pump because I can hear the pump run and I have pressure, just not enough. It's got to be the pump."

If so, you are probably not alone. While it may indeed be the pump, there is a good likelihood that something else may be causing the issue. It could be caused by a faulty fuel pressure regulator, clogged filter, etc. But what many technicians overlook is the electrical system. The heart of the fuel pump is an electric motor. The more voltage to the electric motor the faster it turns, the faster it turns the more pressure and flow it can create. So, let's dig a little deeper to get a better understanding of what we are talking about.



A normal operating system typically runs at 13.5 volts. The fuel pump reaches its optimum capabilities at 13.5 volts. Any decrease in voltage to the pump will have a direct impact on the pumps ability to reach its full potential. In today's vehicles, often times the pressure specification range is very narrow and only allows for a few PSI variance. Fall below the pressure spec threshold and you have drivability issues, including a no start condition. For example, a mere 2-volt loss at the pump can cause a 19 percent drop in fuel volume while at the same time create a 35 percent drop in pressure. Anything more than a 1 volt loss between system voltage and voltage at the pump should be investigated and corrected.

So, with all of this being said, what causes a voltage loss at the pump? The most common causes for voltage loss are a bad ground, frayed or damaged vehicle wiring harness, corroded connections and faulty relays. All easy fixes and all much cheaper than replacing a fuel pump.

To help in diagnosing this problem you can view our Voltage Drop video on the Airtex Fuel TV Channel. Visit: http://youtu.be/72iAJnhFrEo or scan this QR code:

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DON'T SKIP STEPS WHEN SERVICING TPMS

Tire Pressure Monitoring Systems (TPMS) is the hot topic in the tire sales and service industry. If you own or work in a tire shop, chances are at least half of the passenger vehicles you work on each day have direct TPMS.

Much is being made these days about TPMS sensors and programmable aftermarket replacements. You've probably heard the pitch, "clone the ID, skip the relearn and shut off the light!" This isn't true, and more importantly, skipping the relearn is bad form according to NHTSA, who has made it known that the TPMS needs to always remain operating!

When servicing TPMS, there are no "magic wand" solutions for the PROPER diagnosis and service of this safety system. TPMS service is a multi-step process, and it's always best practice to not skip the necessary steps.

1. Verify Make, Model and Year, and always reference vehicle specific TPMS data – Using a TPMS Data System, Let your customers know you are the expert.

2. Test Before You Touch – Using a TPMS Scan tool, inspect the TPMS Before the service begins.

3. Talk TPMS – Using consumer information, inform and educate your customer.

4. Make the repair – By stocking the service kits and sensors, you can quickly service the components as necessary.

5. Re-learn the system – Using your TPMS Scan tool, always program the new sensors to the vehicle EVEN WHEN USING A COPIED (cloned) SENSOR ID.

6. Have a source of knowledgeable tech support for those difficult TPMS repair scenarios.

Every time you service a vehicle with TPMS, complete a "Test Before You Touch" inspection. Getting a "health check" on the TPMS is a key first step to prevent inheriting existing problems. Use a TPMS Tool (with OBD capability) to test the sensors and check for TPMS fault codes. If you can't complete this step, trouble is already on your horizon.

Each and every time you install a new TPMS sensor on a wheel, and attach it to a vehicle, that new sensor ID must be programmed or re-learned, to the vehicle's control module. This is how the vehicle communicates with that sensor (and not with others found on similar vehicles). The TPMS re-learn also accomplishes

another important task; it clears stored TPMS fault codes. This is an important step because with some vehicles this is the only way to clear a TPMS light. It's also an important step if you detected fault codes during the "Test Before you Touch" inspection, as you can now show your customer that you have fully repaired and re-set their TPMS.

So what can happen when you skip the all important re-learn step? A number of things can cause you and your customer problems. You cannot test communications between the sensor and the vehicle. Since the primary purpose of the re-learn is to program new ID's to a vehicle's BCM, it also follows that the re-learn is the best way to test communications between sensors and the vehicle.

Skipping the relearn means you do not establish a system baseline. The TPMS fault code or codes will NOT be cleared. This could lead to the light remaining in a flashing state. For example, let's say you clone a replacement sensor, install it, and let the customer go without doing a re-learn. The next day they return with a flashing TPMS light. How do you know if the problem is with the sensor you replaced or with a different one? Either way, your customer will expect you to correct the problem.

Finally, whenever considering a TPMS solution, whether it be sensors, service kits or tools, always ask the person representing these items how their products help you manage each of these steps. If they can't articulate that with real world scenarios, be very careful on how you proceed. Anyone advising that their solution allows you to skip steps is paving the way for diagnostic, repair nightmares and unhappy customers!

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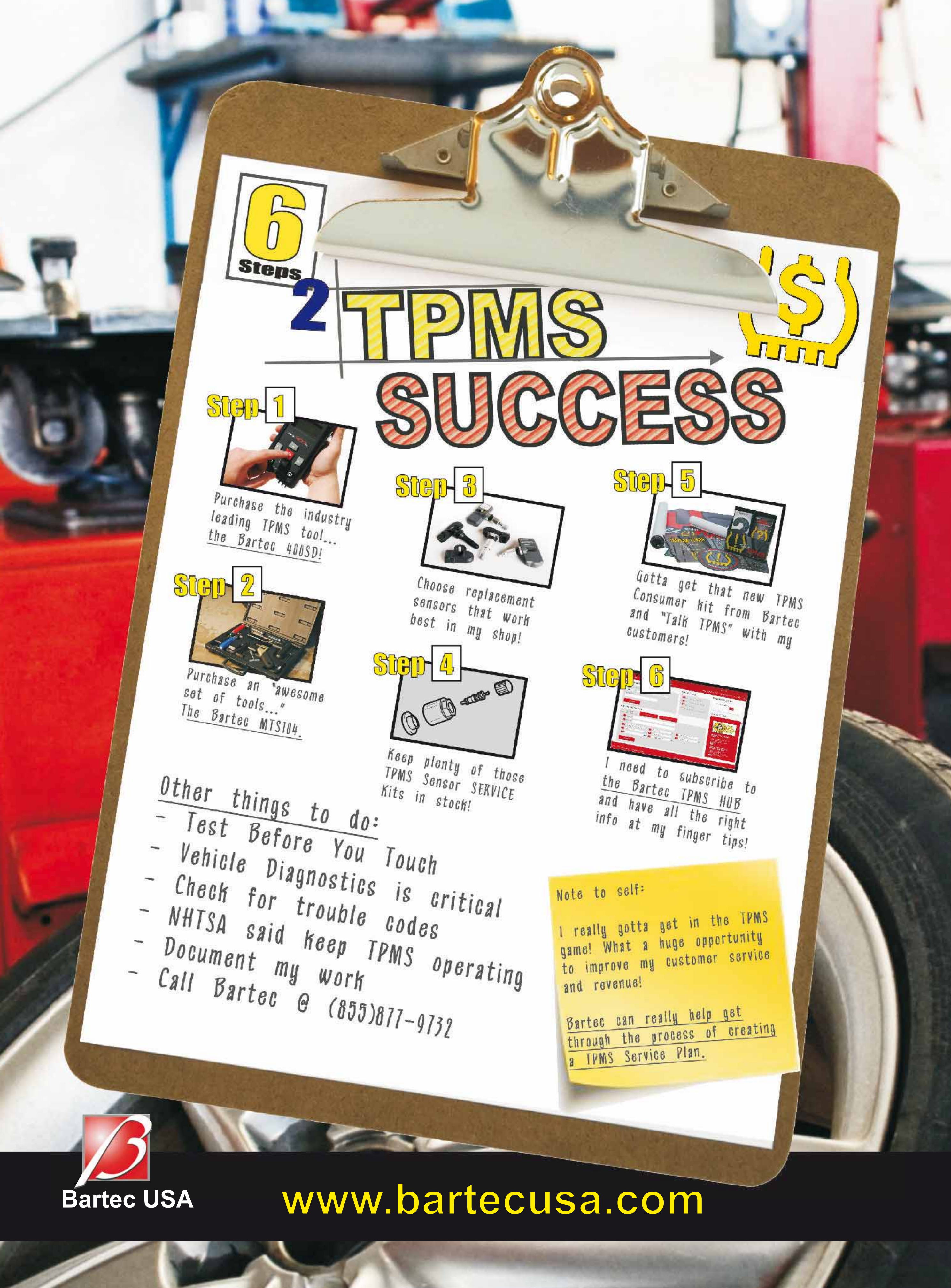

6 Steps 2 TPMS SUCCESS
Step 1
Purchase the industry leading TPMS tool... the Bartec 400SD!
Step 2
Purchase an "awesome set of tools..." The Bartec MTS104.
Step 3
Choose replacement sensors that work best in my shop!
Step 4
Keep plenty of those TPMS Sensor SERVICE Kits in stock!
Step 5
Gotta get that new TPMS Consumer kit from Bartec and "Talk TPMS" with my customers!
Step 6
I need to subscribe to the Bartec TPMS HUB and have all the right info at my finger tips!
Other things to do:
- Test Before You Touch
- Vehicle Diagnostics is critical
- Check for trouble codes
- NHTSA said keep TPMS operating
- Document my work
- Call Bartec @ (855)877-9732
Note to self:
I really gotta get in the TPMS game! What a huge opportunity to improve my customer service and revenue!
Bartec can really help get through the process of creating a TPMS Service Plan.
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OTC GENISYS TOUCH

A vehicle's controller spits out a trouble code – now what?

OTC Genisys onboard resource AutoDetect™, a diagnostic partner for the technician.

Diagnostic trouble codes (DTC) can be a technician's best friend, giving an indication of where a problem exists in a vehicle and a starting point for troubleshooting. However, SAE code definitions often don't give a technician a course of action, leaving them with a laundry list of potential defects and little direction.

Sometimes a DTC identifies only a system – Emissions/PCM

AutoDetect, exclusive to the OTC Genisys Touch, takes a vehicle specific DTC and works as a technician behind the scenes, searching on-tool databases and websites for a list of top-reported fixes. AutoDetect takes an unclear code definition, such as "Mass or Volume Air Flow "A" Circuit Range/Performance," and gives a technician Top Reported Fixes from databases such as Code-Assist®, featuring 7 million confirmed fixes. Repair info is based on vehicle make, model and year, compiled from millions of experience-based Confirmed Fixes™, from technician calls to the Identifix® Repair Hotline™.

A vehicle stumbles on acceleration but no code exists – where do I start?

Diagnostic Trouble Codes (DTC) often give a technician an idea of what's wrong with a vehicle and where to start. However, what do you do when a vehicle isn't running properly, but the computer says all systems are functioning normally?

For example, take a vehicle that stumbles upon acceleration but no trouble codes are present. A technician could spend time searching even turning to Google for direction, potential trial and error parts replacement or asking other technicians. Enter Genisys Touch, equipped with AutoDetect featuring Symptom-Assist™ and Repair-Trac®.

AutoDetect helps a technician diagnose vehicle problems when no codes are present by automatically searching behind the scenes to determine the most likely fix. The search includes Symptom-Assist an on-tool database of more than 14 million reported fixes, prioritizing them by most common. Also included in searches is Repair-Trac, an extensive database of known pattern failures specific to vehicle make, model and year.

AutoDetect functions as an experienced technician, holding the knowledge of all vehicle fixes reported to Identifix™, and providing it to anyone using the Genisys Touch to repair a vehicle.

Genisys TOUCH™

DON'T CONFUSE TPMS RELEARN WITH SENSOR PROGRAMMING

Servicing TPMS equipped vehicles profitably can be a challenge without the knowledge, the right parts and the right tools. In spite of all the training programs and technical articles on the subject, there is still a lot of misunderstanding about TPMS, and the confusion between vehicle relearn and sensor programming tops the list.

Vehicle relearn and sensor programming are completely different procedures

The issue stems from the availability of aftermarket TPMS sensors that come as "programmable", "universal" or "cloneable" sensor units. These sensors must be programmed with the proper protocol/application information for the vehicle before they can be installed in the tire, and then must be relearned to the vehicle. Unfortunately, some shops overlook the necessary relearn step mistakenly believing the sensor programming did the trick. This misconception can lead to service comebacks and customer complaints.

Here are the facts: Vehicle relearn is a standard TPMS service step

Every TPMS sensor must be "relearned" to the vehicle following the prescribed OE relearn procedure after replacement, regardless of whether it is genuine OE or aftermarket. The relearn procedure is mandatory to ensure that not only the replacement TPMS sensor works properly, but also the vehicle's complete TPMS system functions properly as well. With the exception of some Chrysler and Mazda models that may be relearned to the vehicle via a driving procedure, a TPMS scan tool is required to complete the vehicle relearn procedure.

Sensor programming is an extra TPMS service step

Some aftermarket sensors require special programming to meet the vehicle's application specifications prior to installation and relearn. These may include "programmable", "universal" or "cloneable" sensors. In addition to this extra step, technicians may also need to invest in additional specialized tools, training and software to complete the process. And even if a shop has the specialized programming tool, it may need to be updated to provide the latest application or software changes in order to meet the specifications of a particular vehicle.

Multi-application sensors are pre-programmed

Multi-application TPMS sensors, such as the VDO REDI-Sensor, do not require this extra programming step because they are already loaded with the proper programming needed to function with the vehicle's TPMS. These multi-application sensors can help reduce lost service time, eliminate unnecessary expenses and training and cut down on customer complaints and comebacks.

Ready to use out of the box

VDO REDI-Sensor is a multi-application TPMS sensor that works exactly like the OE sensor. It is pre-programmed and ready for the vehicle relearn procedure as soon as the technician takes it out of the box and installs it in the tire. REDI-Sensor follows the standard OE vehicle relearn procedures, and works with all major TPMS scan tools, including those from ATEQ, Bartec, OTC / SPX, K-Tool (T.I.P.S.) and Snap-on.

Furthermore, VDO REDI-Sensor covers over 85 percent of all vehicles in North America with only three sensor part numbers and replaces over 140 OE sensors.

New video from VDO

To learn more, take a look at this new video in the VDO TPMS training series entitled, "TPMS Vehicle Relearn vs. TPMS Sensor Programming at: **www.redi-sensor.com/videos.php.**

For more information, visit: **www.redi-sensor.com** or contact: **salessupport-us@vdo.com**.

REDI-Sensor™

VDO and REDI-Sensor – Trademarks of the Continental Corporation

DIAGNOSTICS

Today, vehicles can have up to 50 computers embedded beneath the skin…all communicating with each other through tens of millions of lines of computer code to manage interconnected systems including engines, brakes, and navigation as well as lighting, ventilation and entertainment… Bottomline, virtually every repair requires the use of a diagnostics tool. A technician must know how these systems interact and how to use the diagnostics tool to assist in their repair.

For example, did you know that replacing a throttle position sensor without a diagnostic tool can cause the cruise control and ABS systems to stop working? It is not efficient for a technician to figure that out AFTER the repair is done.

In conjunction, diagnostics technology is also advancing. Technicians need continual training to get the most out of new diagnostics applications and further in-depth functionality for existing applications. Each diagnostics enhancement and upgrade is designed to assist the technician in an easier diagnosis and repair.

Simply put, remote diagnostics help shops gain time during service… in some cases up to four hours for one repair. And shop owners can experience their return on investment in as little as 20 uses of a scan tool. New vehicle technologies cannot be repaired without it.

Delphi's new scan diagnostics and flash programmer tools offer technicians a complete diagnostics program. The tools simplify the repair process by taking advantage of wireless technology so technicians can move around the shop. Operating on a PC-based platform, the Delphi diagnostics scan tool integrates into any workshop's existing platform. Delphi also offers a compact, WiFi-ready, touch-screen tablet PC as an alternative to the handheld tool and in-house workshop operations.

Even simplest brake repair now requires the use of diagnostics, as the braking system includes ABS sensors. A visual check and a good working knowledge of the system is no longer enough. Without an electronic diagnostic tool, the operation could take much longer or even impossible.

Mode $06

Take Mode $06, the raw or unconverted data used by the PCM to determine if the MIL lamp should be illuminated, as an example. Mode $06 is part of generic scan data, and the various OEM and aftermarket scan tool manufactures have different paths to access Mode $06.

Why is it so difficult to interpret?

Since Mode $06 is raw data; it was intended to be used internally by the PCM. Unconverted, it does not display well on a service scan tool, unless the scan tool manufacturer does a conversion. In the early years, Mode $06 was seldom used or understood. The first generation of scan tools displayed this as the same hex data used by the PCM. Later they did a HEX to DEX conversion, but did not convert the value.

Today, many of the newer generations of scan tools, like Delphi's Diagnostic Scan Tool, are displaying this data in a converted format. In addition, newer vehicles do not need to be converted by either the scan tool or technician today.

Mode $06 data can be a bit overwhelming at first. However, with proper training and understanding, the data can make diagnostics much easier. The newer scan tools are doing a much better job of taking the mystery out of Mode $06.

Training

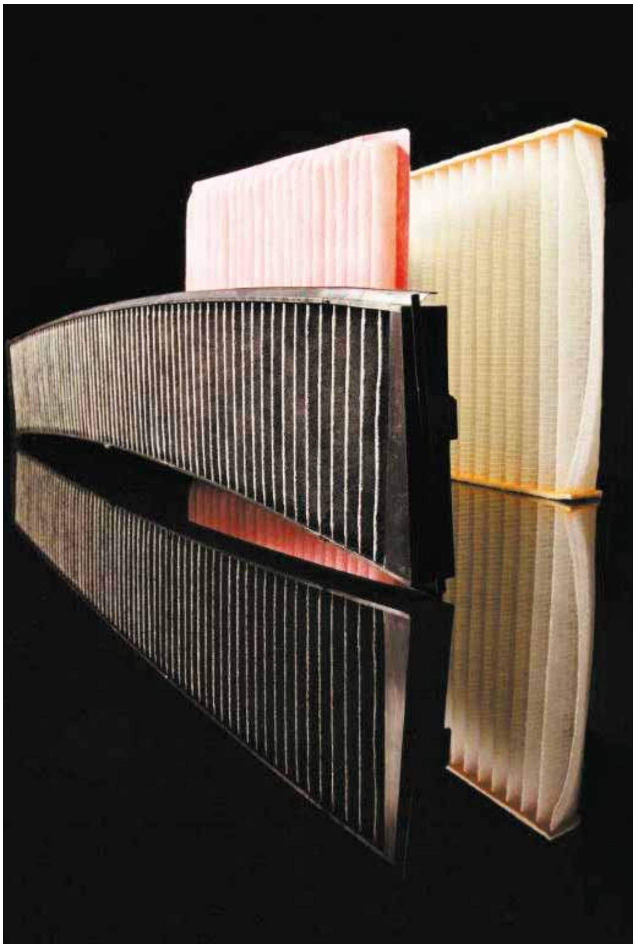
Mode $06 is just one example of how complex vehicles are to repair today. Add in that each OEM have different data for vehicle make and model and year, it's no wonder that continual training with diagnostics is critical for success.

Technology is evolving at a very fast pace and today's technician must continually learn about these new technologies so they can effectively and efficiently serve their customers and provide options for repair. Delphi has a comprehensive training program for technicians, from beginner to advanced, that address diagnostics, diesel, engine management, fuel systems, hybrid vehicles and A/C systems, as well as courses on workshop operations and business management.

DELPHI

AN OVERVIEW OF CABIN AIR FILTER

With increasing public concern about air quality and traffic related contaminants cabin air filters have become a more important necessity. First implemented in northern Europe in the late eighties, the products were particle filters that protected passengers from pollen and dust. The concerns soon expanded to include odors and other particles like diesel soot or gaseous substances like sulphur dioxide, nitrous oxides, or hydrogen sulphide. The industry soon reacted with adsorptive filter systems using activated carbon as the removal mechanism in many grades and to achieve performance characteristics.



Almost all vehicles sold in the North America today have a cabin air filter of some sort, however many owners are not aware that they even have one. If they are aware, they were not clearly informed as to why it should be changed, therefore it generally was not replaced. This can lead to filtration blockage, decrease in electrostatic efficiency, reduced odor removal, and it can become a source for breeding bacteria and other allergens, just to name a few.

Another concern could be additional stress put on the HVAC system due to airflow restriction. So the next time you are having problems with a vehicle air conditioner not cooling, be sure to consider if the cabin air filter needs to be replaced.

Depending on the driving conditions, most vehicle manufactures recommend replacement of a "Pollen cabin air filter" every two years, and changing a "Carbon cabin air filter" every year. Using the vehicle owner's manual would be one of the best ways to determine the cabin air filter type for the vehicle. If the vehicle owner's manual calls for a Pollen type filter and you chose to upgrade, when available, it would be advisable to note the change in the owner's manual.

As a world leader in automotive component manufacturing and a tier-one supplier, DENSO offers a quality aftermarket program. DENSO First Time Fit® cabin air filters are manufactured and tested to the strictest OE standards for unparalleled performance. Each component is precision-built for exact replacement … and a first time fit.

For more information or a distributor near you, visit **www.densocaf.com**.

DENSO
first time fit®

EPA? CARB? CONFUSED?

By Charles Pantano, Eastern Catalytic

Knowing which catalytic converter to install in the customer's vehicle and making sure the one you picked fits properly isn't always a cut and dried affair. Should you use a Federal (EPA) approved cat or should it be a CARB compliant unit? You can't tell by just looking at the converter, the VIN or year, make and model of the vehicle. It's a complicated issue that is bound to get more complex as other states look to adopt CARB standards.

Here are some facts that will help you figure out what type of converter to use

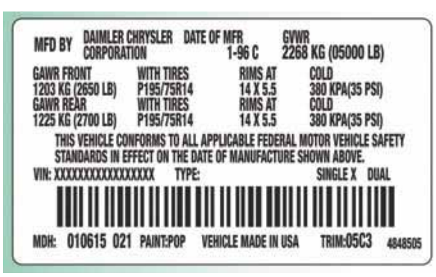
U.S. vehicle emissions are regulated by two authorities: U.S. Environmental Protection Agency (EPA) which enforces the Federal law throughout the country and the California Air Resources Board (CARB), which governs emission laws in the state of California as well as 13 additional states that follow CA emissions laws. So far, only California applies its stringent regulations to the use of aftermarket replacement converters. But New York and Maine are in the process of enacting legislation and more states are expected to eventually follow.

IMPORTANT NOTE: Before servicing any vehicle's catalytic converter, you must determine whether the vehicle was manufactured to CARB or Federal (EPA) specifications.

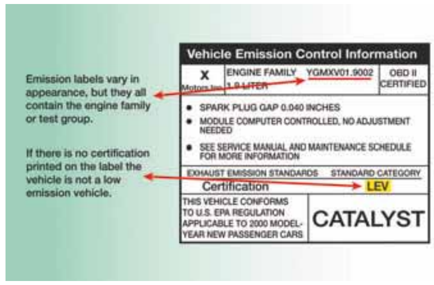
Vehicle emissions systems labels

To properly determine whether the vehicle requires a CARB or Federal converter, you should check the vehicle's emissions system label. Here are the typical labels you'll find:

Typical label identifying a California (CARB) System



Typical label identifying Federal (EPA) System



Typical label showing a L.E.V. (Low Emissions Vehicle) System

Emissions label locations

The vehicle's emissions system label can usually be found in one of three places: on the front radiator support, the strut tower plate, or under the engine hood.

Informative videos and technical tips on emissions identification and other catalytic converter service topics can be found in the Education section of the Eastern Catalytic website at **www.easterncatalytic.com**.

Charles Pantano is the Certification Program Manager at Eastern Catalytic, a leading innovator and world-class manufacturer of catalytic converters. Eastern offers a full range of catalytic converters for universal, direct-fit, manifold, diesel, and heavy-duty applications.

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TECH TIPS

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 and includes System Synergy Technology (SST) which is an 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.

The System Synergy Technology focuses on managing the NVH (noise, vibration, and harshness) 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, hardware, along with friction material, slots and chamfers that all 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.

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," stated 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 will be a major benefit to our professional customers.

"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 continued. "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. For more information, visit www.federatedautoparts.com.

Federated Auto Parts PROFESSIONALS ®

Federated Car Care

ULTIMATE SERVICE TRUCK Sweepstakes

The Ultimate Service Truck for the Ultimate Service Provider

Federated wants to reward one of its Car Care Center customers with the Federated "Ultimate Service Truck." This is not just any truck; it has been modified by Matt Steele and Bruno Massel, hosts of the SPEED show "Truck U."

The Car Care Center grand prize winner of the Federated "Ultimate Service Truck" will also receive an all-expense paid trip to Las Vegas for the 2013 AAPEX Show where they will claim their truck. Plus, hundreds of other prizes will be awarded to Federated Car Care members around the country. Join the ultimate Car Care program today and you could be the ultimate winner!

Federated Auto Parts PROFESSIONALS

All Federated Car Care members enrolled by August 31, 2013 are eligible to win. For more information, visit www.FederatedAutoParts.com or contact your Federated Auto Parts representative.

SUPPLEMENTAL RESTRAINT SYSTEM (SRS) – INTERMITTENT FAULTS

Supplemental Restraint System (SRS) intermittent warning lights and faults can frustrate even the most competent service technician.

These systems come in a wide variety of configurations, from the front driver and passenger single-stage airbag-only system to dual-stage advanced rollover safety systems that include airbags in the headliner and even in the seat belts.

A system that extends to so many different locations with so many components requires a large number of electrical circuits and connectors. And any fault in a connector or circuit that changes its resistance can illuminate the airbag warning light. Diagnosis and service of an SRS can be pretty straightforward when a hard fault occurs due to a failed component, such as an airbag module. However, intermittent faults with their accompanying on-again/off-again airbag warning lights can be difficult to correct.

A lesser known cause of high resistance and intermittent connections can be the result of a condition called terminal fretting.

Fretting is a condition discovered by electrical engineers that can affect low-voltage circuits, such as those of the SRS. Fretting is caused by micro-arcing between the male and female terminals of a connector. The concern may go away by disconnecting and reconnecting the connector, but may reappear later. There is no test for this concern, and you may not be able to see the fretting on the terminal itself.

When an electrical connector is first connected, a thin oxide layer cracks under pressure when the contact is first made. Clean metal is exposed though the cracks in the oxide layer, making a very stable electrical connection. If the contact spot moves a microscopic amount, from fretting motion, which is basically wiggling of the male pin inside the female connector, the clean area is exposed to the air and can quickly form an insulating oxide film. Every time there is motion at the contact spot, the cycle repeats and more oxide debris builds up. With continued microscopic fretting between contacting surfaces, enough insulating oxide wear debris can build up, producing high-resistance and/or intermittent connections.

Severe cases of fretting corrosion look like little dark smudges on electrical terminals. The smudges appear at the locations where the actual electrical contact is made.

One step that can be taken to help prevent fretting is to make sure the connectors fit tightly together, and that movement and shaking around them does not allow them to wiggle. For example, make sure that the power-seat wiring does not bind when the seat moves along its track.

As you may expect, these parts are specific to vehicle year and model and are usually only available from the manufacturer. If you need SRS wiring harnesses, airbag modules or impact sensors for a Ford, Lincoln, or Mercury, many can be found and ordered at **Motorcraft.com**.

Ford Motorcraft®


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YOU HAVE A LOT RIDING ON GABRIEL READYMOUNT FULLY LOADED STRUTS – SO DO WE

A strut module assembly is a structural sub-system in the suspension/steering system of the vehicle. As such, it requires the highest level of quality and performance to ensure vehicle safety and control. So it's important that you know that the fully loaded struts you put on your customers' vehicles have been carefully designed and extensively tested to live up to real-world demands.

"Gabriel recognizes the design and testing that needs to go into all the components and the unit to ensure it meets the vehicle requirements, specifications and durability," said Lisa Bahash, president and CEO, Gabriel®.

That's why Gabriel engineers, located in the Detroit area, precision engineer each new ReadyMount® application to strict tolerances based on their unique knowledge and clear understanding of the original equipment part, the vehicle design, and the performance requirements of the assembly. Only components that meet Gabriel's high standards are specified and used in the assembly.

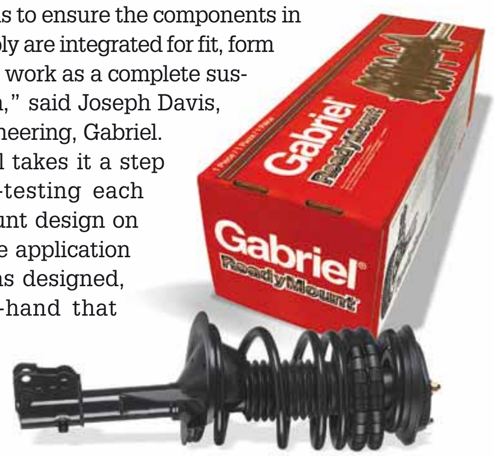
Gabriel starts with a MacPherson strut or coil-over shock design that has been validated to 1,000,000 cycles with a superfinished chromed piston rod for superior corrosion resistance. A structural rigidity test is conducted on the strut to ensure that it meets Gabriel requirements for cornering and braking. Gabriel then adds a premium strut mount, bearing, jounce bumper, dust boot, coil spring, and spring isolator(s).

But that's only the beginning…

Gabriel extensively tests each new ReadyMount design and its individual components on a quarter car testing rig to simulate the real-world articulation of the assembly:

- The assembly is tested to full travel to make sure it lives up to the extreme demands of North American roads and weather
- Side load compensation is also tested to ensure that friction on the strut is minimized
- Steering is simulated to ensure durability of the bearings
- Coil springs, which are a key component to the desired ride, are tested for performance and durability
- A durometer test checks the rubber isolators' load resistance and durability
- Limit load tests, on the rebound springs (or rebound bumper) and on the jounce bumper, are conducted to extreme loads to simulate deep potholes and high curb strikes

Once all quarter car rig testing is assessed, engineers do a complete teardown analysis of the design and all of the components are examined to certify there is no excessive wear.



"We do all this to ensure the components in the final assembly are integrated for fit, form and function, to work as a complete suspension system," said Joseph Davis, director of engineering, Gabriel.

Then Gabriel takes it a step further by Fit-testing each new ReadyMount design on the very vehicle application for which it was designed, verifying first-hand that the design fits properly and can be easily installed. Finally, Gabriel technicians Ride-test the ReadyMount design on U.S. roads to make sure it meets real world performance and Gabriel's standards.

If there is a question, the same Gabriel technicians who Fit- and Ride-test the ReadyMount applications are the Answermen that installers and customers speak to when they call the Gabriel Tech Line.

Not all manufacturers Fit- and Ride-test their module assemblies, and not all manufacturers engineer and design their products to the tight tolerances and precision specifications that Gabriel does for its ReadyMount fully assembled struts. But it's the right thing to do and the right way to do it. Gabriel has a lot of history riding on our products and we think it's what you should expect, especially from the company that designed the first automotive shock absorber in 1907.

The Original Gabriel®

Ride the independent spirit™

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INGERSOLL RAND RATCHET FEATURES IN-LINE BATTERY DESIGN

The Problem

Every technician relies on ratchets to complete tight access service and repair jobs. Most cordless ratchets are designed with standard slide-on batteries and this creates clearance problems during brake, engine and under-car repairs. When a technician angles the ratchet, the battery comes in contact with the work space, inhibiting the operator's ability to fully engage with a fastener. Some tool manufacturers try to solve this issue by turning the battery pack around so it faces the operator, but that interferes with the technician's arm and wrist.

The Solution

The Ingersoll Rand IQ^{V20} *Series* R3130 3/8-inch cordless ratchet gives technicians the power, portability and reach they need to complete tight access jobs. Ingersoll Rand designed the R3130 cordless ratchet with a unique in-line battery design to easily fit into narrow spaces. The battery pack sits behind the palm of the technician's hand, enabling the ratchet to fit into the same spots as his or her arm.

Cordless Versatility

In most service bays, there are two air lines — one on each side of the car — and technicians typically hook up two to five different tools during the course of a job. The R3130 cordless ratchet gives technicians the freedom to move from bay to bay without connecting and disconnecting air lines, increasing their productivity. The R3130 cordless ratchet also eliminates concerns about air lines scratching the vehicle's hood or fender during the repair.

Extended Battery Runtime

The R3130 cordless ratchet is powered by the Ingersoll Rand IQ^{V20} *Series* 20V lithium-ion battery. Technological advances enabled Ingersoll Rand to make significant improvements to the IQ^{V20} *Series* cordless battery platform. The intelligent battery management system provides power-level and flow-rate control from the battery to the switch and motor. The 20V lithium-ion battery delivers a high charge capacity and low internal impedance for maximum power and extended runtime.

Even with its unique in-line design, the R3130 cordless tool is compatible with the other 1.5 Ah and 3.0 Ah batteries in the IQ^{V20} *Series* tool line. The IQ^{V20} *Series* line currently includes the W7150 1/2-inch High-Torque Cordless Impact Wrench, W5130 3/8-inch Mid-Torque Cordless Impact Wrench, D5140 1/2-inch Cordless Drill/Driver, and L5110 LED Cordless Task Light. This enables technicians to buy one tool suite for the garage, and have fully charged batteries available to prevent downtime.

Durable, Ergonomic Design

The R3130 cordless ratchet delivers 54 ft-lb of torque and is manufactured with the same durable head as Ingersoll Rand's air-powered ratchets, which are proven to stand up to tough bolts. It has a patent-pending metal and composite housing case and all-metal gear train to help it survive repeated drops on the garage floor.

The handle is made entirely of plastic so it is lightweight, reducing operator fatigue. The soft touch rubber overmold and contoured handle optimize operator comfort. Additionally, the pivoting trigger is positioned so that the operator actuates the tool with the index finger.

Learn more at **ingersollrandproducts.com/r3130**.

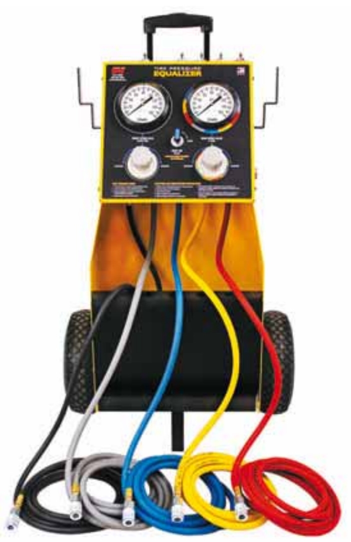
IR Ingersoll Rand

KEEPING TIRE AND FUEL COSTS DOWN

Fleets are well aware that tires and fuel are two of the largest operating costs year after year. Interestingly enough, these two topics are closely related since tires have an impact on rolling resistance which dictates fuel economy. For any fleet, having a direct way to increase both tire life and fuel economy is a highly desirable endeavor. With a little education, and IPA®'s new group of tire products, this goal is easily achieved.

In terms of education, everybody will agree that proper tire inflation is paramount in getting the most from your equipment. Minute discrepancies in inflation pressure can have a large impact on fuel economy as even a 1.5 psi decrease can reduce fuel economy by 1 percent. On paper, this number does not seem astronomical, but consider that a 1 percent decrease in fuel mileage will cost a rig travelling 125,000 miles a year, approximately $750 in extra fuel. Multiply this number by the amount of trucks in your operation and watch the dollar amount skyrocket. Then, combine the fuel cost with the double edged sword of expensive tires wearing out anywhere between 5-20% quicker and suddenly you have a large amount of wasted money leaving your company.

Let us be clear, fleets are by no means ignoring their tire maintenance. Actually, it is quite the opposite. However, utilizing existing methods and poorly designed tire gauges results in a waste of time and money. To combat these concerns, IPA has developed the highly accurate 9060 Mobile Tire Equalizer System. This dual regulated, five tire system uses two 3.5-inch glycerin-filled pressure gauges to ensure your tires are in fact, properly inflated. The system was designed around high flow components, with all internal porting maximized for volume. The use of one gauge for the steer tire and one for all four drive tires was done specifically to prevent a concept called, "tolerance stacking" in which the relative inaccuracy of pressure gauges is compounded, leading to a large variance between tires. Tolerance stacking not only results in improper inflation, but is easily noticed by technicians who revert to older "trusted" and often equally inaccurate means as a result. Additional features such as color-coded tire hoses and corresponding valves make operation straight forward and consistent.



Additionally, a second concept regarding tires, dual tire matching, also warrants careful attention on the part of fleets. If two mated tires vary even slightly, the larger tire is forced to carry a greater load and the smaller tire suffers additional scuffing wear by being forced to drag over the road surface to make up for its smaller comparative size. For example, a ¼-inch variance in tire size (invisible to the naked eye) will cause the smaller tire to scuff for 3.3-foot per mile. After 125,000 miles this tire will have been subjected to abrasive scuffing for nearly 80 miles, significantly reducing its lifespan and adding costly rolling resistance. Another new product from IPA, the 9067 Tire Comparator, simplifies this process by providing a sliding "go/no- go" gauge which will instantly indicate whether dual tires are within tolerance.

By understanding and controlling the forces which govern tires, Fleets will see an immediate impact in fuel and tire costs, as well as avoiding blowouts and road calls. The IPA® line of tire products provides valuable solutions to aid in this process, and ensures optimal performance. IPA manufacturers over 200 innovative products, and is sold through professional tool and equipment distributors worldwide. IPA also works with numerous fleets and OEMs to produce custom solutions. To speak with an IPA technician, call 888-786-7899.

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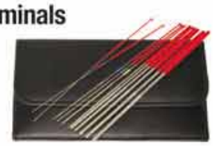

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ORIGINAL EQUIPMENT FOR THE AFTERMARKET

There's no doubt about it:

Age requires a stronger prescription.

Even OE replacement shocks may not be "good enough" for used vehicles.

When OE Isn't Enough

OE shocks and struts are designed and built to work well on a brand new vehicle rather than one with 50,000 miles or more. As a vehicle and its tire control components age and wear, they allow more steering and suspension movements. When you think about it, replacing shocks and struts with OE units on a used vehicle can be like putting used parts back on the vehicle. OE shocks and struts are not designed to compensate for additional suspension wear or movements.

Why are KYB Shocks and Struts a Better Choice for Used Vehicles?

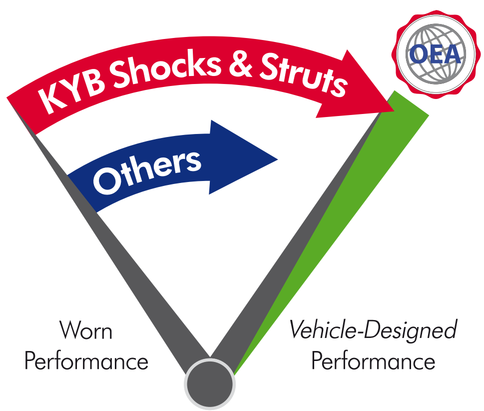
Because they are calibrated to help compensate for age and miles driven. Shocks and struts main job is to control and resist movement. Since a used vehicle will have additional steering and suspension movements, they must be capable of at least or more than the original design if your goal is to restore original vehicle performance.

KYB is one of the world's largest suppliers of original equipment shocks and struts to new vehicle manufacturers. KYB aftermarket shocks and struts are built with the same OE quality and on the same KYB OE assembly lines as our OE products. The only difference is re-calibrated damping rates to help compensate for typical wear.

The result: KYB shocks and struts help restore like-new ride and handling for used vehicles.

Restoring designed ride control performance, like 20/20 vision, requires OE-level manufacturing and aftermarket designed performance: KYB products have both!

KYB offers performance-restoring shocks and struts for almost every domestic and import vehicle on the road today.



KYB®
World Class Shocks & Struts

OEA Original Equipment for the Aftermarket®

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KYB Shocks & Struts

Research, testing, zero-defect manufacturing tolerance and a commitment to original vehicle design and performance. The choice of New Vehicle Manufacturers and Top Service Professionals around the world.

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If it doesn't have the KYB logo - it's not KYB. Anything less than KYB.......is just less!

Please visit us at www.kyb.com to learn more

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. To learn more, visit theperfectbrakejob.com.

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RAYBESTOS CHASSIS PARTS PROVIDE STABILIZING SOLUTIONS

Each Raybestos® Professional Grade® chassis part is engineered, precision machined and performance tested to the design intention of the vehicle's original part. Their advanced technology, low-friction designs reduce endplay and hold tighter alignment tolerances for better steering control, ride quality and service life.

Tech Tip No. 1: Rear Stabilizer Bar End Link

Vehicle Involved: 2009 Dodge Caliber

Condition: Vehicles were shipped with rear stabilizer bar end link nuts torqued incorrectly. May find them broken.

Repair Procedure: Raise and safely support vehicle. Unfasten stabilizer bar from stabilizer bar links. Remove lower stabilizer bar link mounting hardware and remove link from vehicle.

The installation is the reverse of the removal procedure, using the new stabilizer bar link (Raybestos Chassis P/N 545-1431) and recommended new hardware. Install bar link into lower mounting location and upper mounting location. Torque nuts to 37 foot-pounds

Tech Tip No. 2: Stabilizer Link

Vehicle Involved: 2002- 2009 Trailblazer

Condition: Proper installation of washer of stabilizer link

Repair Procedure: RemovalandDisassembly — safely raise and support vehicle. Unfasten stabilizer link mounting hardware and remove link from vehicle.

Assembly and Installation — Install in reverse order of removal procedure, using the new stabilizer link and recommended new hardware (Raybestos Chassis P/N 545-1467 and 545-1468).

Some applications may have a larger hole in mounting bracket, so a new washer is included. Install washer on stabilizer link stud (Sway Bar End) Torque to O.E. specifications. Fasten stabilizer bar to stabilizer link and torque to O.E. specifications.

Raybestos Professional Grade chassis parts come with the industry's best parts and labor guarantee. If any Raybestos Professional Grade chassis part fails within the first two years… the cost of the part… plus the expense of your labor will be refunded.

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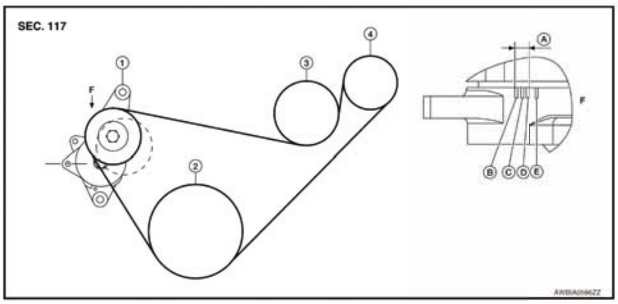
PROPERLY CHECKING AND SETTING BELT TENSION

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.



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).

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.

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.

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.

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.

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!

http://parts.nissanusa.com/

WHEN WILL MY GASKET BE READY TO USE?

Sealing an assembly with a pre-cut gasket spec'd for the job is a no-brainer. Just pop it on, assemble the parts and torque to spec. But what if the cut gasket isn't available, or you can't get it in time to finish the job? Many techs frequently face this situation and turn to a gasket maker for the solution; but even after a successful installation, there can be some nagging thoughts. Did I allow enough time for set up? Has it cured properly? Is the torque right? Will it seep or cause a leak? Here is some information that will help you get the most out of your gasketing efforts:

Not All Gasket Makers Are Created Equal

RTV silicones are the most commonly used gasket makers. Extremely versatile and capable, they can be used in a variety of applications. However, they have their limitations. Silicones need time to set up prior to assembly and may require 24 hours to completely cure before the part can be put back into service. If you're dealing with a metal-to-metal fit on mating flanges, an anaerobic gasket, not an RTV silicone, would be a better choice. If not completely cured, silicones lack the strength to hold their bead when torque is applied and will lose their seal. This could cause contamination due to sealant seepage into the part and may result in a loss of the vehicle's vital fluids.

Advanced Elastomeric Gasket Makers Offer 'Torque and Go' Performance

An alternative to using an RTV silicone is an elastomeric rubber gasket maker offered by Permatex®, an innovation leader and pioneer in gasketing technology. This gasket alternative is known as The Right Stuff®.

The Right Stuff was developed in collaboration with GM and Ford. It is used on their production lines and is OEM-certified for service applications. The elastomeric rubber compound in The Right Stuff has strength before curing (i.e., green strength), allowing it to hold up under torque without a curing period. It will outperform OE gaskets in non-fuel applications and is effective on scored or pitted surfaces.

Caution: 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. Learn more about gasketing technology from Permatex at **www.permatex.com**.

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A HEADLIGHT UPGRADE INCREASES MORE THAN JUST YOUR CUSTOMER'S VISION

It increases your profit margin because the more light you put on the road, the more cash you can put into your pocket. You'll get some extra profits from your lighting service and boost your customers' safety at the same time.

There are a lot of vehicles out there with bad headlights and a lot of drivers who need more light. Headlight bulbs are typically replaced when they burn out, yet in reality, they wear out, losing up to 40% of their brightness after only a couple of years. Add this to an aging population whose eyesight is also dimming and you've got nighttime driving safety issues.

More light is your selling tool

Studies show that most serious accidents occur at night, when driver's vision is weakest. So, what better motivation is there for you or your customers to make sure that the vehicle's lighting is the best it can be? That's where upgrade lighting shines. It features advanced technology that simply outperforms standard bulbs. Upgrade lighting puts more light on the road and delivers a better beam pattern.

Philips offers three upgrade bulb styles to meet the customer's needs.

All these factors focus a bright light on an ideal business opportunity. Upgrade lighting commands a higher price and that means you can earn a higher margin. Lighting maintenance is easy to add to your shop's list of services, whether the customer comes in for a basic oil change or a repair. Most of it involves a simple inspection but can blossom into a reasonably priced yet highly profitable job.

Philips Automotive Lighting, a leading innovator and first choice supplier to carmakers around the world offers a proven range of premium upgrade lighting that can deliver up to 100 percent more light than standard halogen lamps. It's offered in three different styles so customers can choose the level of light that best fits their driving needs and budget.

Philips can help any shop get into the lighting business and suggests a few key steps to get you started:

1. Inspect the vehicle — Make sure all driving, signal, and interior lights are working properly.

2. Check the connections — Inspect for fraying wiring and corrosion. Use dielectric grease for added reliability.

3. Replace bad bulbs — Replace all dim, flickering, and burned out bulbs. Always replace headlight bulbs in pairs so the customer has an even balance of lighting of the road ahead.

4. Restore clouded headlights — Hazy or cloudy headlight lenses can block up to 35 percent of the light. The fix is easy and can save the high cost of a headlight replacement.

5. Check headlight aiming —Headlights and auxiliary lights need to be correctly aimed to work properly. Check vehicle manufacturer's specifications for proper aiming.

6. Install auxiliary lights — Your customers would love those hot new LED daytime running lights if they knew where to get them installed.

For more information, visit **www.philips.com/automotive** or call 1-800-257-6054.

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Philips Vision, VisionPlus and X-tremeVision Headlight Bulbs

Philips halogen upgrade headlight bulbs deliver 30%, 60%, or even up to 100% more light on the road. More light at night makes driving safer and more enjoyable. Give your customers the headlight that's right for the way they drive – from Philips.

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PHILIPS

SKF DRIVE SHAFT SUPPORT BEARINGS PROVIDE COVERAGE FOR GM VEHICLES

The following SKF technical tip offers details regarding the following applications:

- 2000-99 1/2 Ton, 1500 C, K & R series w/4WD
- 2010-99 3/4 Ton, 2500 C, K & R series w/Ext. cab and 4WD

GM offered various drive shaft support bearings for the years and models noted above. Any one of the four drive shaft bearings discussed here could be on the vehicles listed above. To ensure you are installing the correct bearing for the application, a visual inspection of the bearing has to be performed before the removal of the old bearing.

Here are details you should look for on each bearing to ensure you are installing the proper bearing:

If the drive shaft support bearing has a horse shoe-shaped bracket and no mounting block or studs, use HB88505. (See Figure 1)

If it has a horse shoe-shaped bracket, a 9.5 mm thick mounting block on the base and studs, use HB88515. (See Figure 2)

If it has a flat bracket and studs, use HB88532.

If it has a horse shoe-shaped bracket with studs but no mounting block, use HB88540. (See Figure 4)

Rugged SKF drive shaft support bearings – built to meet or exceed OE specifications

SKF drive shaft support bearings feature center support bearings that are pre-lubricated and sealed with metal reinforced seals to prevent contamination; rubber support cushions that are manufactured from durable rubber compounds that provide maximum support while isolating the driveline shaft from damaging vibration; and drive shaft support frames that are constructed from steel or aluminum that provides additional strength and long life in harsh environments.

Recently, SKF introduced 18 new part numbers to its drive shaft support bearings product line. The new part numbers cover Chevrolet/GMC, Dodge, Ford and Saturn applications. The line of SKF drive shaft support bearings now includes over 90 SKU's for the most popular passenger cars and trucks. For many applications, brackets and slingers are included where necessary.

To download the drive shaft support bearings product flyer (457376) containing all the part numbers offered by SKF, visit www.vsm.skf.com.

SKF training truck – Delivering practical knowledge to automotive shops

Today's technicians and jobbers have various ways to train themselves on the latest technologies and trends – eLearning courses and technical manuals to name a few. But with the SKF training truck, you can bring the training right to your doorstep for a face-to-face and hands-on training session with a technical expert.

Manned by an ASE master certified technician, the SKF training truck showcases cutaways of premium SKF hub bearings and explains the differences between SKF hub bearings and competitor components. Additionally, a flat panel TV screen in the rear of the truck provides video demonstrations and eLearning opportunities for group training sessions.

SKF currently has four trucks traveling across the United States. If you'd like a training truck to visit your area, contact your local SKF representative.

For more information about SKF products and services, visit **www.vsm.skf.com.**

SKF
890 North State Street
Suite 200
Elgin, IL 60123
www.vsm.skf.com

DIAGNOSING TPMS LIGHTS ON HYUNDAI AND KIA VEHICLES

Every new vehicle sold in the U.S. since 2008 comes equipped with a tire pressure monitoring system (TPMS). To alert the driver of a problem, a universal "tire tread" symbol is used by all manufacturers. However, Hyundai and Kia use two TPMS lights; the familiar tire tread symbol and the letters "TPMS". A steady illuminated tread light indicates low tire pressure. When the letters "TPMS" are illuminated, it indicates that there is a TPMS system problem and a diagnostic trouble code (DTC) is created. The code is stored and the light remains on to bring the problem to the driver's attention.

While many technicians are familiar with the tread light, they may not be familiar with the diagnostic code light TPMS. The TPMS light can illuminate for a variety of reasons, including:

- Radio Frequency (RF) channel interference (C1312)
- Low or failed battery (C1121)
- Wrong sensor installed (C1318)
- Other system failures

Problem

A customer driving a 2010 Hyundai Elantra wagon pulls into a shop with both the tread light and the TPMS light illuminated. The technician is familiar with the steady tread light, but isn't sure what the TPMS light means or how to fix it.

The technician stops the repair process because of the following reasons:

- The shop's TPMS tool does not have the capability to read and clear the TPMS trouble code
- A diagnostic tool capable of reading and clearing the code is not available in the shop

- The technician doesn't have the training needed to use the diagnostic tool or is unfamiliar with the illuminated TPMS light on the dashboard.

Solution

The TechSmart® T55001TPMS scan tool kit from Standard Motor Products (SMP®) allows any level technician to read the DTC on a variety of vehicles, including Hyundai and Kia.

There is no need for a second diagnostic tool. The TechSmart T55001:

- Performs TPMS sensor relearn process on all import and domestic vehicles
- Displays complete sensor information including tire pressure, tire temperature, broadcast frequency, battery status and sensor ID location
- Only requires the vehicle make to operate
- Reads and displays TPMS diagnostic trouble codes for Asian vehicles
- Clones the original sensor by transferring the ID number onto the clone-able sensor, available from Standard® and Intermotor®
- Tests key fob signals and much more

Standard Clone-able TPMS Technology

As a leader in TPMS technology, Standard provides real clarity in this key growth category, providing more than 98 percent full-line VIO coverage. Standard 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 clone-able sensor has its own unique sensor ID, the right protocol and matching body style. Standard clone-able TPMS sensors offer the technician the advantage of bypassing complex factory relearn processes, therefore saving time and money while maintaining OE fit, form and function.

Standard, Intermotor and TechSmart offer a complete TPMS line including clone-able sensors, mounting hardware, service kits and advanced shop tools. Visit **www.StandardBrand.com** or **www.youtube.com/StandardBrandParts** to learn more about this exciting new TPMS technology.

NISSAN & INFINITI DMF INSTALLATION

LUK

Today's vehicles are becoming more and more complex to service. Proper procedures are very important to follow when making repairs to today's vehicles. This is especially true when working on Infiniti and Nissan dual mass flywheels.

2008-2012 Nissan 370Z 3.7L
2003-2007 Nissan 350Z 3.5L
2002-2006 Nissan Altima Nissan Maxima 3.5L
2005-2012 Nissan Xterra, Nissan Frontier 4.0L
2003-2007 Infiniti G35 3.5L
2008-2012 Infiniti G37 3.7L

The vehicles listed above have a crankshaft tone ring built into the flywheel. The dual mass flywheel is not indexed on the crankshaft and can be installed different ways.

When installed incorrectly, the vehicle may not start, have a check engine light, and the engine will not rev past 2,000 rpm.

When removing a dual mass flywheel from the vehicles listed above it is recommended to make your own indexing marks on the flywheel and crankshaft. When installing the new flywheel transfer your marks from the old flywheel to the new flywheel to ease installation and assure proper indexing.

If you have already removed the flywheel and did not make any indexing marks, follow this procedure for proper installation:

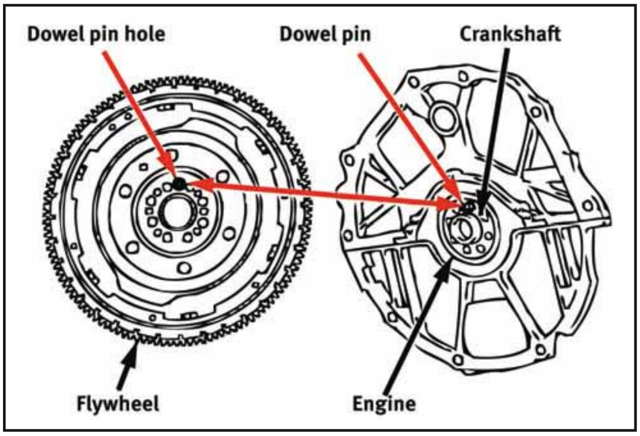
1. With the flywheel removed look for the alignment dowel pin hole on the end of the crankshaft.

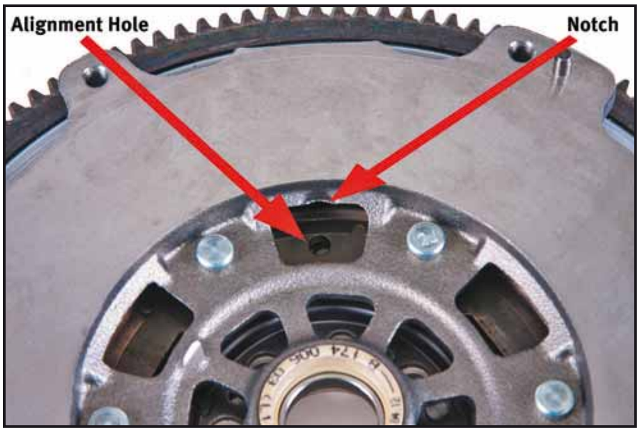
2. On the new flywheel find the same alignment dowel pin hole. This can be done by finding the locating hole and notch on the front side of the flywheel. (Middle figure)

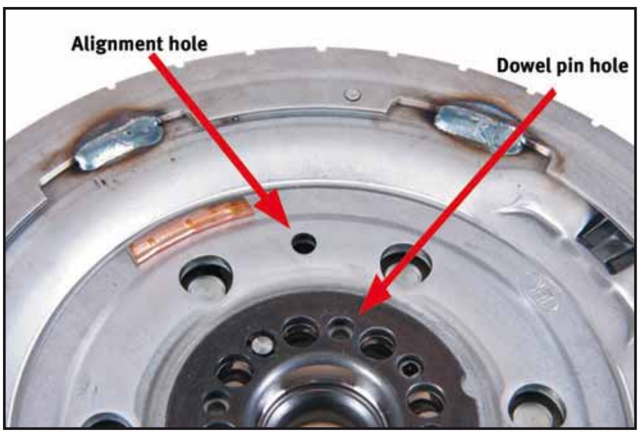
When you have located the notch and hole on the front side, flip the flywheel over and find the same hole that goes all the way through the back side. Then look at the diagrams to the right and find the dowel pin hole.

3. When both have been located align the two holes and torque the flywheel to the proper specifications.

4. See diagrams to the right to aid in locating the correct dowel pin holes.







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www.Schaeffler-Aftermarket.us

SCHAEFFLER GROUP
AUTOMOTIVE AFTERMARKET
LUK INA FAG

'EVERYTHING GETS OLD'... EXCEPT THE RIDE CONTROL OPPORTUNITY

Shock absorbers and struts are hidden beneath the vehicle, and many motorists simply aren't aware of when and how they wear out. In contrast, many other consumer goods – furniture, clothing, tires, and batteries – offer obvious signs that tell the owner it's time to replace old with new.

Tenneco's Monroe® shocks and struts brand is committed to closing the gap between consumer replacement of everyday worn products and the ride control components that help keep motorists safe. The brand's innovative new "Everything Gets Old. Even Your Shocks" integrated marketing campaign is reminding millions of vehicle owners that shocks and struts get old – just like their favorite chair or pair of shoes.

"Shocks and struts often wear out so gradually that many vehicle owners fail to detect the loss of steering precision, stopping performance and stability," said Monroe Brand Manager Carri Irby. "Our campaign reminds consumers that ride control components are just like most other products, including tires and brakes – they get old. And when they do they can compromise the safety of their vehicles and should be replaced at 50,000 miles[1]."

The Monroe campaign includes thousands of print, online and network radio ad placements and hundreds of strategically selected roadside billboards. The "Everything Gets Old" message also will appear in high-visibility banners behind the plate and along the baselines of several leading Major League Baseball stadiums. Digital placements include engagement-driven Web banners, "in-app" music/radio ads and a variety of elements designed specifically for users of mobile electronic devices.

Tenneco is coordinating its radio presence with the launch of billboards in several major markets. In addition, popular radio personalities will make special appearances in conjunction with local Monroe "Ride & Drive" ride control training events to reinforce the importance of inspecting and replacing worn shocks and struts.

World-Class Solutions for Today's Vehicles

When consumers do invest in replacement ride control products, Tenneco offers a comprehensive portfolio of premium Monroe shocks and struts engineered to help restore "like-new" ride and handling:

Monroe Quick-Strut® assemblies – the premium, guaranteed assemblies that helped revolutionize strut replacement – incorporate Tenneco's exclusive, application-engineered damping technologies in a convenient, timesaving solution that helps drive business and ensure a high-quality repair.

Monroe OESpectrum® shocks and struts feature a Twin Technology Active Control system that delivers a new level of control for a broad range of passenger cars and light trucks while filtering out unwanted noise, vibration and harshness.

Monroe Sensa-Trac® shocks and struts combine enhanced control and uncompromised ride comfort for virtually any popular domestic passenger car or light truck application.

Monroe Reflex® shocks and struts, offered in application-engineered monotube and twin-tube designs, help provide enhanced stability and control on full-size light trucks and SUVs.

Learn more about Monroe products and programs by contacting your Monroe supplier, visiting www.monroe.com and/or downloading the new Monroe App for your mobile device.

1 Actual mileage may vary depending upon driver ability, vehicle type and type of driving and road condtions.

MONROE
SHOCKS & STRUTS

Monroe® Shocks & Struts
Tenneco Inc.
www.monroe.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.

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, due to 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**.

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*

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WTI WORLDPACTraining Institute

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the latest products

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

HEAD BOLT SETS

Magnum Gaskets has announced another product line expansion in the second quarter of 2013. Magnum is introducing 33 new OE quality head bolt sets, covering thousands of the most popular make/model/year combinations for domestic and import vehicles, it reports. Magnum resellers have requested head bolts as a natural add-on sale to complement Magnum's cylinder head gaskets and the entire premium Magnum Gasket line. The current line covers more than 80 percent of sales in manifold, valve cover and oil pan gasket categories for domestic and import cars and light trucks at very competitive prices.

For more information, visit
www.magnumgaskets.com.
Magnum Gaskets

UPGRADE HEADLIGHT BULBS

Philips Automotive offers a new range of upgrade headlight bulbs that deliver advanced technology and performance with a focus on safety and style. Drivers can simply choose the level of lighting performance that best fits their driving needs and budget. In this range, Philips offers three lighting options: Philips Vision, which provides 30 percent more light; Philips VisionPlus offering 60 percent more ligh;, and Philips X-treme Vision, which can deliver up to 100 percent more light than a standard halogen headlight bulb, according to the manufacturer.

For more information, visit
www.usa.lighting.philips.com.
Philips Automotive

WATER PUMP PLIERS

The Cobra Quick Set addition to the Cobra Water Pump Pliers family from KNIPEX Tools LP combines features of automatic adjusting pump pliers with the traditional push-button pump pliers. Distinguished by a blue button and measuring 10 inches in length, the Cobra Quick Set Pliers feature a 2-inch gripping capacity. The pliers are ideal for use during repetitive work, the company states. Now, instead of having to press the patented push-button mechanism to adjust the tool, the user can slide the top handle forward. A built-in shifting mechanism allows the operator to smoothly and easily adjust the tool to the correct capacity when access to the push-button is limited.

For more information, visit
www.knipex-tools.com.
Knipex Tools

PROTECTIVE EYEWEAR

Honeywell Safety Products introduced two styles of protective eyewear, Conspire and Relentless. Both feature the new North Signature Fit profile, specially designed to comfortably fit at least 85 percent of wearers right out of the box without the need for advanced adjustments. Given their combined protective qualifications, lightweight design and adjustment-free fit, Conspire and Relentless deliver extreme value to safety managers by simplifying the safety eyewear purchasing process, Honeywell states. The North Conspire Series of safety eyewear features the exclusive North Signature Fit profile to ensure a simple, adjustment-free fit for the widest range of faces. Its lightweight, full-wrap design includes an eight-base, single front with dual lenses for unparalleled protection plus a shaped nosepiece and flexible temples for superb comfort. Conspire contains no metal parts for safe dielectric use. Lens tint options include Clear, TSR Gray, Amber, Silver Mirror and Indoor/Outdoor Silver Mirror for use in nearly any lighting environment. Fog-Ban® anti-fog lenses are available in Clear and TSR Gray tints to provide optimal visual clarity in hot and humid environments. Conspire provides 99.9 percent ultraviolet protection and is certified to meet both the ANSI Z87.1+ standard for high-impact protection and the CSA Z94.3 standards.

For more information, visit
www.honeywellcpg.com.
Honeywell Safety Products

ONE KEY LOCKS

A.R.E. has partnered with STRATTEC Security Corporation to make its BOLT one-key locks standard equipment on all A.R.E. Deluxe Commercial Unit (D.C.U.) pickup caps and Site Commander units. A.R.E. and BOLT have been collaborating in the industry for several

years, merging heavy-duty, fully welded aluminum commercial truck caps with patented, advanced lock technology. Now, A.R.E. truck cap owners can experience reduced downtime caused by lost and broken keys, or having the wrong keys at job sites, while minimizing the frequency of theft, through BOLT high-quality locks, which are permanently programmable to a specific ignition key. Equipping A.R.E. commercial truck caps with BOLT OEM-grade lock cylinders eliminates the need for multiple keys to operate the truck as well as the truck cap, toolboxes and doors, the company says. BOLT technology, which offers quality, durability and corrosion resistance, enables any number of locks to be configured to a single key.

www.4are.com
A.R.E.

EUROPEAN VEHICLE SOFTWARE KIT

The European Vehicle Software Kit for VERUS PRO from Snap-on provides everything that professional technicians need to expand the capability of their new scan tool to include the most popular 1992 through current European vehicles such as for Audi, BMW, Jaguar, Land Rover,

Mercedes, MINI, SMART, Volkswagen and Volvo. Snap-on states the European Vehicle Software Kit for VERUS PRO includes the European software activation on a USB memory stick, VW1 adapter, MB1 adapter, MB2A adapter, BM1B adapter and data cable. VERUS PRO is a new top-of-the-line diagnostic and information system that combines an exclusive suite of tools to give professional service technicians the ability to bring all of the answers to the bay wirelessly, in one tool, to manage the job from start to finish.

www.snapon.com
Snap-on Diagnostics

DISC ONLY ASSEMBLY

SuperTrapp Industries' Disc Only Assembly with Mounting Adaptor is a lightweight, tunable, disc-based assembly with a mounting adaptor. The discs serve as an integrated U.S. Forest Service-approved spark arrestor. Select models include twelve, 3-inch, 4-inch or 5-inch discs. The 3-inch, 4-inch and 5-inch SuperTrapp Disc Only and Adaptor Only are available in several inlet diameters.

www.supertrapp.com
SuperTrapp

HIGH PROFILE SERIES FANS

Maradyne High Performance Fans offers its Champion High Profile Series fans that are ideal for high static pressure applications, it states. Champion High Profile Series straight-blade puller fans are designed to increase engine cooling, horsepower and A/C cooling at idle. They feature wide, paddle-style fan blades for maximum air movement. Maradyne offers a 12-inch straight-blade puller fan (part No. TA12A3001) that delivers 1,860 cubic feet per minute (CFM) with an amp draw of 15.0. The 11-inch straight-blade puller fan (part No. TA11A3001) delivers 1,380 CFM with an amp draw of 11.0. Both fans measure 3.81-inch deep and have a 225 watt heavy duty, closed motor.

www.maradyne.com
Maradyne High Performance Fans

RATCHETS

Ingersoll Rand is adding new ratchets to its evolving IQV20 Series cordless line. The Ingersoll Rand R3130 3/8-iinch and R3150 ½-inch 20V cordless ratchet wrenches provide the power, portability and access users need for tight access jobs. These ratchets are ideal for engine repairs, under-car work, and light industrial maintenance, repair and operations (MRO) applications. The Ingersoll Rand R3130 and R3150 ratchets are in a class of their own, as competitive cordless ratchets are lower voltage and deliver much less power, the company says. The cordless ratchets deliver 54 foot-pounds of torque to complete automotive and industrial equipment repairs quickly. The R3100 Series ratchets are manufactured with the same durable heads as Ingersoll Rand air-powered ratchets. In addition, the patent-pending metal and composite housing and all-metal gear train help the tool survive repeated drops on garage or plant floors.

www.ingersollrand.com
Ingersoll Rand

CAMARO RING AND PINION

Lingenfelter Performance Engineering (LPE) offers premium ring and pinion gear sets for the 2010-2012 Chevrolet Camaro SS. Manufactured by an OE gear supplier and designed to meet OE specifications for long life and quiet operation, all gears are 100 percent single flank rolled to ensure that no gears are unacceptable for noise, vibration and harshness (NVH) characteristics, the company says. The gear sets fit both manual and automatic transmission Camaro SS differentials. The ring & pinion gear sets are available in several different ratios, and the Camaro 3.70 ring and pinion (part No. L380011410) features a 10-tooth pinion and 37-tooth ring design.

www.lingenfelter.com
Lingenfelter Performance Engineering

AIR INTAKES FOR JEEPS

dB Performance by CORSA offers a new line of air intakes designed for late-model Jeeps and trucks. The dB Performance Air Intakes feature filters with PowerCore Filtration Technology by Donaldson, which optimize engine performance by directing air through specifically designed channels that allow clean air to efficiently enter the engine. Made from injection-molded plastic, the dB Intakes contain an application-specific filter box that is engineering to minimize hot air from entering the engine for increased horsepower. In addition, a silicone connector provides flexibility while maintaining strength and thermal stability. The air duct has been sculpted with larger diameters, unique bends and smooth transitions to deliver maximum performance.

www.corsaperformance.com
CORSA Performance

MULTI-PURPOSE SPRAY LUBE

Royal Purple developed its multi-purpose spray lube called Maxfilm. Most brands of spray lube rely on a mixture of mineral-based oils and solvents that work primarily as a Water Dispersant and need to be repeatedly applied to be effective. Maxfilm is a true two-in-one product uses a blend of unique fully synthetic chemistry, including Royal Purple's own Synerlec additive technology, according to the manufacturer. Combining a quickly penetrating and evaporating solvent with a durable, fully-synthetic, high-strength dry film, Maxfilm is great at lubricating and providing long lasting protection from corrosion and wear with as little as one application.

www.*royalpurpleconsumer*.com
Royal Purple

DIGITAL BATTERY TESTER

Clore Automotive presents Model No. 1860, a 125 Amp digital fixed load battery tester, from SOLAR. The 1860 is designed for portable professional use and tests both battery condition and charging/starting system performance. SOLAR Fixed Load Battery Testers offer quick, easy analysis of battery condition and starting and charging system performance, Clore states. The 1860 features an ergonomic design for comfortable use and improved safety. It delivers a true 125 Amp load and is calibrated to test batteries up to 1000 CCA. This unit features an easy-to-read digital output meter and an LED status panel for battery condition assessment. It can be used to test most 12 Volt batteries, starting and charging systems.

www.cloreautomotive.com
Clore Automotive

TWO-POST LIFT

Rotary Lift SPO18 two-post lift has a lifting capacity of 18,000 pounds. It comes equipped with a multi-position locking system that engages every four inches and an overhead switch bar to prevent raising a vehicle too high. A six-position wheel-spotting dish helps accurately spot a wide variety of vehicles, and stackable adapters make contacting the vehicle's pickup points quick and easy. The SPO18 two-post lift is made in Madison, Ind. It has been third-party tested by ETL and ALI certified to meet ANSI safety and performance standards.

www.rotarylift.com
Rotary Lift

VEHICLE DIAGNOSTICS SYSTEMS

AutoEnginuity, LLC has released the new and improved ProLine VCI and ScanTool 11.1 for the Windows platform. ScanTool is an award-winning vehicle diagnostics system for the professional vehicle service industry. The ProLine VCI connector supports new electrical improvements such as the improved protection for ISO pins to prevent errant vehicle power from overheating the connector. Also included is more electronics required for the new Fiat, Ferrari, and Maserati enhancements. Finally, more electrical switches were added to allow for more K line isolation from other protocols making switching protocols more reliable on mixed bus vehicles, the company reports. The ProLine VCI update includes an integrated security dongle freeing up a USB port for other devices and making the connection easier to perform with one less device to connect.

www.autoenginuity.com
AutoEnginuity

DIAGNOSTIC WHEEL BALANCER

Hunter's Road Force Touch diagnostic wheel balancer is now approved equipment for BMW and Mercedes-Benz dealers. The Road Force Touch is the world's leading diagnostic wheel balancer, providing exceptional balancing results and performing a Road Force diagnostic test faster than a traditional wheel balancer performs a typical balance, it reports. Road Force Touch is Hunter's fourth generation design since the platform was introduced in 1997. Road Force Touch machines for BMW and Mercedes-Benz ship from Hunter embedded with each OE's specific settings.

www.hunter.com
Hunter Engineering

RECHARGE HOSE AND GAUGE

IDQ Inc. introduced ACP-400, a reusable long-length recharge hose and gauge that fits all standard R-134a refrigerant cans. A/C Pro's new hose and gauge kit features a longer hose for easier access and a larger gauge for more accurate refilling. The hose is two times longer than the hoses that come with most kits, allowing users to access low pressure ports that on some vehicles are hard to reach, with relative ease, they state. In addition to the longer length, A/C Pro's hose kit includes a 40 percent larger dial-in gauge for easier viewing and more accurate measurements when recharging a car's air conditioning system.

www.acprocold.com
A/C Pro/IDQ Inc.

FULL SYNTHETIC 0W-10 RACING OIL

Champion's new "Purpose-Built" full synthetic 0w-10 Racing Oil offers a lower coefficient of friction than competitive drag racing motor oils. Champion's 0w-10 Racing Oil utilizes a premium ZDDP anti-wear protection package, which contains a unique balance of chemistry including high levels of zinc and phosphorus. This specialized drag racing oil also is designed increase horsepower and torque, resist the thinning effects of fuel dilution, and is highly resistant to evaporative losses, thus reducing oil consumption, according to the manufacturer. These low rates of oil consumption allow oil to flow freely without significant "boil-off" thickening to ensure dependable viscosity, engine lubrication and protection.

www.championbrands.com
Champion Brands LLC

ELECTRICAL CONNECTOR TERMINAL CLEANER SET

IPA presents a tool designed to clean plow electrical connectors, the Plow Electrical Connector Terminal Cleaner Set (No. 8045). This three-piece set will remove corrosion and extend harness life of male and female electrical connections. Over time electrical connections inevitably become corroded and dirty, often causing circuit failure. If left untouched, connection pins will need to be cut and repaired, or the electrical harness will require replacement, the manufacturer states. These reparations are costly and time consuming. The Plow Electrical Connector Terminal Cleaners saves time and money by quickly reconditioning electrical connections. This three-piece set is made for removing corrosion from common round pin (male and female) plow connectors found on electro-hydraulic grill mounted plow connectors such as Meyers, Boss, Fisher, Western and similar.

www.ipatools.com
Innovative Products of America

BRAKE CALIPER BRACKETS

Don't waste time with a wire brush and expensive chemicals to clean old, rusty brackets — CARDONE can do the work for you. The company has released 34 additional SKUs of A1 CARDONE Brake Caliper Brackets covering many popular applications including 14-1443 Honda/Acura trucks 2005-2012, 14-1681 Hyundai/Kia 2006-2012, 14-1547 Nissan Altima/Sentra 2007-2010, 14-1379 Toyota Sienna 2004-2010, 14-1692 Volkswagen Golf/Jetta 2005-2012, 14-1680 BMW 3 Series/Z4 1999-2006, 14-1688 Kia Sorrento 2003-2009, 14-1678 Mazda 3/Volvo 2004-2012, 14-1259 Dodge Caliber 2007-2012, 14-1091 Ford Mustang 2005-2010 and 14-1682 Kia Sepha/Spectra 1994-2000.

www.cardone.com
CARDONE Industries

BELT INSTALLATION TOOL

The ContiTech Power Transmission Group service offering for the automotive aftermarket now includes a new tool box: The ELAST TOOL F01 special tool for installing elastic V-ribbed belts for Ford and Volvo engines. Installing elastic V-ribbed belts can occasionally be a bit of a chore on certain Ford and Volvo engines. The ContiTech ELAST TOOL F01 now gives repair shops a specialist tool that makes changing alternator belts easy — on Ford Focus, C-Max and Mondeo 1.4/1.6 l gasoline models as well as on Volvo S40, C30 and V50 1.6 l gasoline models, the company says. Universal tools do not work on these engines because they would have the belt slipping off the water pump¹s collarless disk. The second, shorter belt on the belt drive — for the air conditioning compressor or power steering pump, depending on the vehicle — can be changed using the installation device in the relevant complete package, or with the universal UNI TOOL ELAST from ContiTech. A flyer for the new tool box, which also includes illustrated installation guidelines, is also available.

www.contitech-usa.com
ContiTech Power Transmission

PERMATEX RIGHT STUFF MAKES GASKETS IN LESS THAN A MINUTE

This form-in-place gasket maker cures in a minute, allowing parts to return to service immediately. A sensor-safe, elastomeric rubber, this formulation is OEM-approved. Blowout resistant, Right Stuff prevents leaks from vibration and thermal expansion and does not break down when in contact with ATF, coolant, oil and other shop fluids. www.permatex.com

Permatex

MOTOLOGIC FROM ADVANCE AUTO PARTS PROFESSIONAL

Save time and turn bays faster with the award-winning MotoLogic. MotoLogic uses a web-based search engine for effortless navigation, and returns instant results for diagnostic and repair information. MotoLogic offers easy access to OE service information including factory wiring diagrams with circuit highlighting, connector views, preserved hyperlinks and enhanced images. Visit AdvanceCommercial.com/MotoLogic.

Advance Auto Parts

REGISTER NOW FOR AAPEX 2013

You will grow your business at the Automotive Aftermarket Products Expo (AAPEX) by seeing the newest products, meeting the right people and getting answers to your important questions. AAPEX 2013 is set for Tuesday, Nov. 5, through Thursday, Nov. 7, at the Sands Expo Center, Las Vegas. To register, visit www.aapexshow.com.

AAPEX
AUTOMOTIVE AFTERMARKET PRODUCTS EXPO

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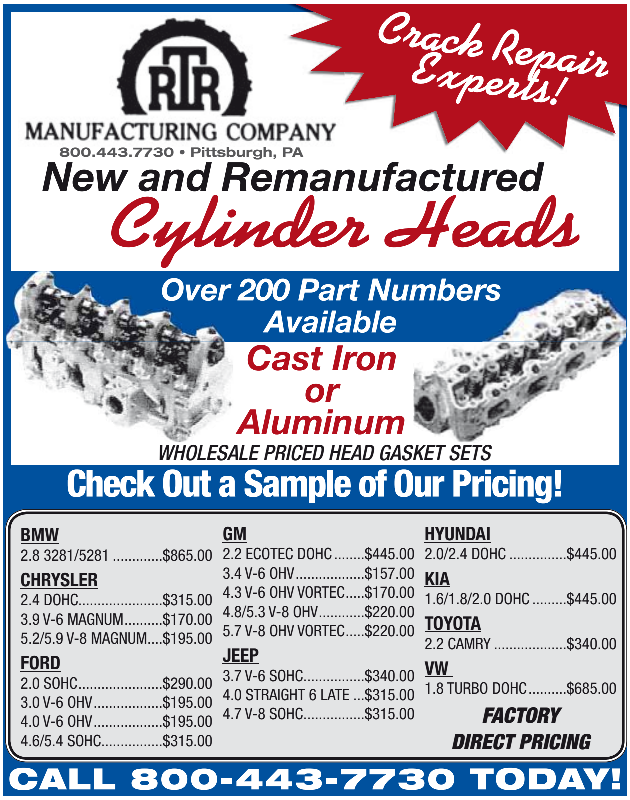

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LET'S SAY HELLO TO MR. DSO

IT'S TIME TO DUST OFF THAT SCOPE AND PUT IT TO WORK.

BY **PETE MEIER**
Technical Editor

MotorAge.com/june13trainer

In this issue of *Motor Age*, contributing editors Bernie Thompson and Jaime Lazarus show how the use of a Digital Storage Oscilloscope (DSO) to diagnose a problem made the task easier and saved the technician a lot of time and aggravation. There is no question that a modern automotive labscope, in the hands of someone who is willing to learn how to use it, is a powerful diagnostic tool.

Many of the technicians we have met around the country tell us that they (or the shop) own a scope but are unsure of how to use it or when to use it. The answer to when is pretty simple. You can only get comfortable using any diagnostic tool or process by doing it a lot, and doing it first on vehicles you know are OK. As we have said in these pages many times over, troubleshooting problems is similar to that old game where you compare two pictures to each other, looking for the differences between the two. If you look at lots of good pictures, then when you see a bad one, it will stand right out.

How to use the DSO is another story, and one we intend to try and help you with right now. In this month's The Trainer video, we will show you the basic settings and how to choose the ranges you want dependent on the signal you intend to capture. We also will show you some common testing procedures and how to connect your scope to perform them. And we will look at why these connections are made the way they are so that you can apply that knowledge to future challenges on your own.

If you can read a schematic and use a digital multimeter, you are well on your way to becoming proficient with a scope. Add in a few of the accessories we will show you, and you will turn that scope into a tool that never collects dust again.

The Trainer is *Motor Age*'s monthly how-to video feature. We aim to teach technicians of all abilities new methods and techniques that will save them time and troubles in the bay. You can view a few years worth of The Trainer archives in the AutoPro Workshop by going to MotorAge.com/thetrainer. And if you have something you would like to learn more about, let us know either in the Workshop or by sending an email to pmeier@advanstar.com. MA

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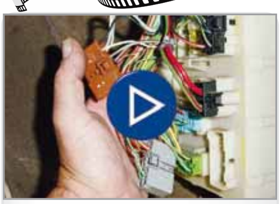
[VIDEOS]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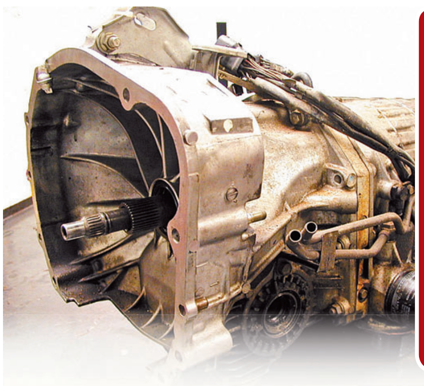

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CROSS-CONNECTING IS A CONCERN IN SUBARUS FOLLOWING SOME MODIFICATIONS.

WAYNE COLONNA

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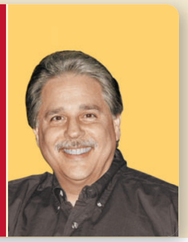

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