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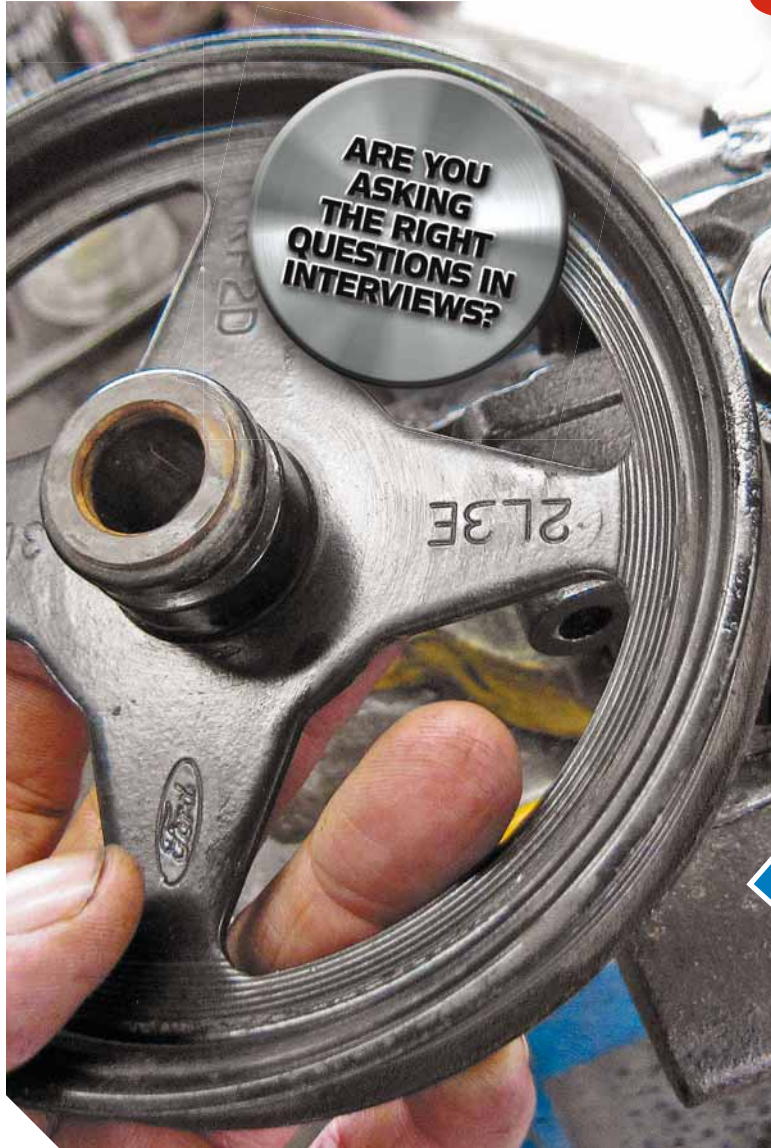
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Vol. 132, No. 10

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PRODUCTS

WHAT YOU MIGHT SEE THIS FALL

Annual trade shows are upon us, meaning new products will be hitting the streets.

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MAINTAINING POWER ASSIST

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TRENDING

EDUCATOR OF THE YEAR NAMED

David Byrd wins the 2013 honor from Mitchell 1.



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6 The North Carolina educator earned the Mitchell 1 award at the North American Council of Automotive Teachers conference earlier this year.

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6 Following its redesign of ASAShop.org, the association updated the legislative website, too.

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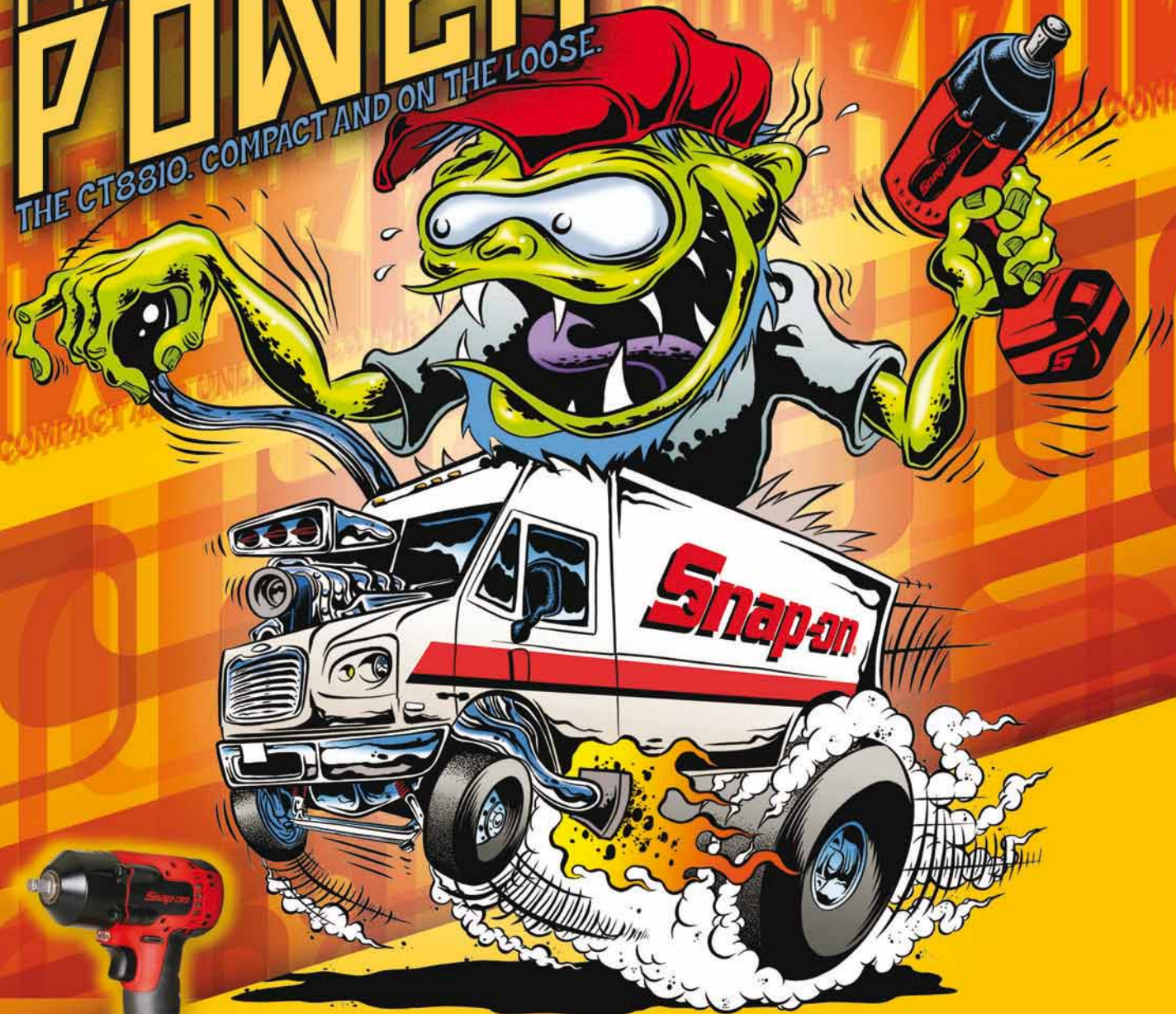
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»» MOTORAGE.COM/ASRWAPP

CARDONE UNVEILS POWER STEERING VIDEO

CARDONE just released a new ProTech technical video, "Simple Power Steering Contamination Test."

»» MOTORAGE.COM/CARDONEPS

FRANCHISES CONFIDENT ABOUT 2013 SALES, MARGINS

Auto service franchises experienced stable or increased sales and gross margins in 2012, an AMBW study reports.

»» AFTERMARKETBUSINESS.COM/FRANCH

TIGER GROUP LIQUIDATING ASSETS OF FENCO

Tiger Group is liquidating the former assets of one of North America's biggest auto parts suppliers, Fenco.

»» AFTERMARKETBUSINESS.COM/FENCO

FINDING KEYS TO CYCLE TIMES

Cycle time is one of those metrics that we all know is important, but do we really know why?

»» ABRN.COM/CYCLETIMES

WINDSHIELD WARNINGS

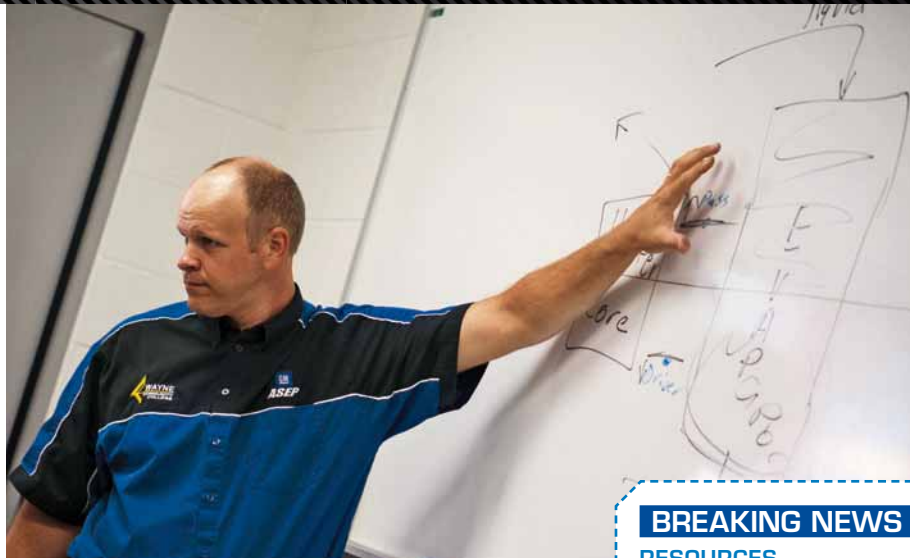
This author heard about a lawsuit involving a Toyota dealer who contracted out a glass repair on a 2005 Toyota Tundra that later was in an accident. Who's liable?

»» ABRN.COM/WINDSHIELD

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David Byrd in action in his classroom at Wayne Community College in Goldsboro, N.C.

SUPPLIER HONORS

David Byrd named Educator of the Year

David Byrd of Goldsboro, N.C. was named the Mitchell 1 2013 Educator of the Year during North American Council of Automotive Teachers (NACAT) conference in Quebec City, Quebec, Canada. Byrd was presented with a check for \$500 and a recognition certificate. He will receive a one-year complimentary subscription to Mitchell 1's ProDemand™ repair, diagnostic and maintenance information program for the school.

Byrd has been an automotive instructor in the applied technologies division at Wayne Community College in Goldsboro for 14 years. As a member of the International Association of General Motors (GM) Automotive Service Educational Program (ASEP), Byrd has served on many committees and currently is the Constitution Committee chairperson. He has participated in the GM ASEP curriculum writing project as well as in a book review for Automotive Engine Performance, published by Thomson Delmar.

Byrd's career also includes working at a Chevrolet-GMC dealership, which later went on to include Cadillac and Oldsmobile. He received a tremendous amount of training from GM and became master certified as a Chevrolet, Cadillac and Oldsmobile technician. He also achieved ASE Master Technician status, which he has held for 22 years. Byrd attended the Universal Technical Institute (UTI) in Houston and graduated from the GM ASEP program at Wayne Community College.

BREAKING NEWS RESOURCES

ASA UPDATES ITS LEGISLATIVE WEBSITE

The Automotive Service Association (ASA) has provided independent repairers access to a web-based advocacy program at the federal and state levels for a number of years.

After researching various online advocacy programs, ASA has been working to remodel its legislative and regulatory website, www.TakingTheHill.com. The new website is more user-friendly and designed to move information quickly to members and to policymakers, ASA states. ASA members are encouraged to visit the newly designed site and sign up for free legislative alerts.

"With our Washington, D.C., office on Capitol Hill looking out for repairers, the industry looks to ASA for grassroots advocacy

[Website] CONTINUES / PAGE 8

Discussion is on-going in MotorAge.com forums



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[Website]

CONTINUED FROM PAGE 6

and information. Redesigning this site is one more step in the association's commitment to provide members with the tools they need to stay informed and be heard on Capitol Hill," said Angie Wilson, ASA's vice president of marketing and communications.

The TakingTheHill.com website redesign was donated by Autoshop Solutions, the website design and Internet marketing agency that recent-

STUDENT WINS AT WORLDSKILLS COMPETITION

Kieron Kohlmann of Racine, Wis., and a student at Ferris State University in Big Rapids, Mich., represented the United States in Leipzig, Germany, during the biennial WorldSkills Competition and won a Medallion of Excellence (scoring at least 500 out of 600 points) in the Automobile Technology competition. Kohlmann competed as a member of the United States WorldTeam. The 42nd international event was held July 2 to 7, 2013.

Kohlmann was also recently awarded the gold medal and received "best in nation" in Auto Service Technology in November 2012 during the WorldSkills America's competition in Brazil where the United States competed against 23 other countries in preparation for the WorldSkills Competition.

Kohlmann works at Bohl Automotive in Racine and took automotive technology classes at Washington Park High School which has an ASE/NATEF certified program. Dave Dixon and Gottfried Georgi were his automotive instructors. Both were excited about Kohlmann's participation with the WorldTeam. "As an AYES automotive instructor and SkillsUSA advisor, I feel very fortunate to have been part of the automotive education for a student the caliber of Kieron Kohlmann," said Dave Dixon. "Kieron absolutely loves anything automotive and has a tremendous under-

"We spent time collaborating with the ASA team in Washington to develop a site that provides a clean navigation and design with featured posts on the home page," – Margaret Klemmer

standing of how to diagnose and repair automobiles," said Gottfried Georgi.

"Kohlmann came to Ferris State University with very high skills and expectations and has continued to develop his technical and professional skills," said Greg Key, director of the School of Automotive and Heavy Equipment at Ferris State University. "I know Kohlmann will go a long way in the automotive industry with his continued effort."

In the WorldSkills Automobile Technology contest, competitors must carry out inspection, testing and repair to vehicle electrical systems; construct basic electrical circuits; carry out inspection, testing and repair of charging and starting systems; carry out inspection, testing and repairs to braking systems; remove and refit driveline components; inspect test and repair steering systems/components; inspect, test and repair of all suspension systems; carry out steering wheel alignment operations; carry out inspection and repairs to four-stroke engines; inspect, test and repair of manual/automatic transaxles/transmissions; inspect, test and repair diesel fuel systems; inspect, test and repair of four-stroke spark ignition engine management systems which include electric, electronic petrol fuel systems, emission control systems, and ignition systems; and, determine the precise location of component faults within various light vehicle systems using advanced diagnostic procedures and specialist diagnostic tooling and equipment.

Every two years, hundreds of young people from 53 member countries or regions compete in the WorldSkills Competition. Member countries include

ly redesigned ASA's main website, www.ASAshop.org.

"It was great working with the ASA team again, this time to launch the legislative website," said Margaret Klemmer, vice president of operations at Autoshop Solutions. "We spent time collaborating with the ASA team in Washington to develop a site that provides a clean navigation and design with featured posts on the home page. We also brought the toolbox components front and center, making it easy for ASA members to take action on the site."

Japan, England, Saudi Arabia, Canada, Australia, Thailand, Brazil and many others. Considered "the best of the best," contestants compete for four days in 45 occupational skill areas from economic sectors including manufacturing, information technology, transportation, construction and services. Accompanied by their teachers, trainers and industry technical committee experts, these young people compete before the public in contests that are run and judged by industry using demanding international standards.

Over its 60-year history, WorldSkills International (formerly known as the International Youth Skill Olympics) has come to symbolize the pinnacle of excellence in vocational training. It provides a unique means of exchange and comparison of world-class competency standards in the industrial trades and service sectors of the global economy. The continued growth of WorldSkills International attests to the fact that traditional trade and craft skills along with the newer technology multi-skilled occupations makes an essential contribution to the economic and social well being of people everywhere.

In 2013, more than 1,000 competitors tested their skills in Leipzig, Germany. Five thousand international experts, delegates and judges gathered from around the world, and 3,000 volunteers were recruited to assist in the event. A total of 150,000 student and public spectators attended the competition at the Leipzig Trade Fair and Exhibition Center. For more information about the competition, go to: www.worldskills.org or www.worldskillsleipzig2013.com.



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MAHLE Clevite kicks off tech contest

MAHLE Clevite Inc. recently announced the third annual MAHLE Clevite Champion Technician Contest, a contest designed to spotlight talented and forward thinking engine technicians and specialists nationwide. By answering a series of five questions, one grand-prize winner will be determined and receive a VIP trip to the 2013 NASCAR Sprint Cup Series Champion's Week in Las Vegas.

"Since its inception in 2011, the MAHLE Clevite Champion Technician Contest has enabled us to recognize the persistence and tireless dedication of today's engine technicians, nationwide," said Ted Hughes, Manager – Marketing for MAHLE Clevite. "In this – our third consecutive year of the contest – we once again will salute one passionate individual who exemplifies a 'champion' in every sense of the word."

In order to enter, participants must answer a series of five questions that describes the nominee's passion about engines and engine rebuilding, explains the history of how their journey in this field began, describes a defining moment in their career, and describes the skills and talents the individual exemplifies to characterize them as a "champion."

Cash back program for green shops

The Find Green Garage public verification program has received new grant funding to provide vehicle service and repair shop owners (as well as their customers) cash-back incentives for improving their carbon footprint and reducing energy consumption.

Shop owners registered in the ENERGY STAR Green Garage Challenge can sign up to receive incentives for managing their green sustainability on a continuous basis. Participants in the program will earn from 3 to 10 percent for purchasing green products, minimizing waste, and reducing their energy usage, according to the organization.

The Green Garage Challenge (www.findgreengarage.com) is an EPA Small

Participants either can submit an entry about themselves, or on behalf of the nominee. Contest registration forms can be downloaded at www.mahleclevite.com/championtechnician. They can be submitted via email to mahle.clevite@us.mahle.com or by faxing the completed application to (248) 596-8899 through Oct. 28, 2013.

The grand prize winner will receive a trip to Las Vegas Dec. 4 to 7, 2013, including coach airfare for two, a three-night hotel stay, a special meet-and-greet with a NASCAR personality, MAHLE Clevite VIP dinner for two at a five-star Las Vegas restaurant, two tickets to NASCAR Victory Lap™ and NASCAR After The Lap™, as well as tickets to the NASCAR Sprint Cup Series Awards™ and the NMPA Myers Brothers Awards Luncheon, a feature on MAHLE's website and social media sites, Las Vegas and Officially Licensed NASCAR merchandise, and a commemorative plaque. The prize package is valued at approximately \$4,000.

See Official Rules for details. No purchase necessary to enter or win. Contest is sponsored by MAHLE Clevite Inc. and is open to legal residents of the 50 United States. Entrants must be 18, and nominated technicians must be 21 or older at the time of entry. Contest ends at 11:59 p.m. ET Oct. 28, 2013.

Business Partnership program for improving energy efficiency in the auto service and repair industry. Shop owners can use the online tools on the site to provide data and receive a rating based on energy usage and emissions.

According to Steven Schillinger, administrator of the Green Garage Challenge, interested shops can receive a free audit to qualify their eligibility. "We have a network of 600 contractors that evaluate the shops to determine where they can improve their performance," Schillinger says. "You look at things like whether they leave the roll-up doors open in the winter, or if they're using an old air compressor, and determine how to improve their energy use."

The rewards are available to shops that achieve a 10 percent carbon footprint reduction.



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Original Equipment Parts for GM vehicles

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Parts to service only GM makes and models

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PROFESSIONAL & ADVANTAGE

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Offered on our most popular part lines

Parts to service virtually all makes and models

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*Visit acdelcotechconnect.com to learn more about the Consumer Assurance Program.

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MOTORAGE.COM/SUBSCRIBE

ASE GUIDES

QUESTION OF THE MONTH



SPONSORED BY **Federated Auto Parts**

SURVEY: Light truck and passenger car diesels are beginning to catch on here in the U.S. If you aren't comfortable with the technology, it might be time to learn. A diesel engine with an HEUI fuel system starts and idles fine, but will not develop normal power. Which of the following could be the cause?

- A. No CMP signal
- B. Defective glow plug control module
- C. Low injector oil pressure
- D. Insufficient turbo boost

Go to MotorAge.com/oct13survey to answer the question and enter our contest from sponsor Federated Auto Parts.

FROM THE BLOG SPHERE

Solving the case of a wife's uncertainty

There are different ways to look at whom is responsible for explanations or questions.

BY JON ELLSWORTH | WORKSHOP MEMBER

Two months ago, my wife's car's odometer finished its slow crawl to the 30,000-mile mark. Her oil change place, looking to capitalize on preventive maintenance, brought the milestone to her attention and provided her with a list of services that "should" be done at 30,000 miles. The total? \$1,250!

She brought the list home and asked if we should do the services now or wait. "I don't even know what most of these things are," she said. "Like differential service. What's that?"

I decided to see what the list looked like through her eyes, so I read down the items, asking her what she knew about each of the services they wanted her to have done. She didn't know what any of them really were or why they were being recommended.

"What's engine oil de-sludge service?" My wife's reply, "Well, duh, that's when they take the sludge out of the engine oil." So I say, "OK smarty pants, what does engine sludge do and why would you want it out of your engine?" My wife's reply, "Ummm, it's messy and no one likes a mess?"

While I agree that no one likes a mess, she clearly didn't have any idea

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

Matt_Cascarino

Features fix focus on what's new

For years, we selected "5 Fast Fixes" from Direct-Hit, our online knowledge database of more than 600,000 Repair Hotline archives, and broadcast them to our customers every two weeks. I never saw the value in choosing five fixes at random, but in the spirit of "If it ain't broke, don't fix it," we never changed it up.

Then a few weeks ago, I was having a conversation with one of our Carline Specialists about the types of calls his team was receiving on our Hotline. Traditionally, we're the ones making the suggestions and dispensing the advice while working through tough vehicle issues with callers, but I asked if we ever got anything out of the calls from a knowledge perspective. "Absolutely," he said. "We see new problems all the time, even new systems when we're dealing with

more recent vehicle models." That's when it hit me that we needed to pull the fixes differently to increase the value of the content even more.

Beginning today, I'll be posting a link to our bi-weekly selection of "5 Fast Fixes," which feature new vehicle issues, specifically those that have been added to Direct-Hit within the last 90 days. Chances are, if we're seeing them for the first time, you may start seeing them in your shop as well.

Junius / Alabama

What today's kids expect

I was working in my office preparing for the Fall semester when a teenage boy and girl came into the shop where I teach auto mechanics to ask if I could help get her car started. As I walked with them, the boy told me about an expensive automotive program he was going to attend somewhere

in Florida and boasted about the big money he would make when he was finished with that \$60,000 program.

As we opened the hood on her Honda, he pointed to a part and asked if that part was the starter, and I said, "No, that's the distributor. The starter is down there."

The boy asked a couple of questions about my program, and one was more revealing than he realized. "Is your program hard?"

It seems that there are more than a few young people who want to go through an easy training program and get an easy job making easy money so they can live an easy life. And while the life of an automotive technician can be extremely rewarding, no successful automotive technician can honestly say the occupation is an easy one.

DECEMBER 5TH 2013
@ 8:00 PM

Transmission Diagnostic Tips

While some fixes are transmission-specific, some diagnostic tips can help anywhere.



PAGE
6

2013 EDUCATOR

DAVID BYRD HONORED

N.C. teacher earns top spot.

PAGE
14

Q+A WITH PETE MURNEN

WAGNER BRAKES

A look at the low-carbon brake line.

PAGE
104

THE TRAINER VIDEO

PETE MEIER

Air can cause more than noise issues.

what they were asking her to pay for. That uncertainty led her to seek out advice, which ended up undermining her trust in her service place.

Some of my clients would argue that the service advisor in this case

didn't do his/her job and if my wife left uncertain, then she should have asked questions. My thinking is a little different.

Share which side you're on at MotorAge.com/wifesuncertainty. **ZZ**

LEARN MORE: MotorAge.com IS UPDATED CONTINUALLY

ENTER WEBCASTS

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NOVEMBER 2013
Electrical Testing Techniques
Produced in cooperation with TST.

DECEMBER 2013
General Transmission Diagnostic Tips
Produced in cooperation with ATSG.

FROM THE ARCHIVES
Cooling System Service and Testing
Produced in cooperation with TST.

FROM THE ARCHIVES
Reading Wiring Diagrams
Produced in cooperation with ATSG



WEBINARS SCHEDULE



STREAMING PROGRAMS

Building a Winning Team for Your Auto Shop Episode 3
Surveying and finding out what good technicians need from an employer.

Drive Radio: Pet Peeves, Winter Driving & Waterless Coolant
Host John Rush and co-hosts Ken Rackley from Tune Tech and Steve Horvath from Jen's discuss driving pet peeves, winter driving and waterless coolant.

NACE/CARS moving to Detroit
The 2014 event will be held in Detroit, Mich., in July, announced Automotive Service Association Executive Vice President Dan Risley during the kickoff to the I-CAR Inter-Industry Conference in Boston on July 23.

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

NOV. 5-7
AAPEX/SEMA
Las Vegas.

MARCH 3-9
VISION HiTech Training and Expo
Kansas City, Mo.

MARCH 21-23
ASA-Northwest Automotive Training Expo
The NASTF spring meeting also will take place at the same time in SeaTac, Wash.



INDUSTRY CALENDAR

MotorAge TOP VIDEOS

MOST WATCHED VIDEO



Turbine input shaft speed sensor repair

SEARCH OUR ARCHIVES OF OVER 800 ONLINE VIDEOS

MotorAge.com/sensorrepair

Servicing serpentine belts

Dayco's Director of Marketing Robert Christy helps determine belt wear and the sources of belt noise.

MotorAge.com/serpentine

A 'Sure Track' to success

Unfortunately, you don't know how valid some info is. One source you may not have heard about is Mitchell 1's SureTrack.

MotorAge.com/stsuccess

Charging system testing tip

Vince Fischelli shares tips on battery, starting and charging system testing techniques he's mastered as a trainer.

MotorAge.com/chargingtips

TO WATCH NOW



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Scan the QR Code with your smartphone's camera, or go to: MotorAge.com and enter the [sensorrepair]

TO GET THE FREE APP: FROM YOUR PHONE'S BROWSER, GO TO: WWW.SCANLINE.COM



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.

1Comment:

A truly great article, I especially liked, "a competent technician's mental database is worth more than most employers care to admit. A large part of the money we earn as technicians comes as a result of our personal experience and the fact that we understand the way modern day automobiles work."

nspectrguy:

Can run on 12 volts? This will be interesting to see. I read somewhere back in the '90s that BMW had

developed an electro-magnetic system but it required around 36 volts, which no one else wanted to switch over to at the time.

Deranger:

I've been in the same business in the same small town for 43 years. In this small world I don't see the sorts of problems you are mentioning as needing a response of an entire industry. Things pretty much take care of themselves here. I've seen shops come and go, techs come and go. If your work is poor for

whatever reason, incompetence, dishonesty, lack of equipment, ignorance ... that doesn't go un-noticed by the community. A bad reputation and you won't be in business long.

autoteacher:

Be careful. Comparing new fluid to used fluid as a sales tool is specifically prohibited by the California BAR. I don't know of any manufacturers that recommend mileage-based or time-based fluid exchanges, so recommending on that basis is out, too.



the community—
join the discussion

MotorAge.com/Community

Q+A WITH PETER MURNEN

GLOBAL MARKETING DIRECTOR,
WAGNER BRAKE PRODUCTS



NEW REGULATIONS ARE AFFECTING THE AMOUNT OF COPPER INCLUDED IN BRAKES. HERE'S ONE COMPANY'S RESPONSE.

BY PETE MEIER | TECHNICAL EDITOR

Governments in California and Washington are looking into legislation to limit the amount of copper used in today's brakes. According to Peter Murnen, global marketing director for Wagner Brake Products, this is in response to finding that copper run-off from brake pads was making its way into waterways and fish. In response, Wagner Brake Products has introduced the Wagner ThermoQuiet Ceramic^{NXT} with OE21 low-copper brake pad.

MA: What does the current legislation call for?

PM: The current legislation calls for brake manufacturers to have copper content below 5 percent by 2021, and to have basically below 0.5 percent by 2025. And if you think about it today, copper is used pretty much as a mainstay in ceramic formulas. Some ceramic formulas can have up to 20 percent copper content, so that's no easy task for a brake manufacturer or formulator to take that amount of copper out of some of the formulations that are out there.

MA: How did Wagner get so far ahead of the game?

PM: What you have to remember about Wagner is that we are big in the after-

market, but we are also the global OE leader. So from an OE standpoint, the OE manufacturers really took the lead on this and came to us as an OE manufacturer of brake pads. They said, 'You need to hit this spec early, we need to be green, we need to be ahead of the curve on this.' If you think about it, the OE guys are thinking about it just like the aftermarket guys would be. They can't have a separate car just for California and Washington; those are two pretty big markets in the United States. So the OE manufacturers are redesigning their braking systems around these regulations that are going into effect, basically in 2014. It's really the OE side that drove us on the aftermarket side.

MA: What can we expect to see from this new formulation in terms of being able to do what the older pad designs did?

PM: When our R&D guys, our engineers got together and started working on the challenge, they took it upon themselves to challenge themselves. They said, 'We have to reformulate, we're an OE leader, we're the aftermarket leader. We're not going to come out with something new that's anything less than our best. Let's come out with something that's the best product that we've ever made.' They



didn't try to meet the standards of what we had been making before, they tried to surpass the standards of what we had been making before and improve the product.

MA: It's not required in all states yet, so why, as a tech, would I want to select this formulation instead of the conventional pads?

PM: Just like a lot of the innovations that have happened in the past, a lot of it is based on what's going on on the OE side, and this is the biggest thing on the OE side. So from a tech perspective, I know the techs out there really want to follow the OE innovations, they really want to be up on the latest and greatest, they want to replace on the vehicle the same performance they took off of the vehicle, especially on a premium brake job. *TM*

Photo: Federal-Mogul



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NAPA Platinum Oil Filters were designed to endure high operating temperatures for those heavy-duty towing jobs and long idling times. In fact, we create all our oil filters with wire-backed, reinforced, fully synthetic media. Why? Because we KNOW HOW to make a filter right. Visit your local NAPA AUTO PARTS Store today.



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OPERATIONS

TAKE CONTROL
OF YOUR BUSINESS

IN THIS SECTION

- 16** Management
- 18** Profit Matters
- 20** Shop Profile

read it on **MotorAge.com****ASRW MAIN
STAGE SCHEDULE**

The Main Stage will showcase a different industry speaker every hour.

/mainstage

**SKF'S SOCIAL
MEDIA PROGRAM**

SKF has launched a Twitter page and YouTube channel.

/skfsocial

**SHOP OWNER
HONORED**

Mighty Auto Parts recognized the charitable work of Eden Prairie Auto.

/humanitarian

MANAGEMENT

DO YOU HAVE THE RIGHT MIX OF TALENT
IN YOUR BUSINESS?BY **BRIAN CANNING** | CONTRIBUTOR

IN LOOKING at our shop and staffing levels, we always want to be positioned to best handle whatever diagnostics, repair, service and maintenance needs come in our door. We will want to have technicians with the skills to handle the greatest numbers of possibilities. A big temptation is to staff heavily on the lower skill maintenance and service end, noting that this will represent more than half of the production in most shops and from 60 to 70 percent in Honda specialty and high end European shops.

The problem is the low B and high C techs cannot handle any of the diagnostics and typically are not as time efficient as either the seasoned A or B techs. The best strategy is to have strong, seasoned and productive B techs who can handle some diagnostic, all the repairs you would see and virtually everything else in the shop, reliably making effective use of time.

That we have analyzed our work load and our work categories is very important because these numbers will fluctuate

a great deal from week to week, from shop to shop. Two things worth noting with Honda specialty and high-end European shops is that this market tends to be more structured than the general market, so the labor breakdown between the technician skill levels will tend to be more consistent week over week. These customers also tend to be more reliable and willing in their maintenance.

The numbers I quoted are an ideal and demands that total production and efficiency to be at or at least near 100 percent. The example I had here was anticipating my A and B techs at slightly more than 100 percent between them and my C tech (or lube techs) being significantly under 100 percent. This is never a problem at some shops but most of us are not able to do this week in and week out. Frequently it is the B techs driving production and the A tech being consistently at or around 90 percent efficient. But to me this is not acceptable. The A tech has the years and experience and should be a leader in production. You often have to trade production

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New Parts Guide: Fall 2013
Are You TechSmart®?





"TechSmart® takes OE replacement to the next level."

- Lou Murante, Owner, Murante Auto Repair



C60002
Battery Current Sensor
GM 2013-05

5.7 MILLION
VIO



G83001
Cam Synchronizer
Install Tools
Ford 2008-95

1.3 MILLION
VIO



F66001
DISA Valve Repair Kit
BMW 2000-97
VIO over 250,000

PROBLEM SOLVER

Repair just the damaged flap portion of the DISA valve instead of replacing the entire assembly. Includes a new flap, hinge, pin, retaining clip, and an extractor screw for easy removal of the damaged OE hinge.



F66002
DISA Valve Repair Kit
BMW 2012-01
VIO over 500,000

PROBLEM SOLVER

Repair just the damaged flap portion of the DISA valve instead of replacing the entire assembly. Includes a new flap, hinge, pin, retaining clip, and an extractor screw for easy removal of the damaged OE hinge.



F66003
DISA Valve Repair Kit
BMW 2006-01
VIO over 400,000

PROBLEM SOLVER

Repair just the damaged flap portion of the DISA valve instead of replacing the entire assembly. Includes a new flap, hinge, pin, retaining clip, and an extractor screw for easy removal of the damaged OE hinge.



C57002
EGR Tube Connector
Ford 1999-97
VIO over 830,000

PROVEN QUALITY

OE unit is prone to rust and corrosion. TechSmart's zinc coated connector helps prevent this OE problem.



S20062
Electronic Throttle Body
Ford F150 3.5L
Ecoboost 2013-11
VIO over 270,000

NEW NOT REMAN

High-quality NEW direct replacement for failed OE throttle bodies.



► TechSmart® DISA Valve Repair Kits

The DISA Valve within the variable intake manifold on BMW vehicles is used to raise the low and midrange torque and the top end power output. Over time, the OE flap becomes stripped, rattles and stops working. TechSmart® now offers high quality repair kits for faulty DISA Valves on 2012-97 BMW vehicles. Save time and money by simply replacing the damaged flap and not the entire assembly. Kits come complete with new flap, flap hinge, hinge pin, retaining clip and extractor screw.



S20063
Electronic Throttle Body
GM Vans 6.6L Diesel
2013-09

NEW NOT REMAN

High-quality NEW direct replacement for failed OE throttle bodies.



S20067
Electronic Throttle Body
Ford 2013-09

1.6 MILLION
VIO



S20068
Electronic Throttle Body
Ford 2013-11
VIO over 840,000

NEW NOT REMAN

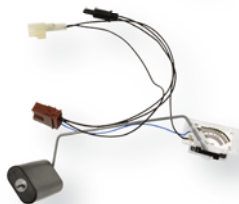
High-quality NEW direct replacement for failed OE throttle bodies.



Z49033
Expansion Tank Service Kit
Audi 2010-05

COMPLETE KIT

Includes tank, cap, and fluid level sensor for a complete drop-in install.



K07013
Fuel Level Sensor
Nissan Murano 2009-03
VIO over 600,000

PROBLEM SOLVER

Replace just the failed fuel level sensor, not the entire fuel pump assembly



"I want my customers to drive away knowing their new parts will last. That's why they drive away with TechSmart®."

- John Filippone, Owner, Piedmont Tire and Auto



F81002
Fuel Pressure
Warning Light Kit
Dodge Ram 5.9L Diesel
2007-98
VIO over 900,000

PROBLEM SOLVER

Installs in line with the injection pump and illuminates when fuel pressure is low to help warn the driver to shut off the engine before damage occurs to the fuel pump assembly.



T48001
Fuel Pump Cam Follower
VW/Audi 2013-06
VIO over 1.0 million

PROBLEM SOLVER

Replace damaged OE high pressure fuel pump cam follower on VW/Audi 2.0T engines. Replacing the cam follower prevents damage to the fuel pump and camshaft.



C82003
Gear Repair Kit - Power Seat
Infiniti 2007-03
VIO over 325,000

PROBLEM SOLVER

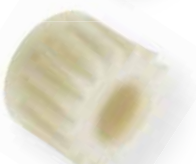
Replace just the damaged power seat track gears instead of the entire seat track assembly to restore power seat movement.



C82004
Gear Repair Kit - Power Seat
Nissan 2010-03
VIO over 140,000

PROBLEM SOLVER

Replace just the damaged power seat track gears instead of the entire seat track assembly to restore power seat movement.



C82005
Gear Repair Kit - Power Seat
Nissan/Infiniti 2004-00
VIO over 475,000

PROBLEM SOLVER

Replace just the damaged power seat track gears instead of the entire seat track assembly to restore power seat movement.



C82001
Gear Repair Kit - Speedometer
Ford 1998-94

6.3 MILLION
VIO



C82002
Gear Repair Kit -
Steering Column
Lexus 1996-90
VIO over 130,000

PROBLEM SOLVER

Replace just the stripped steering column adjustment gear instead of the entire steering column. Restores tilt and telescoping steering column function.



▶ TechSmart® Turbocharger Actuator

TechSmart® now offers our R75002 Turbocharger Actuator, or Variable Geometry Turbocharger (VGT) Control Valve for Ford 6.0L diesel engines. The 6.0L VGT actuator controls the flow of the exhaust gases through the turbocharger and when they fail, the vanes can stick, the vehicle can lose power and/or generate too much or too little boost pressure, causing damage to the turbocharger. TechSmart® now offers a high-quality, direct replacement for failed VGT actuators to help restore proper turbocharger function.

See page 10 for product applications.



C82006
Gear Repair Kit -
Steering Column
Lexus 2000-92

PROBLEM SOLVER

Replace just the stripped steering column adjustment gear instead of the entire steering column. Restores tilt and telescoping steering column function.



F90001
Headlight Wiring Harness
High Temp H7 Bulb Harness

PROBLEM SOLVER

High temp ceramic design for H7 bulbs prevents the connector from melting when using high intensity aftermarket light bulbs.



F90002
Headlight Wiring Harness
Mercedes E-Class 2000-96
VIO over 150,000

PROBLEM SOLVER

Replaces damaged headlight wiring harnesses to restore proper headlight function.



F90003
Headlight Wiring Harness
Mercedes CLK-Class
2003-98

PROBLEM SOLVER

Replaces damaged headlight wiring harnesses to restore proper headlight function.



F90004
Headlight Wiring Harness
VW PASSAT 2005-00
VIO over 350,000

PROBLEM SOLVER

Replaces damaged headlight wiring harnesses to restore proper headlight function.



"Hard to find parts aren't so hard to find anymore with TechSmart®."

- Oswaldo Lorenzana, Owner, Tolima's Auto Center



R66013
HID Ballast
Nissan Maxima 2003-02
VIO over 120,000

PROVEN QUALITY

High-quality direct replacement for failed OE HID ballast restores proper headlight function.



R66014
HID Ballast
Toyota Avalon 2012-09
Toyota Venza 2013-09
Lexus RX350 2012-10
VIO over 280,000

PROVEN QUALITY

High-quality direct replacement for failed OE HID ballast restores proper headlight function.



R66015
HID Ballast
Nissan/Infiniti 2013-04

2.1 MILLION VIO



R66016
HID Ballast
GM Trucks 2006-03

2.8 MILLION VIO



F04027
HVAC Defrost Mode Door Motor
GM 2005-00
VIO over 400,000

THINK TECHSMART FIRST

TechSmart features chamfered pins for a better connector fit.



F04034
HVAC Floor Mode Door Motor
Cadillac Seville 2004-98
VIO over 130,000

THINK TECHSMART FIRST

TechSmart features chamfered pins for a better connector fit.



F04026
HVAC Temperature Blend & Floor Mode Door Motor
GM SUVs 2008-02

THINK TECHSMART FIRST

TechSmart features chamfered pins for a better connector fit.



▶ **TechSmart® Keyless Entry Transmitters (Key Fobs)**

TechSmart® now offers 24 new complete key fob assemblies for GM and Ford vehicles. Each FCC and IC approved, complete key fob assembly replaces units damaged from water intrusion, terminal corrosion, circuit board failure, or case damage. Each high-quality TechSmart® unit follows the OE programming procedures for ease of use and a direct-fit replacement.

See pages 7-9 for 12 new additions to the TechSmart® lineup.



F04029
HVAC Temperature Blend & Recirculation Door Motor
GM 2011-05

1.6 MILLION
VIO



F04028
HVAC Temperature Blend Door Motor
GM 2005-01
VIO over 580,000

THINK TECHSMART FIRST

TechSmart features chamfered pins for a better connector fit.



F04031
HVAC Temperature Blend Door Motor
Buick LeSabre 2005-00
Pontiac Bonneville 2005-00
VIO over 925,000

THINK TECHSMART FIRST

TechSmart features chamfered pins for a better connector fit.



H11002
Ignition Coil Repair Harness
Mercedes-Benz C280
2000-96

PROBLEM SOLVER

Replace just the damaged piece instead of the entire harness.



C02012
Keyless Entry Transmitter
GM 2009-07
VIO over 260,000

THINK TECHSMART FIRST

High-quality direct OE replacement key fob.



"Some jobs are tough.
TechSmart® parts are tougher."

- Steven Baker, Owner, Lee's Crossing Tire and Auto



C02015
Keyless Entry Transmitter
GM Trucks 2013-07

1.2 MILLION
VIO



C02016
Keyless Entry Transmitter
GM 2011-09
VIO over 470,000

THINK TECHSMART FIRST

*High-quality direct
OE replacement key fob.*



C02017
Keyless Entry Transmitter
GM Trucks 2013-07

1.2 MILLION
VIO



C02018
Keyless Entry Transmitter
GM Trucks 2010-07
VIO 1.0 million

THINK TECHSMART FIRST

*High-quality direct
OE replacement key fob.*



C02019
Keyless Entry Transmitter
GM 2013-07

2.4 MILLION
VIO



C02020
Keyless Entry Transmitter
GM 2005-01

1.9 MILLION
VIO



C02021
Keyless Entry Transmitter
GM Trucks 2013-07
VIO 1.2 million

THINK TECHSMART FIRST

*High-quality direct
OE replacement key fob.*

► **TechSmart® Gear Repair Kits**



TechSmart® now offers Gear Repair Kits for various applications that are not sold separately by the dealer. Only replace the part that failed, not the entire assembly.

1. **Speedometer Gear Repair Kit** – C82001 – Don't replace the entire gauge cluster when the OE drive gear fails. Restores speedometer function. Fits Ford 1999-94.
2. **Steering Column Adjustment Gear** – C82002, C82006 – Don't replace the entire steering column when the OE adjustment gear fails. Restores tilt and telescoping steering column function on Lexus 1999-90.
3. **Power Seat Adjustment Gear** – C82003, C82004, C82005 – Don't replace the entire power seat rail when the OE gear fails. Restores power seat adjustment on Nissan/Infiniti vehicles 2010-03.

See pages 4-5 for applications.



C02022
Keyless Entry Transmitter
GM 2011-05
VIO over 680,000

THINK TECHSMART FIRST

*High-quality direct
OE replacement key fob.*



C02024
Keyless Entry Transmitter
GM 2011-01

**1.4 MILLION
VIO**



C02025
Keyless Entry Transmitter
GM Trucks 2001-98

**3.0 MILLION
VIO**



Z88001
Leak Detection Pump
BMW 2013-98
VIO over 960,000

PROVEN QUALITY

*Replaces damaged OE fuel vapor
leak detection pump restoring
proper leak test functions.*



Z16006
Oil Separator Kit
BMW 2006-08
VIO over 730,000

PROBLEM SOLVER

*Insulated to help prevent oil
separator and hoses from cracking
in cold weather climates.*



"My degree in electrical engineering helped me determine that TechSmart® is the smart choice."

- Tom Farrell, Owner, Electro-Tech Auto Repair



Z16007
Oil Separator Kit
BMW X5 3.0L 2006-04

PROBLEM SOLVER

Insulated to help prevent oil separator and hoses from cracking in cold weather climates.



B05002
Shift Interlock Lever
Mercedes-Benz 2006-00
VIO over 180,000

PROBLEM SOLVER

Replace just the broken shift lever instead of the entire shift assembly.



B05003
Shift Interlock Lever
Mercedes-Benz 2006-00
VIO over 160,000

PROVEN QUALITY

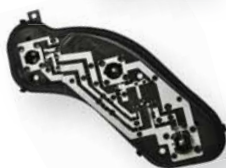
High-quality direct replacement for failed OE HID ballast restores proper headlight function.



B05004
Shift Interlock Lever
Mercedes-Benz 2006-00
VIO over 160,000

PROVEN QUALITY

High-quality direct replacement for failed OE HID ballast restores proper headlight function.



Z46010
Tail Light Circuit Board
Nissan 2013-12
VIO over 145,000

PROVEN QUALITY

High-quality direct replacement for failed OE tail light circuit boards.



Z46011
Tail Light Circuit Board
Nissan 2013-12
VIO over 145,000

PROVEN QUALITY

High-quality direct replacement for failed OE tail light circuit boards.



R75002
Turbocharger Actuator
Ford Trucks 6.0L 2010-04
VIO over 800,000

PROVEN QUALITY

Replaces damaged or clogged turbocharger actuators on Ford's Variable Geometry Turbocharger (VGT) equipped 6.0L Engines.



New

Catastrophic Failure



► **TechSmart® High Pressure Fuel Pump Cam Follower**

TechSmart® now offers a high-quality direct replacement High Pressure Fuel Pump Cam Follower for 2013-06 VW/Audi 2.0T. The low-friction coating on the original units can wear down over time causing excess friction against the cam lobe and high-pressure fuel pump plunger. This can lead to extreme engine damage and an expensive repair. Checking and replacing the cam follower with the TechSmart® T48001 will save in the long run.

See page 4 for product applications.



L86001
Turbocharger Speed Sensor
Dodge/Ram Trucks 2010-07
VIO over 250,000

PROVEN QUALITY

High-quality direct replacement for failed Turbocharger Speed Sensors on Dodge Ram 5.9L and 6.7L Diesel Engines.



Z56003
Variable Intake Manifold Actuator Repair Kit
Mercedes-Benz 2011-05
VIO over 940,000

COMPLETE KIT

Replaces the damaged OE plastic intake manifold hinge with a metal unit. Includes everything necessary for a complete repair.



L53010
Variable Valve Timing (VVT) Solenoid
Ford 2013-11
VIO over 500,000

THINK TECHSMART FIRST

High-quality direct replacement for failed variable valve timing solenoids on Ford 1.6L engines.



Z49046
Windshield Washer Fluid Reservoir
Toyota Corolla 2002-98
VIO over 780,000

PROBLEM SOLVER

Designed to sit lower in the engine bay to clear hood, preventing the body from cracking when the hood is closed on it like the OE unit.



R87001
Wiper Control Module
Hyundai Santa Fe 2006-01
VIO over 400,000

PROVEN QUALITY

High-quality direct replacement for failed rear wiper control module restores rear wiper function.



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► TechSmart® Leak Detection Pump

TechSmart® now offers our Z88001 Leak Detection Pump to replace failed units for BMW vehicles from 2013-98. A leak detection pump regularly checks the vehicle's fuel system for possible vacuum leaks. Even small leaks can allow fuel vapors to escape into the atmosphere. Government regulations require on-board testing to confirm the evaporative system is functioning properly. A defective Leak Detection Pump will trigger a P1447 DTC and can cause emissions inspection failure. Replace faulty Leak Detection Pumps with a new TechSmart® unit to ensure this important emissions system is functioning properly.

See page 9 for application information.



► TechSmart® Shift Interlock Lever

The shift interlock lever found in early-to-mid 2000's Mercedes shifter assemblies is known to fail due to the OE plastic construction. When the OE plastic lever fails, the car will not shift out of park. TechSmart® has constructed a replacement shift interlock lever assembly out of anodized aluminum for long-lasting strength, durability and smooth shifting operation. With TechSmart® you don't need to replace the entire shifter assembly when just the lever fails.

See page 10 for application information.

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“WE NEED AN A TECH TO HANDLE THOSE FEW DIAGNOSTIC/ HEAVY REPAIR JOBS. BUT LIKE EVERYTHING ELSE, THIS PORTION OF OUR BUSINESS HAS TO BE PROFITABLE AND HAS TO PROVIDE A REASONABLE RETURN ON INVESTMENT,”

BRIAN CANNING [CONTRIBUTOR]

for knowledge and experience, which is unfortunate for everybody.

A Breakdown

A reasonable staffing model for four technicians and adequate car count:

- A Tech: 10 hours diagnostic, 25 hours repair, 10 hours service/maintenance = 45 hours

- B Tech (two of them): 5 hours diagnostic, 20 hours repair, 55 hours service/ maintenance = 80 hours (between two techs)

- C Tech: 30 hours service and maintenance (or two lube techs) = 30 hours

Having reasonable expectations for my A tech producing 45 billable hours per week, my two B techs each producing 40 billable hours per week and my C tech producing a total of about 30 billable hours, I should be well positioned to handle nearly anything my market would care to throw at me.

With hypothetical production at 155 billed hours per week for this hypothetical crew in this hypothetical shop, the math there is my A tech generating 29 percent of total production, most of which should be repair and diagnostic. My B techs produce 52 percent of the total, which should be mostly service and repair and some diagnostic. B techs will pick up a good amount of service and maintenance work out of their vehicle inspections and repair work. There always is a certain amount of variance and fluctuation in these numbers, but this is what I would like to see in any production plan.

I would suspect that in the high-end European and Honda worlds, maintenance is something that our customers are well trained at and they are reliable in doing the things they should be to keep their cars safe and reliable. By the same token, cars are very complex and when a tough repair or diagnostic job comes in, we want to be able to handle it. If we are not able to pro-

When staffing your shop, make sure employees understand what marketing plans are in place.

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vide that expertise or are not able to handle these types of labor operations efficiently, our production and profitability suffer. We should not be overstaffed with A techs, because the vast majority of our services do not require that level of knowledge and experience and that wage can easily make many of

our routine services far less profitable.

We need an A tech to handle those few diagnostic/ heavy repair jobs, but like everything else, this portion of our business has to be profitable and has to provide a reasonable return on investment. If our A tech is not productive and not generating the hours from week to week, than we certainly would want to look at what value he brings to our service operation. If there is little or no value to what he is doing, I would look to replace him, not eliminate his position. In my opinion, we need an A tech, but we have to make use of him in the right way and he needs to be productive.

The backbone of our business should be tied into our B techs, who should be motivated and productive. Again, they need to be providing a return on investment. Ideally they can handle most of what would come in our door and be there if our B- and C+ techs get themselves in trouble.

If you look at our car count over the long haul and our production week over week, we should be able to establish baselines of who is turning out what work and establish reasonable expectations for production at all levels of expertise. Maybe my assumption is that we do a lot of diagnostics and the truth is that we do very little. Maybe we don't do enough repair or diagnostic work to justify our having as much experience on staff as we currently do.

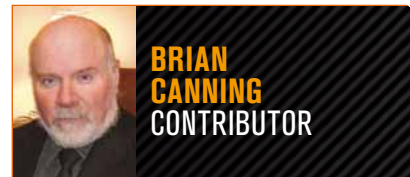
Being an A tech is not a union job and I believe that those years of knowledge and that extra experience

make A techs more responsible and accountable for getting the job done, not less. We should be able to count on them to lead the way, and we should compensate them very, very well when they do. I have no patience with A techs who want to sit on their certifications and not turn out the hours and whine when somebody less knowledgeable buries them in billed hours. Knowledge and experience are huge assets to any service operation but only if we are productive, efficient and proficient in that effort.

I would staff toward the center with B techs first, C techs second and if the business potential and return on investment was there, find a great A tech to fill out my staff. Having that guy allows me to stand out from the competition, but he has to pay his way and be of value to the business. My B techs allow me to open my doors every day, turn out the cars and be profitable week over week. My C techs represent my future.

There is no doubt that operating rooms and surgeons are expensive, but it is the room and the bed that allows any hospital to survive. Those many technicians and nurses, food service workers and assistants are what pay the bills. Your shop is no different, and you have to staff it to handle the routine service and repairs that are coming in your door first and foremost. Brain surgery (or diagnostics) is something we can think about later.

Staff to your center and expand outward from there. That is the sweet spot of your operation or at least should be. **ZZ**



BRIAN CANNING
CONTRIBUTOR

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

Email Brian at brimarc@hotmail.com

ARE YOU ASKING THE RIGHT QUESTIONS?

WHAT YOU ASK POTENTIAL HIRES CAN SET THE STAGE FOR YEARS OF SUCCESSFUL — OR UNSUCCESSFUL — EMPLOYMENT.

BY CHRIS “CHUBBY” FREDERICK | CONTRIBUTOR



I THINK everyone will agree the interview process is one of the more uncomfortable things we do as owners or managers. When I first started interviewing, I would ask candidates to tell me about themselves and why they were looking for a change. I would manipulate most of the time during the interview selling the job and the company. I've learned I was doing almost everything wrong when interviewing. Let's hear how Mike Haley, ATI team leader and instructor, teaches shop owners to make better hiring decisions.

I also have been on the other side of the desk and have seen managers conduct poor interviews. One in particular comes to mind. I remember this manager walking into the office and sitting down across from me. He did not have my application, resume or any prepared questions on a notepad to ask me. This manager did not ask anything about my history or experiences. He jumped right in to what I believe was the only thing he wanted to know. He asked me, "What is leadership and how should you lead people?"

I answered his question giving him the Webster's dictionary version

of what leadership is and then listed several ways in which one could lead. He sat across from me with a smile and nodding as if to say this guy gets it!

As I watched his approval, it became very apparent this manager was only going to ask me if I knew how to lead and manage people. He never asked me to give him examples of when I managed or led people and what the results were. There is a big difference between the two approaches.

Preparing for the Interview

Preparing for the interview is just as important as the interview itself. Before you interview anyone, no matter the position, you need to decide what competencies and traits are important to you and your company. You are building a team and culture in your business, which requires everyone to display and use competencies you deem important.

What are competencies? A competency is a defined level of expertise that is an essential fundamental to a particular job. This expertise, along with pooled knowledge, is what allows an organization to have an advantage over its competition. So what does this mean for interviewing? We need a candidate



“WHO SHOULD BE DOING MOST OF THE TALKING IN AN INTERVIEW? ANSWER: THE APPLICANT SHOULD TALK 80 PERCENT OF THE TIME AND THE INTERVIEWER 20 PERCENT.”

CHRIS “CHUBBY” FREDERICK [COMPANY IN BRACKETS]

who brings job-related experience and also shows behavioral competencies.

I believe most owners and managers are comfortable asking questions about job competencies such as, “What type of alignment equipment have you used?” I would like to spend more time on behavioral interviewing. Most owners do not take the time to write out what behavioral competencies are important. I have developed a list of behavioral competencies owners should ensure their employees have: customer service, judgment and decision making, teamwork, quality of work standards, work ethic and motivation, reliability, problem solving and analysis, planning and organization, communication, honesty and integrity, stress tolerance and adaptability.

Ask Behavioral Questions

After selecting the behavioral competencies you want in your employees, you need to write open-ended questions for those competencies. By reviewing a candidate’s application, resume and any other personality profile surveys, you can begin to create your interview questions. By looking at the applicant’s positions held and work history, you can create questions that allow them to tell you how they have performed in the past. Typically how a person performs in the past is exactly how they will perform in the future.

Once a day and time is agreed upon for an interview, you should write out each question you want to ask to explore a behavioral competency. I write my questions on my interview sheet, which numbers my questions and has plenty of room for me to write notes on how the candidate answers the questions. Whenever possible, I have a manager or co-owner share in the interview process. This gives me another perspective on the candidate and a buy-in from the team that we are doing due diligence in hiring the best candidate.

Behavioral questions ask the candidate about an experience they have had in the past and the outcome of that experience. The more we know about how a candidate handles situations, the better



we can assess how they will handle situations in our business. How many times have you hired someone and then said to yourself, “I wish I had known how they were going to act under those circumstances before I hired them.”

Ask for a Real Story

Let’s say you want to ask a question that gives you insight into how the candidate communicates. You could say, “Tell me about a time when you had difficulty getting a customer to understand. How did you overcome it?” While the candidate is telling the story, you are taking notes and deciding whether these are good behaviors and whether the candidate is not meeting or just meeting the minimum expectations of customers and fellow employees. As an example of trying to find out how a technician solves problems, you could ask, “Describe a time when you were stuck on a diagnosis. What steps did you take and what were the results?”

A reliability question to ask a potential manager could be, “Tell me about a time a great producer was consistently absent or late for work. How did you handle it?” A planning and organizing question could be, “How do you handle doing 10 things at a time?” Remember to keep asking for a lot of

detail and examples. If the story ends how you or the candidate would consider not favorable, ask the candidate how they would do it differently.

To get the best responses, you need to give specific instructions before the interview begins. Explain that you have written out questions and you want the candidate to take their time and give a lot of detail when responding. You are going to be taking notes and so there might be an awkward pause while you are continuing to write. I know when I first started interviewing, I hated the awkward silence and felt it was my responsibility to fill that void. In the perfect interview, the candidate should talk 80 percent of the time and the interviewer should talk 20 percent of the time.

If you would like to receive my behavioral question sheet, simply go to www.ationlinetraining.com/2013-10.



Chris “Chubby” Frederick is the CEO and founder of the Automotive Training Institute. ATI’s 108 associates train and coach more than 1,150 shop owners every week across North America to drive profits and dreams home to their families. Our associates love helping shop owners who have had the same struggle as many of them have had, and who are looking for the same answers – and in some cases looking for a lifeline. This month’s article was written with the help of Mike Haley, ATI Team Leader and Instructor.

E-mail Chubby at cfrederick@autotraining.net

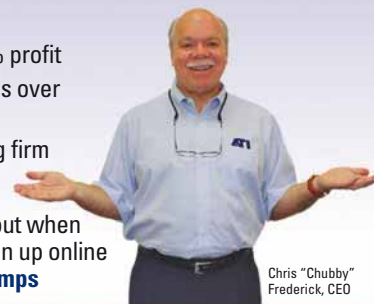
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Chris “Chubby” Frederick, CEO



SHOP PROFILE

A snapshot of one of the industry's leading shops

TARVIN AUTO SERVICE / BATAVIA, OHIO



Catch and Release

From rain retention to customer retention, let's take a look at this Ohio shop.

BY **ROBERT BRAVENDER** | CONTRIBUTOR

A few repair shops might have an aquarium — maybe even a fish bowl — but how many have a fish pond out back? “In this area rain water retention is a big thing,” says Kim Tarvin, describing the region of Batavia, Ohio. “Plus, I wanted to elevate the shop because it was a little bit low.”

Tarvin Auto Service started off as a three-bay facility in 1988, but by 2004 had moved into a bigger facility “next to the Batavia School District bus garage in order to accommodate an increasing number of customers and to provide the next level in excellent customer service and care.” Tarvin needed to dig a pond about 350 feet behind the building and three to four feet deep to catch runoff from the side of the shop.

“All that was going to be was a cat-tail marsh with mosquitoes — who wants that?” he rationalized. “So I said, ‘Let’s dig it out deep.’ And now we stock it; there’s some killer catfish in there, bass, crappie, perch. Of course, we’ve stocked minnows — it’s an ecosystem that we take care of.”

The shop has some poles here customers can borrow. “(Customers) think it’s pretty cool when they bring a fleet vehicle in to get serviced for an hour they go out back and fish.”

“The lot’s open,” Tarvin confides. “You could go fishing back here tonight. I don’t have signs posted, I don’t advertise it, but if my regular customers have kids, I tell them about it. It’s pretty neat when you see a 12-year-old with a catfish that weighs 15 pounds and he’s got it above his waist trying to hold it up. It’s catch and release, and leave it better than you found it.”

In a way the fish pond has come to symbolize Tarvin’s approach to business and life: laid-back but well-maintained. Passionate about car repair and customer safety, he says, “I like to do good. I see that in all phases of life. Nothing makes me madder than a situation where if I pay you, you don’t give me that value back in service. That’s what we have to do for our customers.”

On the other hand his droll sense of humor is evident even in the way Tarvin filled out his profile: ‘ASE member since it was N.A.I.S.E... Man I’m old.’

AT A GLANCE

Tarvin Auto Service

Shop name

Kim and Darla Tarvin

Owner

Batavia, Ohio

Location

1

Number of locations

25 years

Years in business

8

Total number of employees

7

Number of technicians

10,000 square feet

Shop size

12

Number of bays

70

Average vehicles per week

\$315

Average weekly repair ticket

\$1.2 million

Annual gross revenue

ASE

Shop affiliations

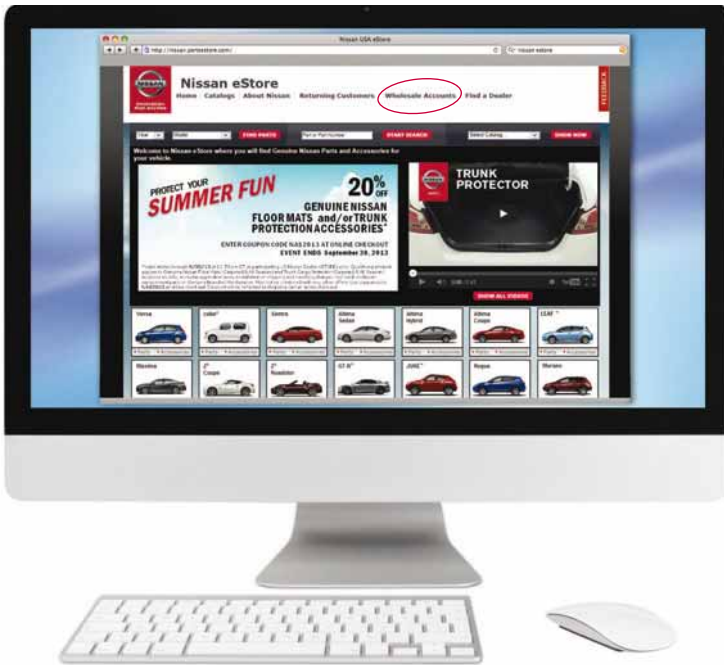
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Batavia is a small town about 30 miles outside Cincinnati near the Kentucky border, but has seen its share of

Photos: Tarvin Auto Service



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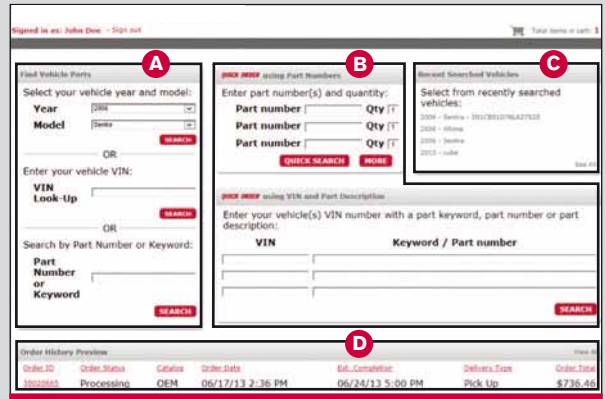
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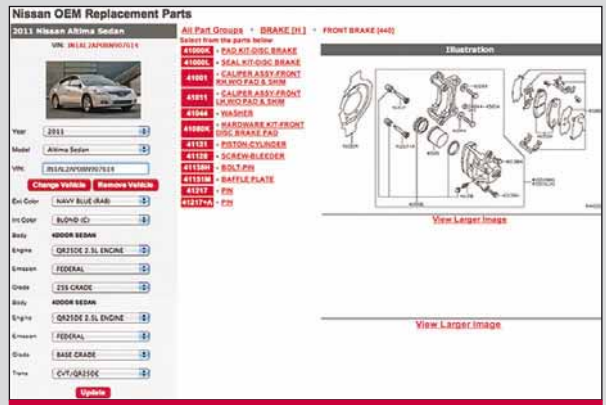
When you are unsure how to fix it, call the Nissan Installer Repair Hotline powered by Identifix: 1.855.828.4018

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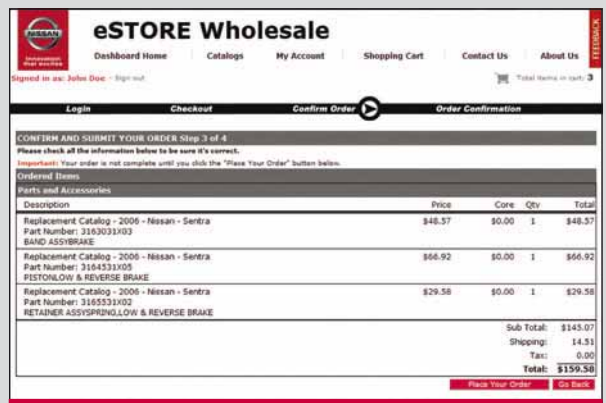
- A** Order by Make, Model, Year, or VIN, or Part Type.
- B** Quick Order if you know the Part Numbers or VIN.
- C** See recently searched vehicles.
- D** Check order status.

Confirm Parts Selection. Fast.

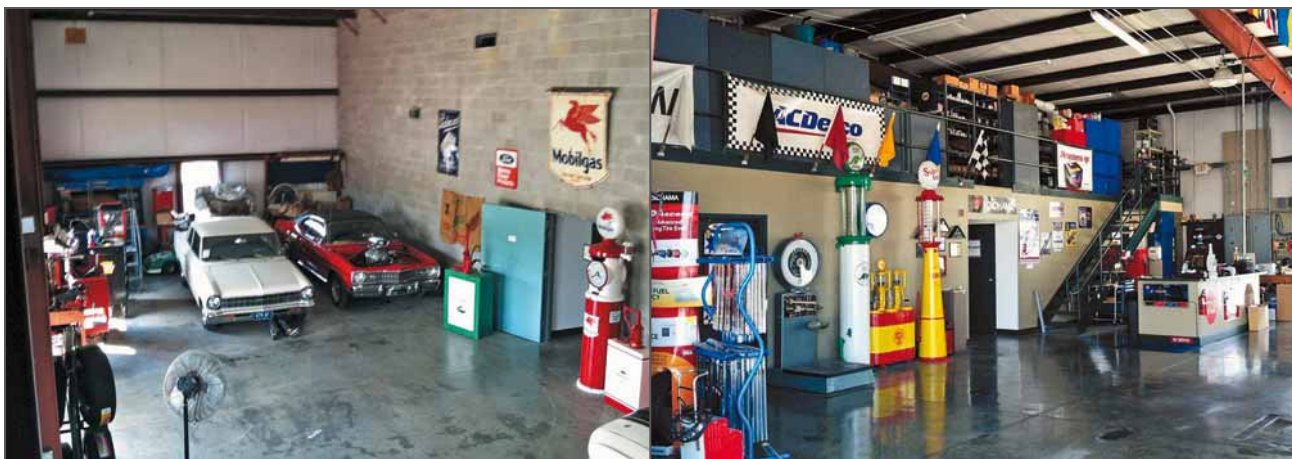


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(Left) The front counter gives a feel of an old service station. (Right) The main showroom and entrance is unique at Tarvin Auto.

changes in the automotive market. “Changes? Have there been changes?” jokes Tarvin. “Education is first and foremost. I study all the time, and I’ve been a member of the (International) Automotive Technicians Network (iATN) since it had 900 members. That’s quite a thing, talking to technicians all over the world. The internet has been great for a lot of information and learning.”

At one time Tarvin was an Aston Martin mechanic because the GM dealership he worked for also sold the British marque. “I’ve been through the factory, I worked on Lagondas, Vantages, Volantes; they’re beautiful cars. It’s just a milestone, an achievement. I’ve worked on Ferraris and Rolls-Royces and that’s great, too, but you make your living working on Chevrolets, Hondas and Toyotas.”

Tarvin also relies on the more tried-and-true means of marketing, focusing on word of mouth, although there are a few exceptions. “Growing your business is extremely hard,” he maintains. “I don’t put much stock in those Groupons and

ValPac things because all people want are the free stuff and they don’t do a lot for you. We grow by families — I do the dad’s car, then the son’s, the new wife. That’s something else I do, too; you have got to remember peoples’ names, like by the third time they come in. You tell me you were going to the Outer Banks, and when you come in for an oil change, I’d say, ‘Hey, how were the Outer Banks? Have a good time?’”

But when necessary, Tarvin’s willing to adapt. “We now sell tires,” he points out. “I picked up other venues to make money.” For this he came up with a direct mailer program. Printed on postcards was a picture of a car with doughnuts as wheels, the caption reading, “Are you driving on doughnuts?” The cards were mailed using Tarvin’s client list. Tied in with a local bakery, customers would get a free dozen if they bought four Yokohama tires and an alignment. “We sold 65 sets in about four months!” exclaims Tarvin. “But word of mouth is the best, no question; however you must earn it daily.”

Because, as Tarvin states, it’s expensive to gain and keep a customer, but it’ll cost even more should you lose them. Case in point: “We had a TPMS tool made that was \$1,290,” he recalls. “It looked great, we loved it, we used it. But then we tried to do a Hyundai and it just would not reset this lady’s TPMS. I bought new sensors, I did everything, but it was a software problem.

“Hyundai is a big part of (our) market; they’re cheaper cars, people are buying them, but you have got to have the gun that gets it all done. You can’t tell them to take it back to the Hyundai dealer, because the dealers are actively going after our work now. You have got to capture the work with your own style, you have to communicate with the customer.

“I finally just bought this Bartech tool that cost \$1,500. Plugged it in, dink, dink, dink, her car was fixed. You have got to spend the money. We have the newest Hunter rack, we have a Road Force balancer. It’s hard to have that equipment, it’s expensive.”

But like the minnows, you’ve got to have them. **ZZ**



The retention pond offers an area for customers to fish.



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.

Email Robert at rbravender@comcast.net

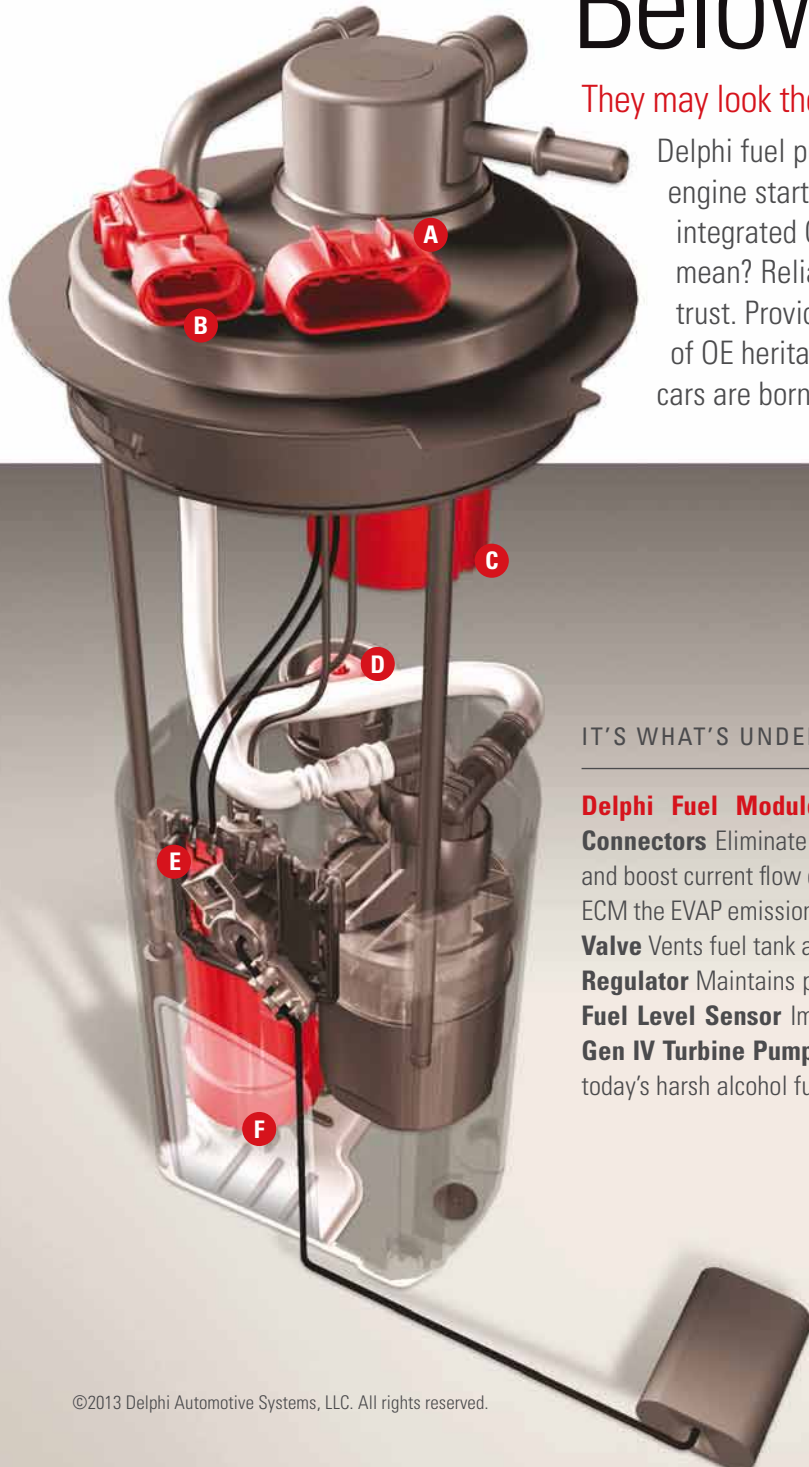


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IN THIS SECTION

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HYBRID REPAIR

How do you decide if you should service, repair, rebuild or replace hybrid trans? /hybridtrans

DOUBLE-CHECK PARTS

Verify replacement parts. It could save you thousands. /doublecheck

21ST CENTURY PRESSURE TEST

What if we could take pressures & plot them on a graph? /21sttesting

Nissan's RE5R05A Transmission

WHETHER YOU'RE LOOKING AT TAGS, FLUID OR OTHER ASPECTS, THERE ARE MANY SPECIFICS TO CONCERN YOURSELF WITH ON THESE MODELS.

BY **WAYNE COLONNA** | POWERTRAIN PRO PUBLISHER

THE REAR wheel drive five speed transmission known as the RE5R05A (Figure 1) is used in both Nissan and Infiniti vehicles as far back as 2002 to present time. Typically fitted behind 3.5L, 4.0L, 4.5L and 5.6L engines, this transmission is offered in both 2WD and 4WD configurations. As with many transmissions these days, this transmission is gear

ratio sensitive. Similar in design to Mercedes 722.6 and the Dodge NAG1 transmission, the three planetary gear sets produce three different overall ratios (Figures 2, 3 and 4).

Because of the variety of vehicles this transmission finds itself in, there are various style gear shift options as well (Figure 5). The TCM that matches the vehicle's calibration specifications is mounted on the valve body (Figure

6) with the exception of first production Infiniti models (Figure 7).

With these mentioned variations alone, the ID tag is a critical piece of information when ordering parts or exchanging units (Figure 8). Of course we know that in real life this tag is never missing, right? Or, if the tag is present, it guarantees that no one used incorrect planetary assemblies in the rebuild process right? Incredibly, mismatched parts and/or units do not occur with the frequency as one might assume. So when it does, it can catch you off guard.

Whether the wrong planetary system is used or the wrong TCM, gear ratio errors are the immediate consequences. In some cases, shift scheduling is altered to earlier shift points, yet will not shift at wide open throttle until it hits the rev limiter. Gear ratio errors soon follow. With this transmission having several other issues that can cause gear ratio errors, infrequent mismatched parts or transmission combinations sometimes can take a shop several days to discover.

One issue that has plagued this transmission over the years is the engine coolant mixing with the transmission fluid. This problem is quickly identifiable, as the transmission fluid looked like a strawberry milkshake. The same occurs with the RE5R05A, yet it seems to depend on how much glycol has actu-



Figure 1



WAYNE COLONNA

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

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Figure 2



Figure 3



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- AC/Heater
- Power Steering
- Radiator
- Fuel System
- Limited Slip Differential
- And many more!

ally mixed with the fluid. Often times the vehicle comes into the shop with a converter clutch slip or shudder problem. When the pan is dropped, the fluid might not be pink in color. A trained eye might notice that the filter bolts have some pitting to them or oxidation above the fluid line inside the transmission. In other cases, there is visible rust or it's just loaded with pink fluid.

Another telltale sign of glycol intrusion is that it destroys piston seals. The seals on the piston inside the aluminum direct clutch drum (Figure 9) will expand so much that the piston will not come out, requiring the need to obtain a whole new drum assembly. The 5.6L vehicles have a different design direct clutch drum escaping this problem. However, in addition to piston seal failure, what all vehicles are subject to, regardless of engine size and design is TCM failure.

This is critical to know when taking on this repair, as TCM issues might not be readily present at the time of



Figure 4



Figure 5

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rebuild. Sometimes solenoid and/or pressure switch circuit fault codes are logged. If the tech is aware of possible glycol intrusion, the thought is the water in the fluid has caused the codes. After repairs, the codes clear and the vehicle is delivered. A day or two later, the vehicle returns to the shop with the same circuit fault codes. In either case, it's an expensive lesson to discover that glycol was responsible for damaging the TCM after all repairs are done.

Another costly scenario we have seen is when this glycol intrusion is not detected. The transmission is rebuilt and sent out. A day or two later it comes back with these circuit fault codes. The first loss is now realized when they discover that the TCM is defective. They do not know why it is defective; they just know that it is. A new one is purchased; it's a plug and play computer, so down the road it goes. No codes, all works well. The problem is the radiator is still defective. It now slowly introduces glycol into the system. The newly installed TCM and transmission is on its way to repeat failure.

Besides a trained eye or strawberry milkshake fluid, how does one know if there is a glycol intrusion problem? One sure way is to test the fluid using a glycol kit such as the HI 3859 kit from Hanna Instruments. A poorer man's method I have been told is to drip some fluid onto a hot plate. If there is smoke, no glycol, if it sizzled, you have glycol. I also have been told glycol glows under ultraviolet light.

Recently, I was able to obtain a defective radiator and valve body assembly from a local shop (Figure 10). Separating the bottom tank from the radiator is quite simple to do. It's just a matter of bending some tabs with a screw driver (Figure 11). Once the tank was removed, I was able to separate the cooler from the tank and decided to pressurize it (Figure 12). If there was a leak, I couldn't hear it or see it, even when submersed in water. I then decided to go the opposite way and pull vacuum on the cooler. Surprisingly enough, I pulled near 25 inches of vacuum where it held for a few seconds before beginning a slow decent stopping at 5.

Having now confirmation that there is an opening somewhere in the cooler,

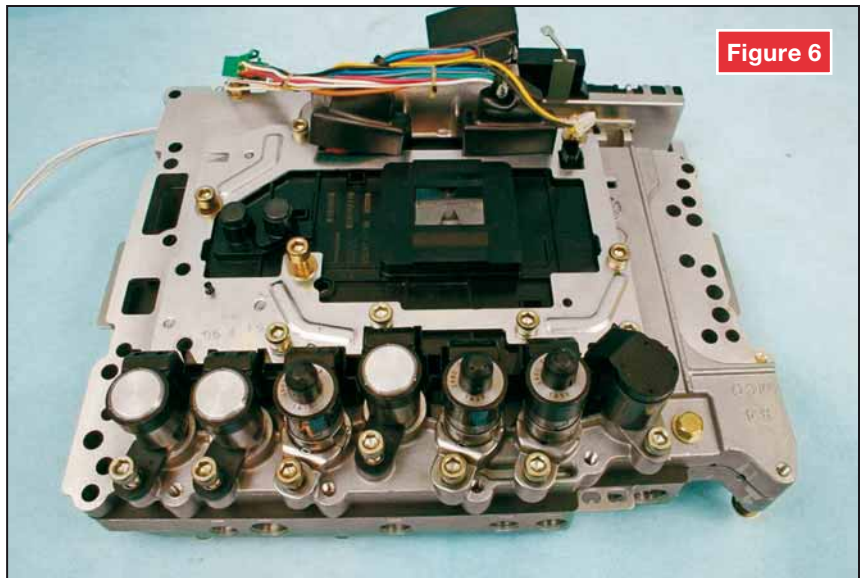


Figure 6

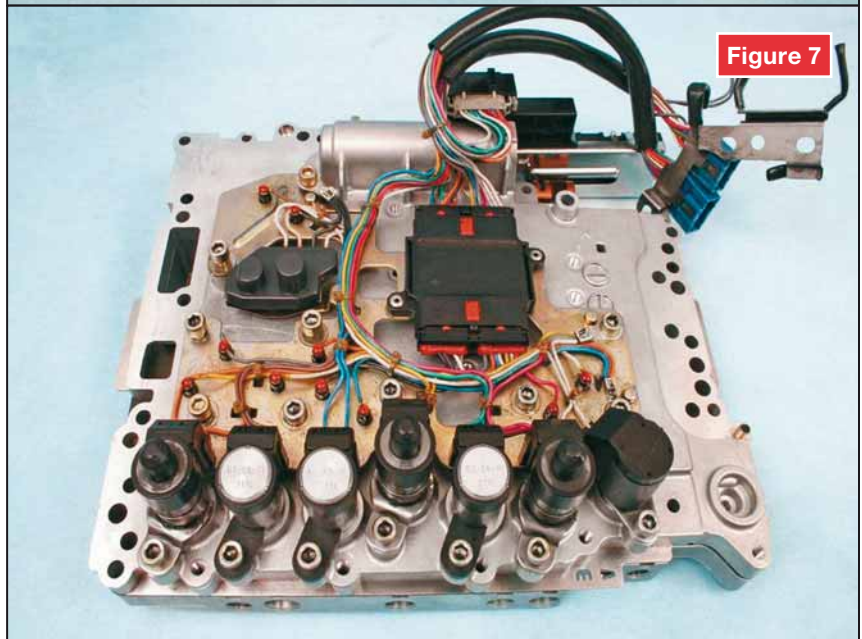


Figure 7



Figure 8



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Figure 9



I began my search to find its location. So I decided to heat the cooler up to approximately 220°F, monitoring the temperature with a temperature gun (Figure 13). To my amazement, it held 25 inches (Figure 14). To be sure, I repeated the test with a different vacuum pump (Figure 15), which confirmed the results. I then poked the cooler into a freezer for a couple of hours and tested it cold. Sure enough, it had a slow leak. The result of this test explained why in some rare instances this problem occurs slowly. In other instances the cooler fails more severely when hot rather than cold explaining the sudden and extreme intrusion of glycol.

A new radiator from Nissan cost approximately \$225. This has caused some shops to buy an aftermarket radiator for near half the price. Some have bypassed the radiator completely, installing an aftermarket auxiliary cooler. Both scenarios have caused converter clutch issues. If an auxiliary cooler is installed without any restriction, a loss of back pressure alters torque converter (Figure 16) pressure. Although this is a three-port converter design (one port to apply the clutch, one port to charge the converter and one as a return to the cooler), the charge pressure works against the piston that applies the clutch.

Figure 10



POINTS ON A VEHICLE WHERE ACCURACY REALLY MATTERS



CAMSHAFT BEARING STRIP

Loosening Torque: 2.5 Nm
Angle of Rotation: 45°

OIL PAN

Loosening Torque: 8 Nm
Angle of Rotation: 90°

CYLINDER HEAD BOLT

Tightening Torque: 30 Nm
Ext. Angle of Rotation: 90°
Cont. Angle of Rotation: 180°

TORQUE CONVERTER

Tightening Torque: 45 Nm

REAR DIFFERENTIAL COVER

Tightening Torque: 90 Nm

WHEEL NUT

Tightening Torque: 88 Ft. Lbs.

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Figure 11

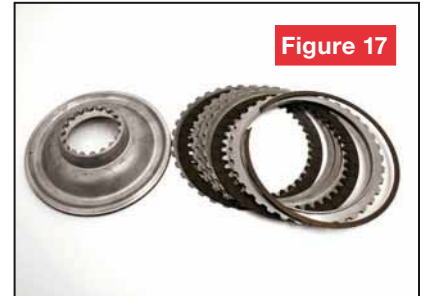


Figure 17

This piston does not have a return spring, which would normally be calculated into the apply and release strategy of the clutch (Figure 17). Without a return spring, it now relies on torque converter charge pressure to do its job. This means if this pressure is too low, it can result in affecting converter clutch apply and release functions.

Some aftermarket radiators have a complete opposite effect. When the cooler inside the radiator reaches operating temperatures, cooler flow becomes overly restricted. This causes too much back pressure inside the converter causing issues with the apply and release of the clutch.

For 2005 to 2010 Frontier, Pathfinder and Xterra vehicles, Nissan has extended its warranty to eight years/80,000 miles. You can obtain information on how to file a claim through their web site www.nissanassist.com. If the transmission failed as a result of cooler failure and it was rebuilt, along with the replacement of an OE radiator and fluids, Nissan has been very good about paying the bill any where in the range of 40 to 100 percent.

A final predicament that needs to be addressed is when this transmission comes in to the shop for other reasons. The radiator has yet to fail. What do you do? Consider when it does fail. Besides rebuilding the transmission, it will require changing the torque converter, the radiator and the TCM. Why do this type of repair under warranty?

I suggest including a new radiator with all repairs. If not and it fails afterwards, you were the last one to touch the vehicle in the owner's mind. At best, warn the owner before hand of the potential hazard. In this way you can be released from the damage it will cause when it does fail. **TZ**



Figure 12



Figure 13



Figure 15



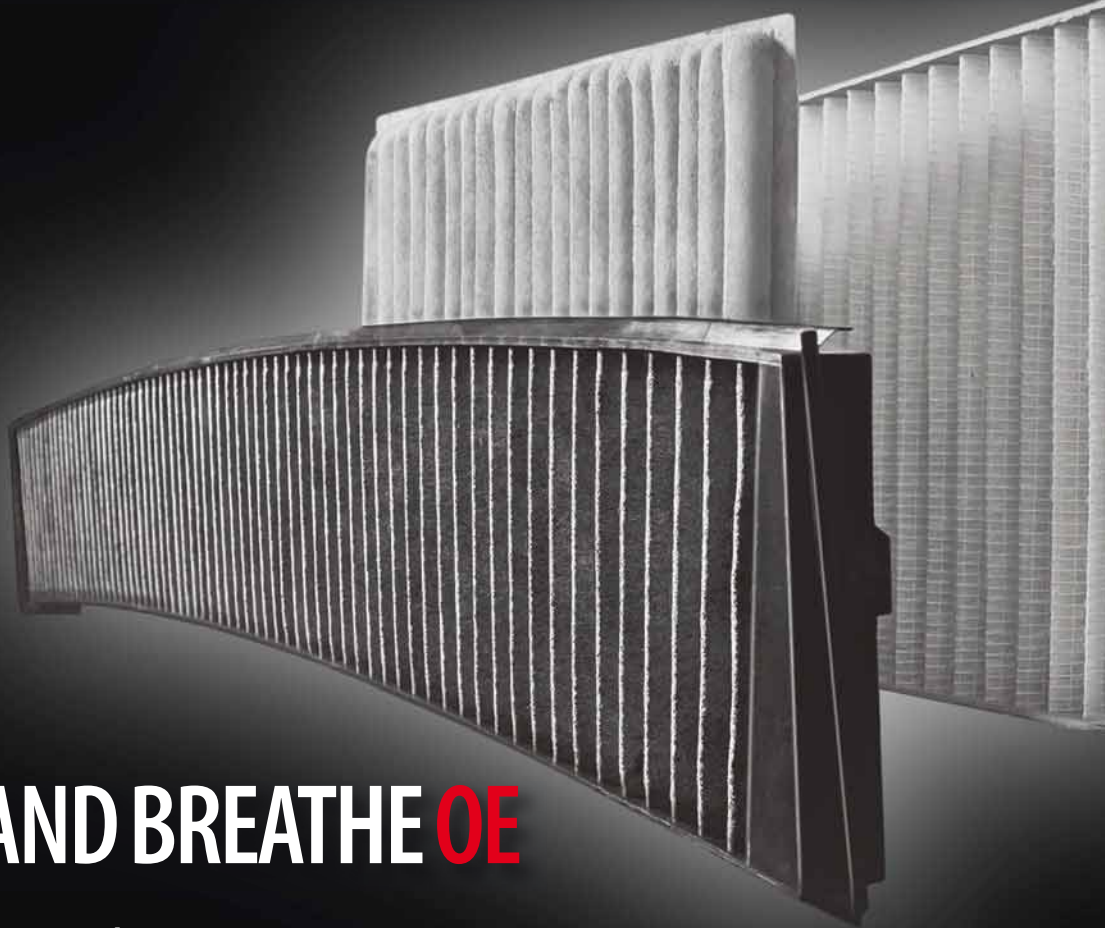
Figure 14



Figure 16



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GM's EN-V concept car is closer to reality than you might think, with GM actively seeking cities for pilot testing. V2V-equipped, it can be driven manually or autonomously.

SAFETY SYSTEMS OF THE PAST SET THE STAGE FOR AN ACCIDENT-FREE FUTURE.

BY PETE MEIER | TECHNICAL EDITOR

I might be dating myself here, but I remember the days when the only safety feature a car had was its sheer size. The bigger of the two in an accident usually won. Seat belts didn't exist, kids stood in the back window trying to get the trucker behind them to blow his horn and Mom sat in the middle of the bench seat, close to Dad, as they all motored down the highway.

In 1965, nearly 50,000 people just like them died.

While death rates are significantly lower today, the real impact of vehicle safety systems can be seen in the death rate per vehicle miles driven. In 1965, the rate of fatalities per 100 million miles driven was 5.03 compared to 1.10 in 2012. And with the technology being developed right now, the possibility of an accident and fatality free future is becoming a real possibility.

In The Beginning

Braking ability, the ability to bring a car down from high speed to a complete stop in a controlled manner in order to avoid a pending collision, was a matter of driver training and experience. We were taught to "pump" the brake pedal to come out of a skid when we had pushed the tires to the limits of their traction. (This technique was especially useful when driving in slippery conditions.)

The idea was simple enough. If the tires locked up due to the pressure exerted by the brakes, it broke traction from the road surface and steering control was immediately lost. To regain control, the driver had to momentarily release the brakes and get the wheel(s) turning again. The problems, though, were two-fold. First, a panicked driver often forgot to take their foot off the

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Scan this QR Code to read on your smartphone SKF tips on servicing GM hub bearings with ABS. Or visit MotorAge.com/skftips

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brake pedal and second, if the driver did raise their left foot, they weren't slowing down and stopping distances skyrocketed.

Enter Anti-lock Braking Systems (ABS). First used on aircraft as far back as 1929, they didn't make it to the automotive scene until the late 1950s, early 1960s and did not enjoy widespread use in production vehicles until the start of the 1970s. This was about the time that engine management duties were being turned over to a dedicated computer, and we began to witness the birth of the automotive electronic age.

Some early ABS systems (light trucks mostly) controlled braking only on the rear wheels. A single sensor, usually mounted in the rear differential, moni-

Photo: GM



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A driver's eyes might drift and fade, but the onboard camera and radar "eyes" always are awake.

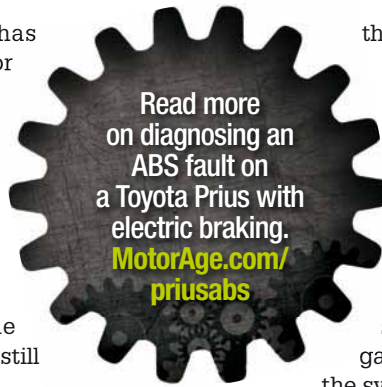
Photo: Bosch

tored the wheel speed and a single brake line led to a splice that fed the rear brakes. Because there is only one line being controlled, the system was referred to as a "one-channel" system. Both rear wheels need to lock before the ABS function would kick in and it was possible for one wheel to lock while the other kept turning, limiting brake effectiveness.

Adding the front wheels to a one-channel system created the three-channel, three-sensor ABS system.

Each front wheel has its own speed sensor and is individually controlled by the system's electronic control module. The rear, meanwhile, remains tied together on one line and uses the same single sensor in the rear end. Better, but still not ideal.

Adding dedicated lines and sensors to the rear introduced the four-channel, four-sensor system, and most late model vehicles equipped with ABS use this platform. In all ABS systems, the idea is to monitor wheel speed, and if it is found to be varying from the rest, the electronic control module alternately releases and applies the hydraulics to "pump the pedal" at a rate mere humans could never hope to match. This helped maximize emergency braking under a variety of (but not all) road conditions and did much to improve driver safety. To be effective,



Read more on diagnosing an ABS fault on a Toyota Prius with electric braking. MotorAge.com/priusabs

though, drivers had to be educated on the need to apply full pressure to the brake pedal and keep it applied, even when they felt the pedal rapidly pulsating under their foot. If released, the ABS system would disengage and the benefits of the system were lost.

Why Just for Braking?

If ABS could use electronic control modules to prevent wheel lock-up under hard braking, why couldn't that same system be used to prevent wheel spin? This thought by some engineer somewhere (Bosch usually gets the credit) led to the development of Traction Control Systems (TCS). Also known by its (translated) European name, Acceleration Slip Regulation (ASR), traction control seeks to prevent wheel spin under acceleration. Think of it as ABS in reverse, with a twist.



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The onboard camera can detect approaching traffic and even be used to monitor how well the car is staying in its lane.

What do you think of when you first hear the words “traction control?” At first, the function of the system appears obvious, doesn't it? Traction is defined as “adhesive friction, as of a wheel on a track or a tire on the road,” and there are different kinds of traction. One, controlled by the ABS system, is braking. Another is under acceleration and yet another is when we turn. Traction control systems focus on the second, maintaining that “adhesive friction” under lateral (front-to-back) loads, the kind produced when we hit the gas.

It uses the same inputs as the ABS system does and controls the braking

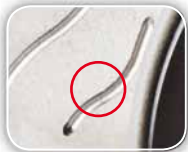
system using the same means, but there is one additional control it takes advantage of: throttle position. Out with the old cable-operated throttle body and in with the new electronic throttle body, complete with redundant accelerator position sensors. With these new mods, the TCS can reduce throttle opening, thereby reducing engine power, as a means to eliminate wheel spin when encountered.

Traction control worked well when faced with wheel spin caused by wet or icy roads as long as the car was traveling in a straight line. However, put that slick spot in the middle of a curve and



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reactions to the effectiveness of TCS were mixed and varied.

Forget the Yaw Factor

Your wife is heading home, the baby in the back seat securely strapped into his car seat. It's been a rainy day; heck, a rainy week, and the roads are slick. As she heads down the hill just a few miles from home, the baby begins to wail and momentarily distracts her attention from the task of driving the car.

She's picked up a little speed on the downhill run, and as she nears the base she lifts her head back to the road just in time to see an F250 pulling out of a side street in front of her. She slams on the brakes and swerves to miss the truck, and she can feel the rear end brake loose and begin to swing around.

“Couple the goal of accident-free operation with zero emissions and the move away from fossil fuel, and you might live to see the day when your toddler son grows up to own a car cartoon icon George Jetson would be proud of.”

Instantly, the Electronic Stability Control system kicks in with no required input from the driver. The appropriate wheel brakes are applied or released as necessary to slow the car and end the fishtail. Disaster averted, everyone safe!

ESC is a result of the natural progression of onboard vehicle safety systems. Increased computer processing speeds, miniaturization of electronic components, and software development now allow the elements of the ABS/TCS systems to protect the occupants from loss of “adhesive friction” in turns. The addition of steering angle and yaw rate sensors allows the body roll to be monitored in addition to the existing sensors for acceleration/deceleration. All three axis of the car can be controlled with no outside input from the driver necessary.



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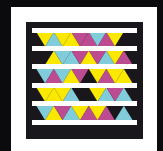
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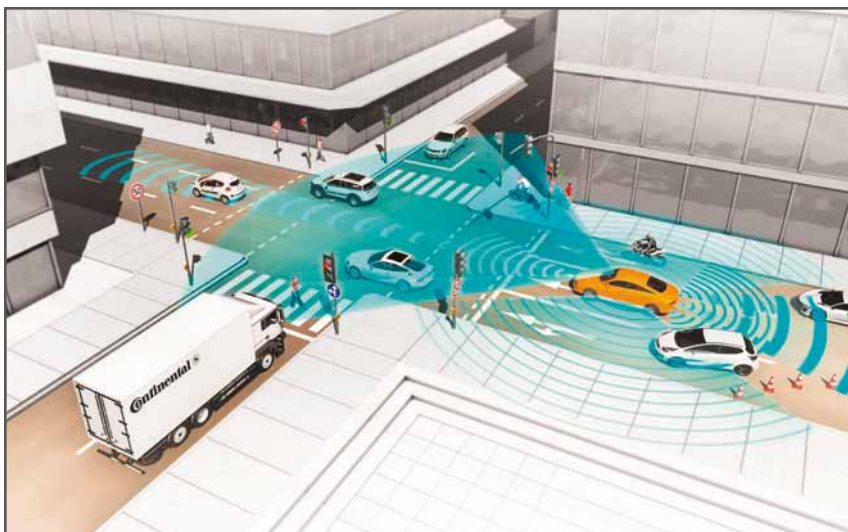


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The impact ESC has made on reducing deaths and injuries, especially from rollovers, is significant. According to the National Highway and Traffic Safety Administration (NHTSA) estimates, ESC will reduce single-vehicle crashes of passenger cars by 34 percent and single vehicle crashes of sport utility vehicles (SUVs) by 59 percent, with a much greater reduction of rollover crashes. They further estimate ESC would save 5,300 to 9,600 lives and prevent 156,000 to 238,000 injuries in all types of crashes annually once all light vehicles on the road are equipped with the system. Hence, the requirement that electronic stability control systems be installed on all passenger and light duty trucks (GVWR of 10,000 pounds or less) starting with the 2012 model year.

And while trained professionals can still do donuts with a car equipped with ESC, the majority of drivers will benefit from the addition of a system that will help keep the car stable under the majority of road and weather conditions.

Tech Points

With each step up, these onboard safety systems require a bit more from the servicing technician. Even performing routine tire and brake service can negatively impact the ability of these systems to work as they should. Let's be clear, though. The foundation brake system should continue to function normally if there is a detected fault in the ABS,

TCS or ESC, but these are vital SAFETY systems and you should be encouraging your customer to keep them working and serviced.

Many of the issues you likely will encounter with any of these systems will be due to a problem in the wheel speed sensor signals to the control module. Be aware of harness routing and plug connections when working around the wheel speed sensors. A little corrosion can go a long way to throwing off a signal, and connectors damaged by repeated use can keep a system offline.

Know that worn hub bearings can cause erroneous wheel speed data, and may not set a code but result in unwanted activation of the braking functions. A scope can be a very useful tool when isolating a weak sensor, an excessive air gap or damaged reluctor and, coupled with a micro-amp clamp, might be the only way to know for sure if a Magneto Resistive Sensor is on the last legs of its lifespan.

When performing any repair involving wheel position or steering column alignment on vehicles equipped with ESC, be sure to perform any required relearn of the steering angle and yaw rate sensors. As with any diagnostic dilemma, make the first stop your service information system and look for related Technical Service Bulletins (TSBs), especially for updated software requiring control module reprogramming.

What's Next?

We laughed when we first saw the Google car, didn't we? Visions of the robot car scene from "Total Recall" spring to my mind when I think of an autonomous car. But the truth is, we aren't that far from turning fiction into reality.

Right now, midrange consumer cars are coming off of the showroom floor with the ability to park themselves, warn their drivers when another vehicle is currently occupying the lane they are trying to move into, slow the car and blow bells and whistles when a front end collision is imminent and lots, lots more. And while they still require active participation from the driver, these systems are going a long way to protect the driver from others on the road and in some instances, protect the driver from himself (lane departure warnings, for example).

A year ago, I reported that the Department of Transportation and a "Who's Who" collection of OEM and aftermarket industry leaders had joined together to conduct the first real world test of cars using vehicle-to-vehicle (V2V) communications. There were 3,000 cars equipped with what amounts to onboard WiFi and GPS handed over to regular folks, who were asked to drive them normally and report back on their experiences.

Called Dedicated Short Range Communications (DSRC) devices, they allow a vehicle to communicate with other, like-equipped, vehicles and even with traffic infrastructure (toll booths, traffic lights). Unlike many of the systems in use today that utilize



Required in every new passenger car and light truck starting with the 2012 MY, ESC is the natural evolution of ABS and TCS.

radar and/or cameras to detect threats, V2V does not rely on line-of-sight to be effective. It knows where everyone is, how fast everyone is going and what direction everyone is heading in.

Here's a scenario for your consideration, and one I'm willing to bet you've really experienced. Ever pull up to a stop light, have the light turn green and just as you start to pull forward another vehicle (usually a really big 18-wheeler) blows through the light? A second earlier or later and you would have been struck dead center and likely killed or seriously injured.

But with V2V, your car would know that the truck was coming and that it wasn't slowing down. It would sound off warnings and flash red lights on the dash (or a heads-up display on your windshield), all in an effort to warn you to stay put. And if you ignore the warnings, it wouldn't let you go anywhere until the way was safe even if you slammed the throttle to the floor.

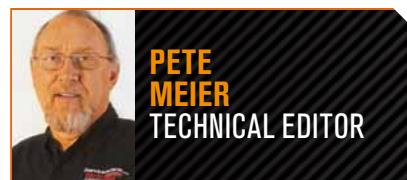
The NHTSA thinks that this type of technology could eliminate nearly 80 percent of the accidents caused

by a distracted driver and could save thousands of lives in the process. The pilot test in Ann Arbor, Mich., that I reported on was phase two of DOT's Connected Vehicle Safety Pilot program and NHTSA officials were cited as saying that, pending a successful outcome, rule making could begin in just a few years.

Truly autonomous technology is already here. On some European roadways, the concept of an auto "train" has been successfully proven. Drivers mate up with lead vehicles on the Autobahn, ask to join the train and when accepted, the lead vehicle takes over. The linked vehicles simply follow the leader while their drivers are free to read, catch up on their sleep or watch TV. When the final destination exit is near, the driver simply detaches from the train and resumes control of the car.

Several states around the country have issued special licenses for the testing of autonomous technology on their highways. Nearly every OEM has programs developing new and

integrating existing technology into autonomous platforms. Couple the goal of accident-free operation with zero emissions and the move away from fossil fuel and you might live to see the day when your toddler son grows up to own a car cartoon icon George Jetson would be proud of; electric powered with hands-free operation. More importantly, the technology in use today (and the technology certain to come in the near future) may mean a near-zero loss of life on our nation's highways about the same time. *TM*



PETE MEIER
TECHNICAL EDITOR

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

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NISSAN'S RE5R05A P1716 - TURBINE REVOLUTION SPEED SENSOR CIRCUIT

KEEP YOUR EYE ON THIS ARTICLE AS THESE SENSORS GO 'ROUND AND 'ROUND.

BY **WAYNE COLONNA** | POWERTRAIN PRO PUBLISHER

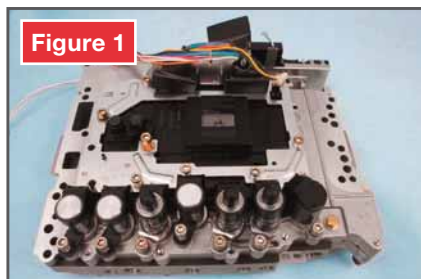
Sitting on top of the valve body are two revolution sensors mounted and connected to the TCM circuit board (Figure 1). The sensor most forward to the front of the vehicle is called the Turbine Revolution sensor 2. The next one back is the Turbine Revolution sensor 1. These sensors poke through a hole in the case as seen in Figure 3. Figure 4 shows them as seen from inside the transmission with the pump and drums removed (Figure 5). The sensors appear just slight behind the band (Figure 6).

Bear with me for a moment as I explain who reads what. Once I get

through this I will be able to simplify it to terms we can use practically. Here we go: Turbine Speed Sensor 2 (TSS2) reads the sheet metal windows attached to the front planetary sun gear shell. Turbine Speed Sensor

1 (TSS1) reads the input housing planetary shell that is attached to the turbine shaft (Figure 7).

Now, what does this basically mean? TSS1 is an actual turbine shaft speed sensor that will provide a turbine rpm



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Figure 3



Figure 5

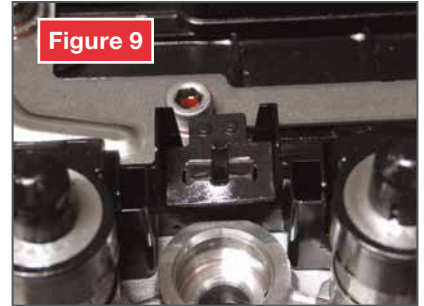


Figure 9



Figure 6



Figure 8

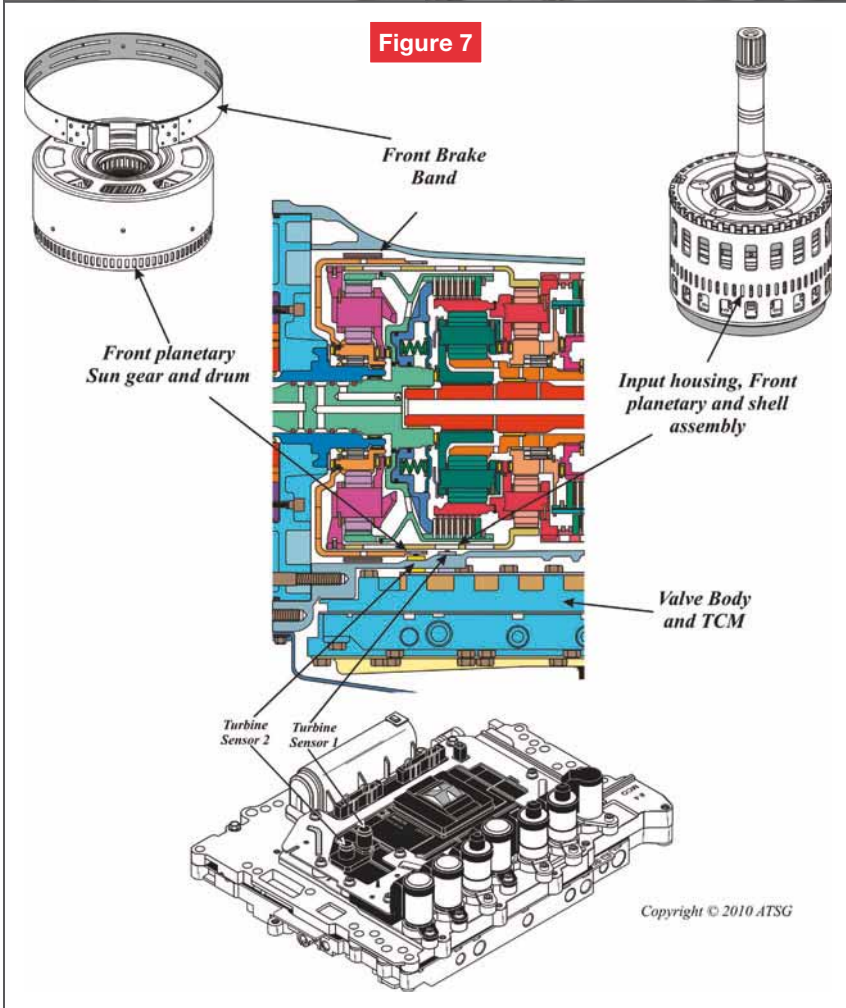


Figure 7

reading anytime it is in rotation. The TCM uses this to determine transmission gear ratio against the OSS rpm sensor. It also determines converter clutch slip against the ERPM sensor. So it's a typical TSS/ISS. However, TSS2 reads the sun gear in the front planetary assembly. This drum is held stationary by the Front Brake Band for every gear except fourth.

This is the only time you will see an rpm reading from the speed sensor. This means code P1716 sets when it does not see an rpm reading at the time the TCM command fourth gear. This could be due to a faulty solenoid or a stuck valve. This is critical to understand, otherwise you might be dropping close to \$1,000 for a new TCM and valve body. Be sure to exhaust all other possibilities before committing yourself to this purchase.

It is interesting to mention that the Front Brake Band solenoid controls the Front Brake Band. What is odd about it, this solenoid remains on at all times except for fourth gear. At which time the solenoid turns off and the band applies. I would have thought to turn the solenoid on when I need the band to be applied. Especially since it is only applied in one gear: fourth.

Of the entire rack of solenoids on the valve body, this is the only one with a rubber seal between the circuit board blades and the solenoid (Figures 8 and 9). It appears that since this solenoid is on near 99 percent of the time, it could get a little warm. It certainly is subject to failure as a result of it (P1716).

I suspect this rubber seal is used in an attempt to prevent capillary action pulling fluid into the TCM's command center. It's just one of those things I scratch my head over wondering why. I would enjoy speaking with the engineer who designed as they usually have good reason. I can only speculate. *TLZ*



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DRIVABILITY



The Ranger uses a mass airflow fuel management strategy.

FUEL TRIM FOR DIAGNOSTICS

HOW IMPORTANT IS IT TO KNOW WHAT KIND OF FUEL MANAGEMENT SYSTEM WE ARE WORKING ON?

BY **ALBIN MOORE** | CONTRIBUTING EDITOR

Day after day, we work on cars with drivability problems. Many of us see a lot of GM and Ford vehicles in our shops, which means we see a lot of P0171 and P0174 (System Lean: Banks 1 and 2) diagnostic trouble codes (DTCs). But is the cause of a P0171 the same thing on a Ford 5.4 engine as it is on a GM 4.2 engine? Hold that thought while we delve into the theory of fuel management.

The vehicles that come to our shops use one of two types of fuel management strategies: speed-density or mass airflow as measured by the mass airflow (MAF) sensor. In both strategies, the weight of the air entering the

engine must be calculated (as opposed to volume) so the Engine Control Module (ECM) can supply the correct amount of fuel (also by weight) to efficiently power the engine. The outcome of these two different fuel control systems is the same: an engine that produces good power, runs efficiently and has a clean exhaust.

Mass airflow engine air calculations are the simplest for me to understand. There is a MAF sensor installed somewhere in the air intake system between the air filter and the throttle plate. This strategy does not need to know anything about throttle position, exhaust gas recirculation (EGR) flow, engine temperature or even barometric pres-

sure. All the ECM is interested in is the total air mass that is flowing through the MAF sensor. In order to be accounted for, all the air entering the engine must travel through this sensor. If some of the air bypasses the MAF sensor, say through a torn intake tract boot or leaking manifold gasket, the ECM has no way of knowing that and will add only the amount of fuel required by the air mass it does know about. This means a miscalculation that results in too little fuel being added for the actual amount of air that has entered the engine. And that's not the only way a mistake can be made.



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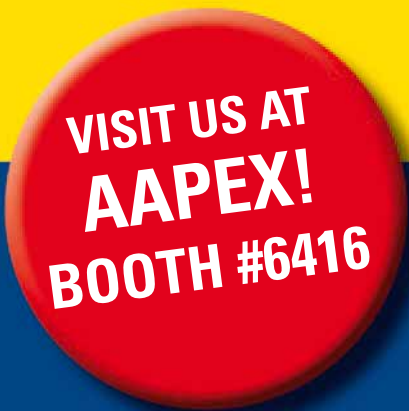
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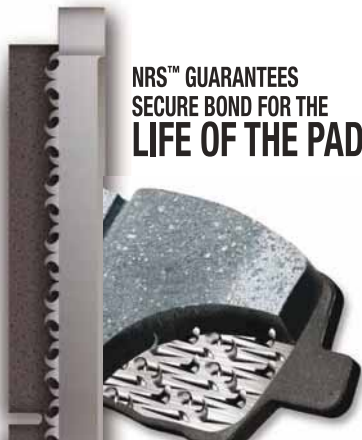


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The Envoy, on the other hand, relies on the speed-density fuel management system.

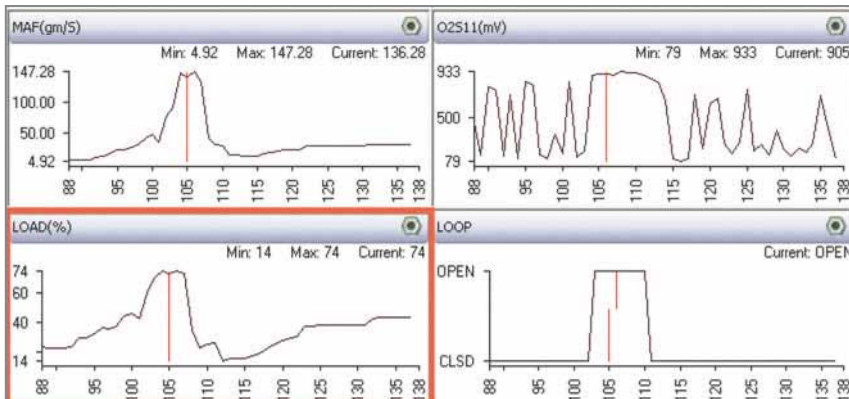
If, for some reason, the MAF sensor does not measure the air flowing through it properly or if the oxygen sensor feedback is not reported correctly, DTCs will be stored in the ECM and the Check Engine light will be illuminated.

One the amount of air (mass) is determined by the ECM, it uses this formula to calculate the proper amount of fuel (also by mass) for correct engine operation.

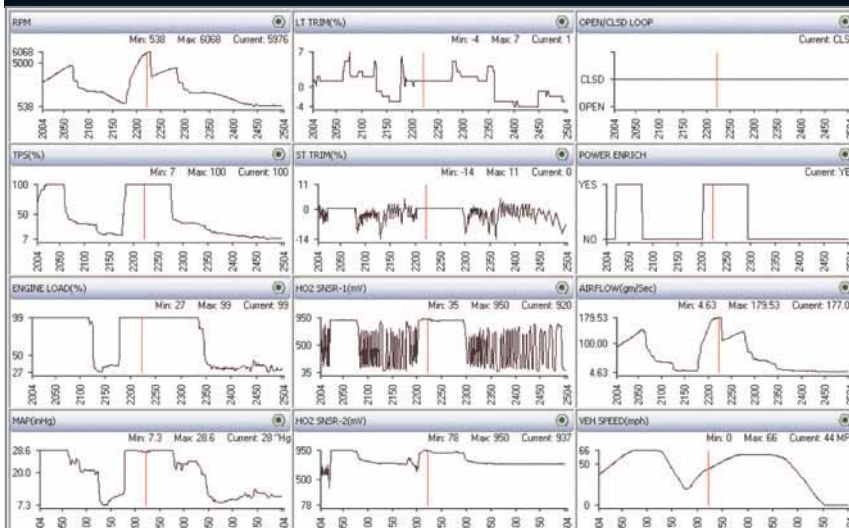
$$\text{FUEL MASS} = \frac{\text{AIR MASS} * \text{SHRTFT} * \text{LONGFT}}{\text{EQUIV_RATIO} * 14.64}$$

The speed-density method of fuel management achieves the same end result as the mass airflow strategy but the route taken is much different. This method of calculating the weight of the air ingested into an engine depends on several different sensor inputs and several mathematical calculations. Data needed by the ECM to properly calculate the weight of the incoming air (air mass) includes engine rpm, engine volume, throttle plate position, manifold absolute pressure, intake air temperature and barometric pressure.

Each of the two fuel management systems have their strengths and their weaknesses, but all in all, each of them does a pretty good job of keeping an



With a man-made exhaust restriction in place, the Ranger exhibited low power. The only PID that changed was the LOAD PID, reading 74 percent when it should be reading closer to 95 percent.



Even though the Envoy is struggling to stay at 60 mph, the data PIDs show nothing out of the ordinary. Just goes to show there is more to drivability than just knowing how to read a scan tool.



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engine running smoothly, efficiently and with a clean exhaust.

A few years ago I thought the speed-density system was on the way out, being replaced by the mass airflow fuel management system. Today, though, some of the vehicles boasting ultra-clean exhaust emissions are using the speed-density system, so it would be a good thing to dig a little deeper into this strategy and compare the two fuel management systems. Being aware

of the way they operate will give you an edge on proper diagnostic processes.

As we discuss the fuel/air management systems, I would like to present a few things I have found that simplified the understanding of how they

Find out more on diagnosing lean codes on a mass airflow system from Pete Meier
MotorAge.com/mafleancodes

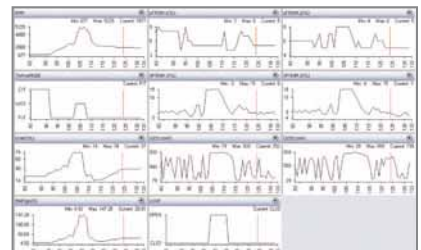
work. Both the mass airflow and speed-density systems calculate the weight of the air that enters the engine. The fuel trim Parameter Identifiers (PIDs) on the scan tool are telling you how the ECM is adjusting the fuel injector's "on time" (pulse width) in order to add the correct amount of fuel based on that measurement. The ECM can only regulate the amount of fuel based on the amount of air it knows about. The ECM cannot do anything about the relationship of air to the amount of fuel, but it has everything to do with the amount of fuel delivered in relationship to the air entering the engine.

Basic Mass Airflow Strategies

Any line tech that has worked with OBDII knows that fuel trim PIDs are displayed in two ways, short term and long term fuel trims. V6 and V8 engines have two sets of both fuel trim PIDs, one for each side (bank) of the engine. Even some in-line four cylinders have two sets, one per cylinder pairing (cylinders 1-4 and cylinders 2-3 typically).

Short Term Fuel Trim (STFT) is representative of the current adjustments the ECM is making to injector pulse width (fuel control) and Long Term Fuel Trim (LTFT) is a learned correction over a period of time. Positive numbers indicate the addition of fuel (lean correction) while negative numbers indicate removal of fuel (rich correction.)

In the mass airflow strategy, the MAF sensor is in control of telling the ECM how much air the engine is inhaling. If there is an air leak in the air intake system any place between the sensor



At cruise, the Ranger hardly noticed the exhaust was plugged. And neither did the PIDs."

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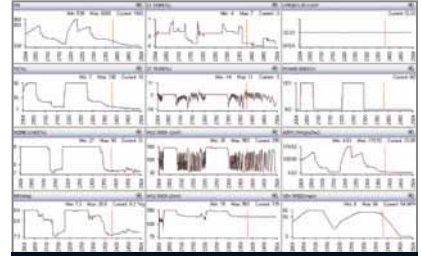
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and the intake valves (air boot, leaking vacuum lines leading to the intake manifold or leaking intake manifold gaskets are just a few possibilities), the fuel trims will show a positive number at idle. This is due to air entering the engine that has not been properly measured. The ECM incorrectly thinks the engine has taken in less air than it actually has. The end result is a lean idle condition that the ECM will attempt to correct using STFT and LTFT.

Raising the engine speed from idle will cause the airflow into the engine to increase and the trims to trend back closer to normal. Since the air entering through the leak is of a smaller proportionate amount at higher throttle openings, the impact on fuel mixture is reduced, even eliminated. This depends a lot on the size of the air leak and the position of the air leak.

Dribbling and leaking fuel injectors, on the other hand, will display a



As with the Ranger, the GMC hardly noticed its loss of power at cruise.

negative fuel trim at idle as more fuel is added than needed. As the engine speed and engine load are increased, the trims will move back closer to normal. Just as with the air leak, fuel leaks at idle represent a greater portion of the total fuel getting to the cylinder at idle than it would at higher loads and engine speeds. The trims also will work this way for a leaking purge solenoid or leaking fuel pressure regulator, since there is an excessive amount of fuel that is not accounted for by the PCM calibrations.

Errors in the actual MAF sensor output (bad sensor ground, contaminated hot wire/film, and the like) will show up with a lower than normal load PID value, the long term and short term fuel trim data also will point to the error in air calculation dependent on the MAF fault. Later on there will be a case study on this issue. Because all MAF sensors do not fail in the same way, it is impossible to say the trims will show specific things, such as "short term trims will follow throttle position." Over the years, I have learned to never say never and or have hard and fast rules for things. Rather, I try to encourage technicians to learn the theory of operation for their specific system and then apply the theory to the problem they are facing in their bay.

Basic Speed-Density Strategies

Speed-density fuel management systems uses several different sensor inputs to calculate air mass. Any data that is misreported by any of the sensors; MAP, TPS, O₂ sensor, ECT or IAT can cause a miscalculation in the air mass. Each different vehicle manufacturer will use the inputs of these sensors differently, so don't think just because the GM product you worked on yesterday calculated air mass one way that Subaru that's here today will be the same.



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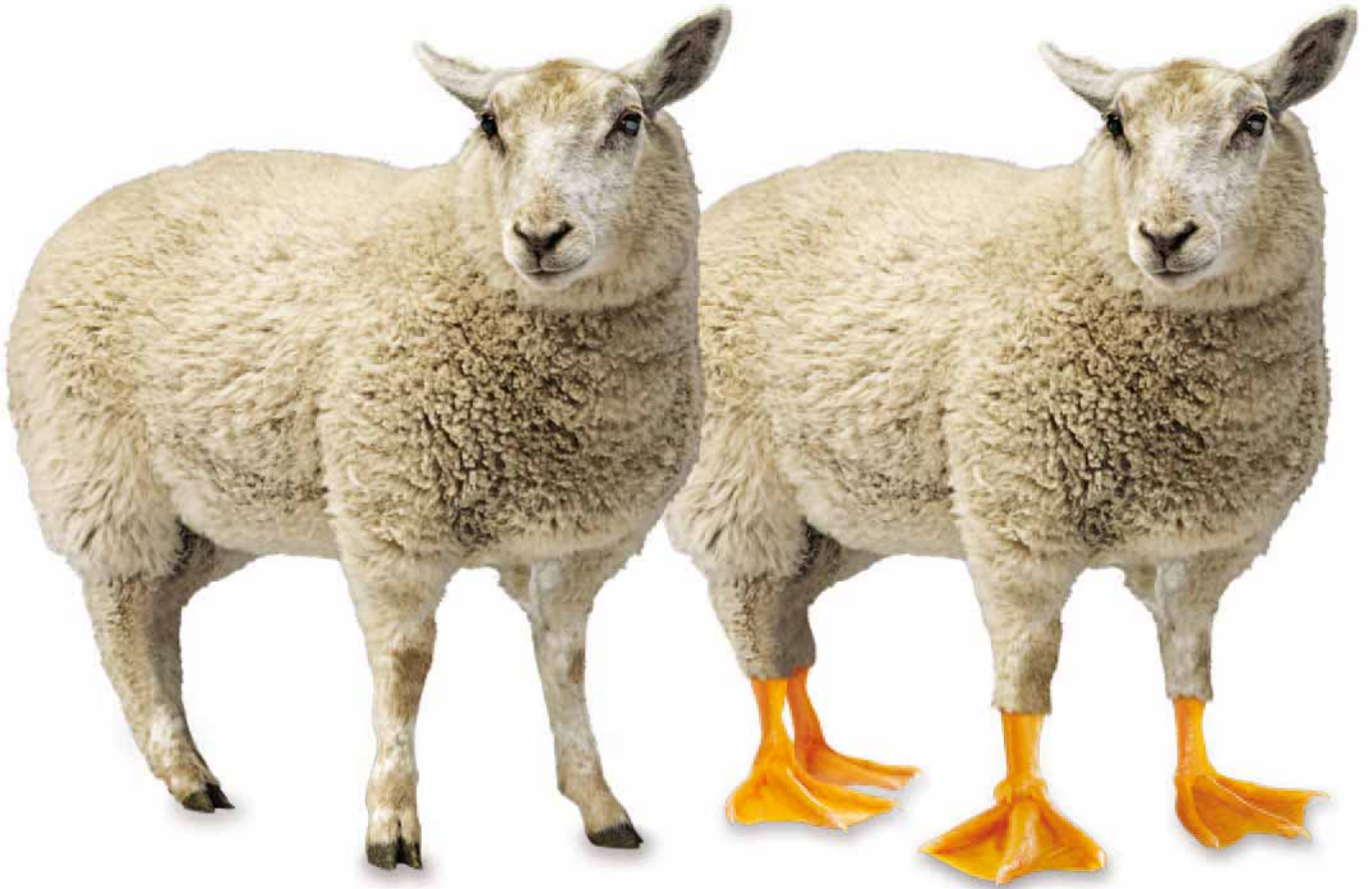
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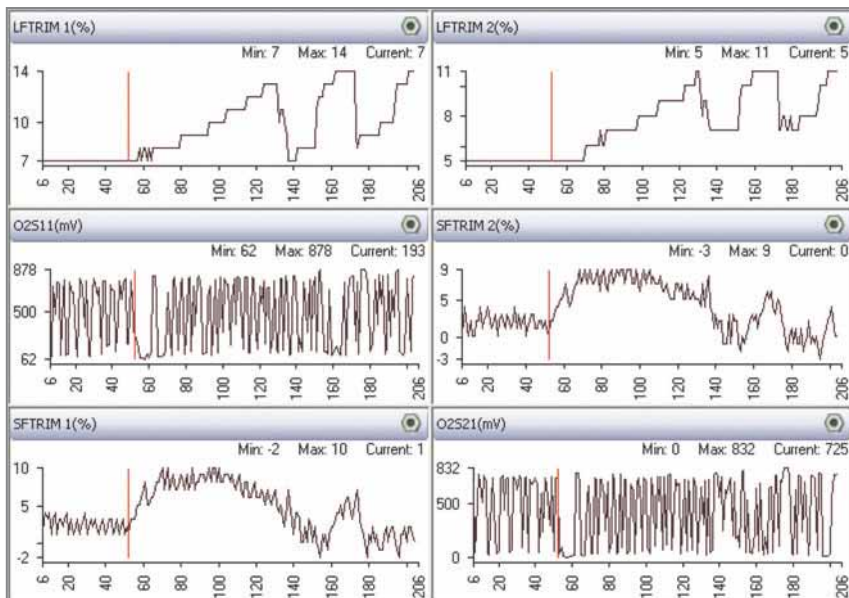


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The red cursor shows where the vacuum leak was introduced. Notice how the STFT, LTFT and O₂ PIDs reacted.

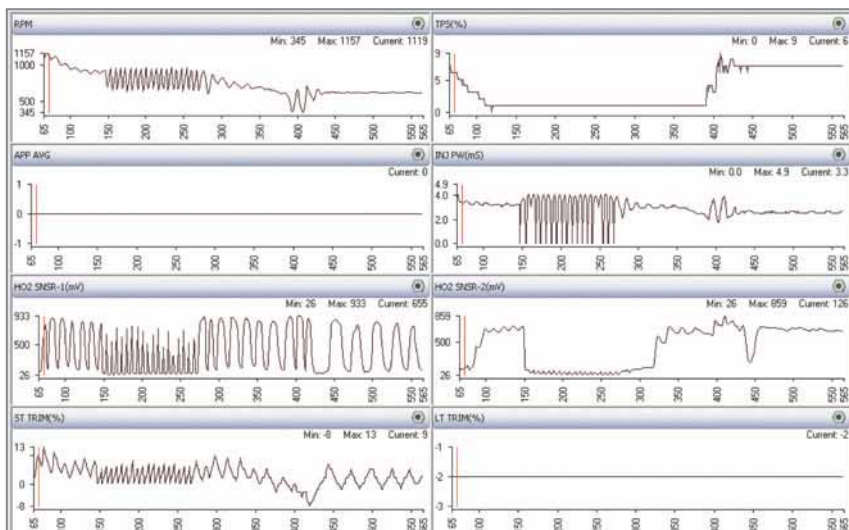
Vacuum leaks on a speed-density engine are not unmetered air and do not cause a shift in fuel trim. Vacuum leaks also will not cause a P0171/P0174 code. And, unlike a mass airflow system, a vacuum leak on a speed-density engine will raise the engine idle speed since the leak is the same thing as having the throttle blade open. Exhaust restrictions can set a P0172/P0175 (System Rich: Banks 1 and 2) codes on some vehicles, depending on how the sensor software is written. Low fuel pressure will cause P0171/P0174 codes, just the same as a mass airflow system.

Speed-Density and Mass Airflow Compared

Two different vehicles will be used to demonstrate the different fuel management systems.

Vehicle No. 1 is a 2001 Ford Ranger powered by a 4.0 OHC engine. The power runs through a 5-speed automatic transmission and the odometer shows 250,000 miles have been traveled. The Ranger uses a mass airflow fuel management system.

Vehicle No. 2 is a 2002 GMC Envoy. The engine is the 4.2 in-line six-cylinder and is also mated to an automatic transmission. The odometer shows 140,000



The vacuum leak is so great the throttle blades are closed to minimum position. When the throttle blades cannot control the engine speed, the PCM turns off the fuel injectors.

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miles have slid by under the vehicle. The Envoy uses a speed-density fuel management system.

Both of these vehicles are in very good shape and have no problems. A scan tool was used to graph data from both vehicles and each vehicle was driven with a restricted exhaust, then each vehicle had a vacuum leak induced so the scan data would show how each fuel management system reacted to the same problem.

With restricted exhausts, the only symptoms were lack of power and the transmissions were reluctant to shift out of second gear while climbing a 4 percent grade at 60 mph. Both fuel management systems were able to keep the air/fuel ratio well in control and the exhaust emissions in check. As the vehicles went into the cruise portion of the test drive, the exhaust flow slowed to the point the restriction in the exhaust had no effect on the engine operation.



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“When it comes to diagnosing emission related diagnostic trouble codes, it is very important you are aware of what fuel/air management system you are working on.”

When vacuum leaks were induced on each engine a big difference can be seen in the two fuel management systems. The mass airflow system shows a lean condition which will cause the fuel trims to move positive in an attempt to add enough fuel injection pulse width to keep the fuel delivery in check with the amount of air that is actually passing through the engine.

Watching the data on the speed-density engine shows the only effect the added air has is an increase in engine RPM. There is no effect on the air/fuel ratio since the air leak amounts to the same thing as opening the throttle blade. The Manifold Absolute Pressure (MAP) sensor is able to sense the change in manifold pressure and the ECM opens the fuel injectors to compensate for the added air passing through the engine.

When it comes to diagnosing emission related diagnostic trouble codes, it is very important you are aware of what fuel/air management system you are working on. Without a good understanding of each system operates, you will be wasting a lot of time diagnosing and repairing the problems that come to your bays. *MM*



ALBIN MOORE
CONTRIBUTING
EDITOR

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

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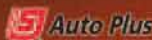
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MAINTAINING POWER ASSIST

The new power steering pump in this picture was replaced because the owner drove it for more than a year with the remotely mounted reservoir screen stopped up. Even after the screen was cleaned, there was no power assist. This pulley is the original one, and the puller bolt is threaded into the pump shaft in preparation. But be careful when you're replacing one of these pulleys with an aftermarket one. Some of the low-cost country-built ones are a bit too tight and won't go on. And don't put the pulley on backwards.

KEEPING LOOSE WHEN FACING STEERING PROBLEMS.

BY RICHARD MCCUISTIAN | CONTRIBUTING EDITOR

Some folks will drive vehicles for many a mile with inoperative power steering or brakes. While the exercise they get that way builds muscle mass, it's anything but safe, and parking maneuvers in a crowded lot are murderously difficult. Once my extremely self-reliant aunt was driving an old Buick that suddenly lost its power steering and she had angled across two parking spaces because it was the best she could do. And when an angry motorist shouted a question as to why she didn't take three parking places while she was at it, my always dignified and unflappable aunt simply replied that the two parking places she had would do her just fine.

Which Way and How Much?

There was a time in my early career as an automotive professional that I

believed I could fix anything, and in many cases, I was right. After all, we rebuilt power steering racks as a part of a recall when I worked at the Mazda dealer. But the exuberance born of too many successes in coloring outside the lines can lead to a smack-down.

One hot summer day about 30 years ago, I drew a work order on an early 1970s Mustang with power steering trouble. I don't remember the original write-up, but I do remember making the discovery that a person without sufficient training shouldn't tear a ball nut steering gear down to the bare parts and reassemble it expecting it to work right.

Just because I had successfully fixed the power steering systems on so many tractors and forklifts, I figured I could whip this one, too. As it was, I got things so out of whack on the spool valve adjustment that whenever the

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engine was started, the steering wheel would whirl all the way to the right so hard that you couldn't force it back to the center. For the life of me I couldn't figure out how to fix that; I repeatedly tried to adjust the spool valve, but it was no use. After burning most of a day on that one, the decision was made to replace the steering gear with a used salvage yard unit, and I had egg on my face. In the years after that I replaced some pitman shaft seals and whatnot, but I never attempted a total steering gear rebuild again. After all, a replacement gear doesn't cost all that much and the repair is finished a lot sooner.

On any kind of power assist, whether brakes, steering or whatever, the control part of the system has to know when power assist is necessary. And

Photos: Richard McCuistian

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in the case of steering, it needs to know which way that help needs to be directed. The same is true of electric power steering, and there is a very sensitive torque sensor built into the column on the hybrid vehicles Toyota makes, and it is that input that triggers the electric motor to muscle up.

On hydraulic rack and pinion systems, power steering pump sends fluid pressure to a spool valve that is connected to the steering wheel via

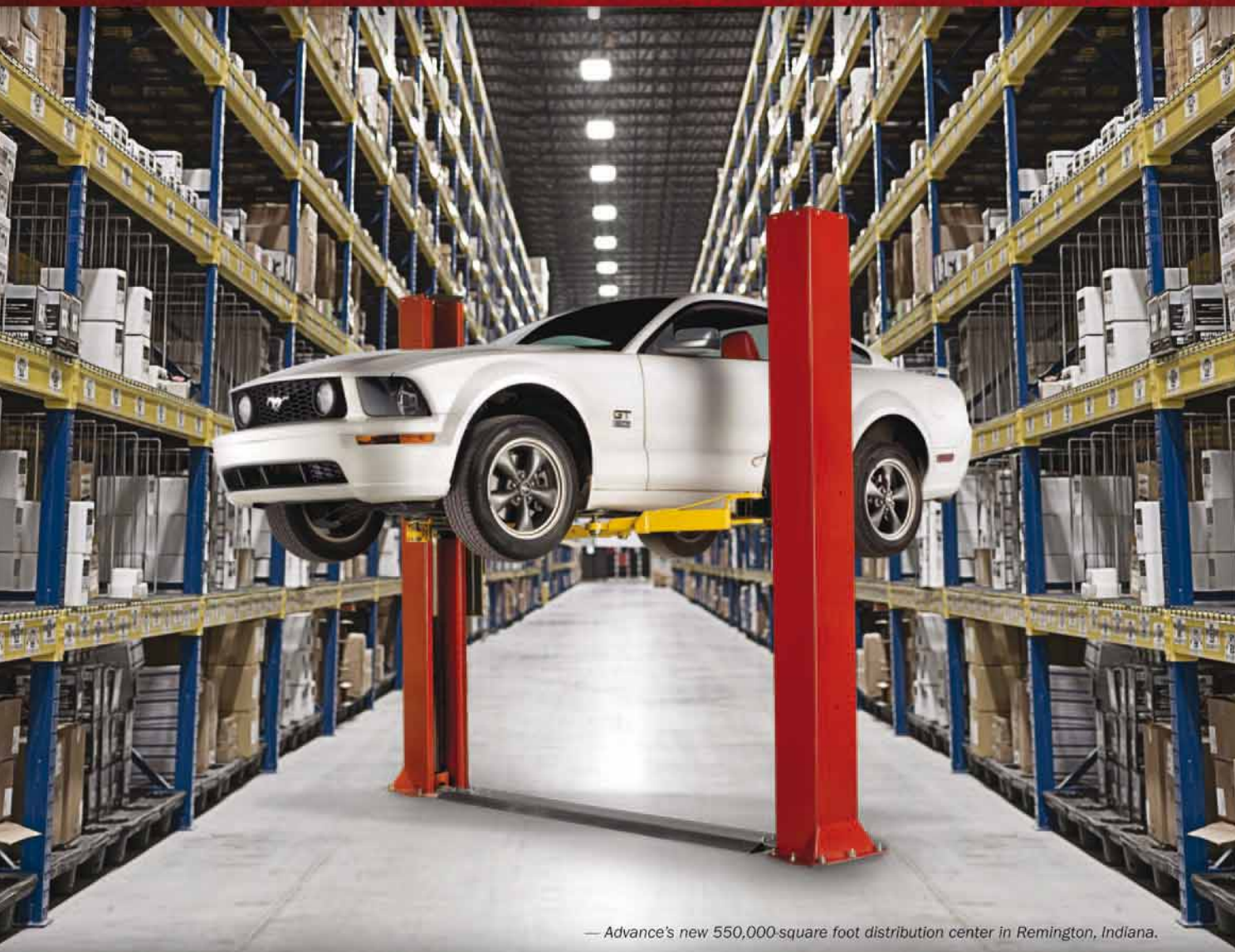
Watch this episode of The Trainer, our monthly how-to video, on power steering service
MotorAge.com/powersteertrainer

the column; that spool valve is triggered by steering motion to direct the fluid. There is sealed flange attached to the steering rack that travels inside a polished bore in the tubular steering gear housing. Each end of the steering rack is attached to a tie rod with a ball socket, and the opposite end of each tie rod is connected to the spindle arm so as to turn the wheels on their axes. Fluid directed to one side or the other of the rack's inter-



While the long-time norm for power steering was to have an integral reservoir right on the pump, space considerations have driven engineers on some platforms to mount the reservoir remotely with a very compact pump sequestered somewhere below it. The fluid is fed through a screen and travels to the pump through a large hose. This makes the reservoir easy to access, too.

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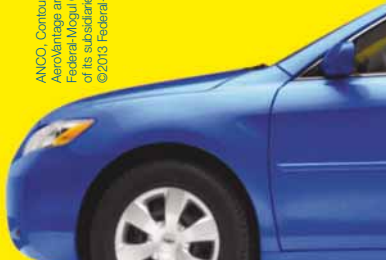
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Electric power steering comes in many forms — here are two. The top photo is the electric steering unit from a hybrid vehicle. The bottom photo was taken under the dash of a 2005 Chevy Cobalt, which is similar in form to the Toyota Prius. All you see under the hood on a Cobalt is what looks like a manual steering rack.

nal sealed flange provides the assist. Rubber accordion-style boots on each end of the assembly protect the rack from dust and moisture, and the only thing that is supposed to be in those accordion boots is air, which, in many cases is transferred from boot to boot through a small tube. Fluid dripping from these accordion boots on the end of the rack assembly means the rack is leaking internally and needs to be resealed or replaced, and some steering racks are extremely difficult to replace. These boots obviously need to be replaced if somehow ruptured.

What to Do

Power Steering pumps produce between 1,200 and 2,000 pounds of pressure to do their work, and there is a specially designed flow control valve just inside the pressure outlet fitting.

When the power steering pump isn't spinning fast, such as during parking maneuvers, not as much fluid flow is necessary, but high pressure is still required. Be that as it may, the flow control valve's internal orifices and springs act to bypass some of the pump pressure internally so that the pump's output pressure is slightly less than what the pump is producing, and it is this pressure that is delivered to the steering gear.

When the pump is spinning faster but with little or no steering activity (straight driving), fluid flow is increased, which reduces pressure at the pump outlet. Excess fluid is directed back to the pump inlet by the flow control valve. One way or another, the flow control valve's springs and orifices are tuned to provide needed steering assist.

With the steering wheel held at full-lock and the assist chambers in the steering sector/gear are fully pressurized, the flow control valve acts as a bypass to prevent the pump from stalling out completely. If the flow control valve malfunctions, you might see a quietly spinning pump that is full of fluid but producing no pressure at all. Obviously, replacing the pump is the most viable option — but I have on occasion replaced flow control valves when they were available. The problem is that in some cases they're stuck in the bore and are too much trouble to remove. There is a test procedure using a pressure gauge to test the flow control valve, but it's a pedantic test that's too much trouble to fiddle with and we won't waste time with it here.

Power steering lines have distinctly bent metal tubes where they connect to the steering pump and the gear.

QUICK RUNDOWN ON ELECTRIC POWER STEERING — GM STYLE

The Power Steering Control Module (PSCM) on GM vehicles takes inputs from the torque sensor, motor rotational sensor, vehicle speed and calculated system temperature inputs to determine how much to assist. As the steering wheel is turned, steering column shaft torsional twist is measured by the torque sensor, providing input and output shaft sinusoidal voltage signals that the PSCM processes so it can determine steering wheel angle and movement. The PSCM applies the appropriate current to the power steering motor, a brushless three-phase motor that pulls about 35 amps when it's working its hardest. It is mounted under the dash just forward of the knee bolster and attached to the steering column housing, and it applies assist to the column shaft by way of a worm and reduction gear.

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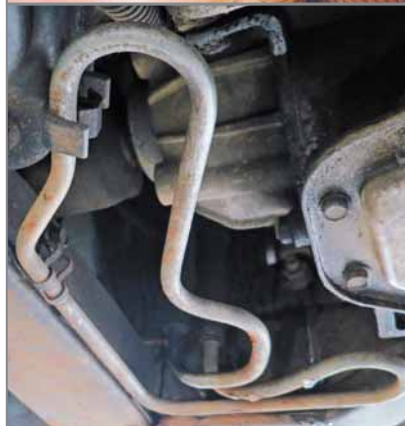
Oil-leaking steering rack boots are a dead giveaway. Nothing but air is supposed to be inside this boot. This steering rack needed replacing or re-sealing. We replaced the rack with a reman unit.

Because the pump is on the engine and the gear is frame-mounted, the fluid travels through high pressure rubber hose en route for flexibility. Some power steering lines have an O-ringed joint to handle the movement, and if you buy a cheap or cheaply built power steering line, expect that joint to fail almost immediately. That kind of failure happens more than it should these days, and it's no laughing matter when power steering fails suddenly and the person driving the vehicle is low on muscle power.

When looking for a power steering leak, I like to start by having an assis-

tant turn the wheels while I watch under the hood. If the pressure line is leaking, you'll find it that way, and it's wise to wear safety glasses. Some power steering pressure line fittings are in tight spots where you might get a line wrench on them but have no room to move the wrench (and every technician needs a good set of crow foot line wrenches). Some pressure lines are long and convoluted so as to cool the fluid en route, and some of these convolutes have fins to help with the cooling.

The pulley on just about all power steering pumps requires a special puller, and a good one costs about



Two things here. First, the curvy routing of many power steering lines that seem longer than necessary is specifically engineered to cool the fluid, which is heated as it is pressurized by the pump. Secondly, these Teflon® sealing rings on Ford power steering fittings are slightly a pain to install if you don't have the cone-shaped tool to stretch them over the threads, but it can be done. A new one is just about always needed after the line has been disconnected.

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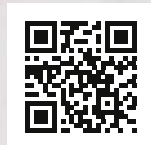
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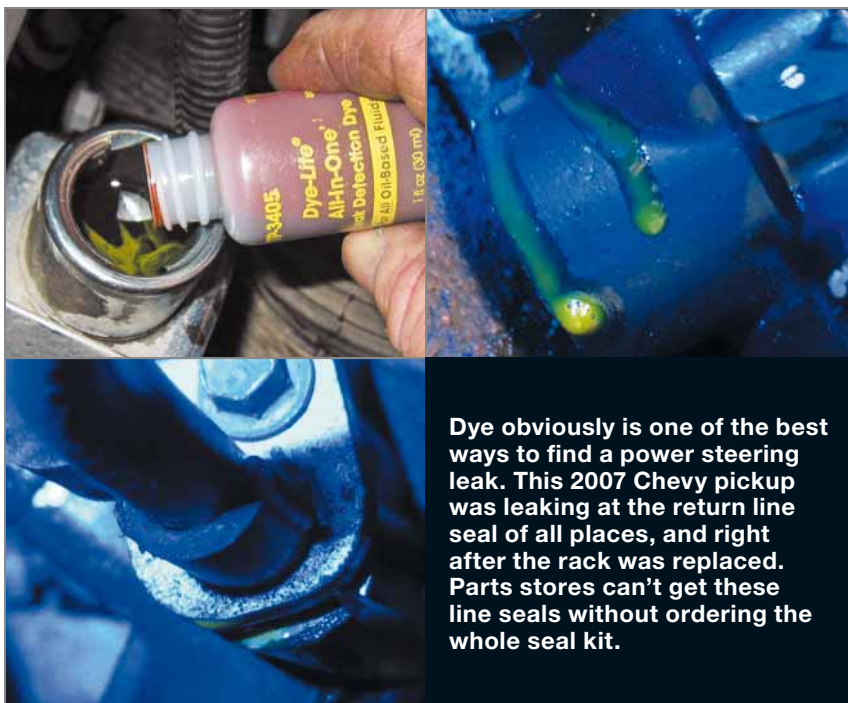
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Dye obviously is one of the best ways to find a power steering leak. This 2007 Chevy pickup was leaking at the return line seal of all places, and right after the rack was replaced. Parts stores can't get these line seals without ordering the whole seal kit.



Make sure to generously grease the threads on your puller. I've seen more than one of these pullers weld itself together to the point of ruin when the pulley was being difficult. Also, some power steering pump pulleys are extremely tough to remove. Note also the large diameter of the pulley; this pump works hard.

\$60, but you can buy a decent one for less than \$20 on Amazon.com. Due to variability in the field, some pulleys require more effort than others to remove. It's a press fit, and they're all tough, so always put plenty of grease on the threads on the pump pulley puller threads or it might weld itself together. I've seen it happen more than once, and when that jackscrew stops turning on dry threads, you have one piece of metal that used to be two.

Many of today's pulleys are made of plastic but with metal hubs, and if you buy a cheap aftermarket pulley, recognize the fact that the pulley's hub might be a bit too small to fit the shaft. This has happened more than a few times and brings the repair to a screeching

halt. And on a plastic pulley, putting it in the oven for expansion is a no-go. The pump shaft itself has threads tapped in the hollow end of it for pulling the pulley back on (the pulley tool has adapters that screw into those threads), but sometimes the threads are filled with rust or stuffed with dirt by doblers and will need to be chased with an appropriate thread tap. The best pulley tools will have a thrust bearing that makes things go easier, and once again, grease the threads.

Remotely mounted power steering reservoirs are more or less the order of the day, and there is a screen in the bottom of the reservoir that likes to clog, confusing owners who find the reservoir full on vehicles where the

steering is whining and hard. This plays out two ways – either the pump will be replaced without the reservoir screen being cleaned, or the pump will be destroyed from fluid starvation because the customer puts off getting repairs for too long. Always check the screen on one of these before replacing the pump, but realize that the pump probably needs to be replaced anyway if the whining has gone on for too long.

As for noise, don't be fooled by those odd belts that look like sort of like gatorback belts but are shiny on their traction surfaces when they're new. They can cause a nasty whine that can cause a technician to replace multiple components including the power steering pump. I've seen it happen again and again, and while the manufacturer of those belts seems to have stopped making them, you might see one in your service bay. Hear a whine? Look at the belt. *ZZZ*



One important point to remember when replacing a steering rack is to lock the steering wheel in the center and make sure it stays there or else you might destroy the airbag clock spring. One of my students ruined the one on his Honda Civic that way. That clock spring was nearly \$400.



**RICHARD
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CURING HANDLING COMPLAINTS

If a vehicle regularly carries heavy loads on one side, the alignment might need to be done with the load in place.

HANDLING 'HANDLING' COMPLAINTS ISN'T DIFFICULT IF YOU HAVE A PLAN AND A FEW TRICKS TO FALL BACK ON.

BY VANESSA ATTWELL | CONTRIBUTING EDITOR

Ride quality complaints are much more common now than they were even just a few years ago, which can be tough for drivers to handle. But it's great news for the technicians who know how to fix these problems.

In very general terms, drift, pull, wander and vibration concerns usually mean wheel, tire, alignment and drivetrain concerns and those ride quality complaints usually can be corrected by diagnosing and fixing problems in those systems. But it's important to know what to look for and where to look to keep repairs profitable and keep diagnostic time to a minimum.

Here's a guide to get you started.

Defining the Concern

When diagnosing ride quality complaints such as drift, pull, wander or

vibration, it's important to start with the basics before getting into deeper diagnosis. A good place to start is with the tires themselves. If you've spent much time with newer-model cars and trucks, you've probably noticed that many of those new vehicles now are coming right from the factories with larger rims and tires than they were a decade (or more) ago. And since larger tires have larger contact patches, big-wheeled cars and SUVs can be more susceptible to directional and handling issues when they encounter ruts left in the roads.

Tire pressure

Adjusting tire pressures used to be a favorite trick for those "undercover test" cars. TV shows would send "bugged" vehicles to various garages to test how honest they were: one tire would be set much lower than the oth-



ers and the "customer" would complain about a pull to one side. The "correct repair" was simply correcting the tire pressures, and usually a painfully high number of shops did not repair the problem correctly, instead selling alignments and complete sets of new tires as the hidden cameras rolled.

Checking and correctly setting tire pressures usually is pretty easy, and it's very important because incorrect pressures can and do cause problems. If one tire pressure is incorrect, the vehicle can pull. If all tires are overinflated, the ride can be harsh (among other problems). Therefore, even on vehicles with tire pressure monitoring systems, it's still important to check that tire pressure is correct and also that it's checked correctly (usually on cold tires) with an

Photos: Vanessa Attwell



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accurate gauge before going any further in the diagnostic process.

And if indeed one tire is much lower than the rest, it's important to find and repair the cause of the leak (possibly a leak or puncture) so that the customer doesn't return with the same problem in a few days.

Watch this video of techs at VISION 2013 driving cars with old suspension vs. new Monroe-equipped rides.
MotorAge.com/visionvideo

Tires, Rims, and Wheels

Even big tires can wear out surprisingly quickly and worn tires, uneven tread, feathered tread, shifted belts, or similar tire problems can cause very noticeable handling concerns. Unfortunately, sometimes the way to repair handling complaints is by replacing tires. But tires are expensive, so it's important to make sure that is indeed the problem before recommending this costly step.

Start by visually inspecting the tires for problems (you can do this as you check tire pressures to save time). Look at the treads and run your hand across them. If the edges are rough or feathered, the vehicle's alignment might have caused rough tire wear patterns and you might have found the cause of the problem. If so, be sure to correct the vehicle's alignment when the new

tires are installed to protect the customer's rubber investment.

Along with noticeable signs of rough wear, also look for human-error things that can cause ride quality problems such as directional tires installed incorrectly, mismatched tires, aggressive treads that are used on smooth, dry roads and the like since those things can and do cause handling complaints, especially on vehicles that are seldom used (such as seasonal vehicles or pleasure crafts).

Note too that snow or mud build-up on the rim can cause ride quality complaints, as can wheel damage or rims with the incorrect bolt pattern. I'm mentioning bolt pattern because one of our customers once bought rims on the Internet with the wrong bolt pattern, so he drilled his own holes and came to us hoping we could repair the resulting vibration. (We did not even try; new rims were the only fix.)

If the tires and wheels look OK but you still suspect a bad wheel, find out if the problem occurs everywhere the vehicle's driven or only on a particular road. If the condition occurs everywhere, start the diagnosis by rotating the wheels front to rear (if possible). If

the condition stops, then likely there was an issue with one of the tires and it's time to closely inspect them for problems. In some cases it might even help to swap each wheel assembly, one at a time, with a known good one until the problematic assembly is identified. If the condition continues even with the wheels rotated, then a deeper alignment issue may be the cause.

However, if the problem only occurs on one particular road, find out more about the road – you may be trying to fix the unfixable if the road has a steep incline or is severely “crowned” to facilitate water run-off.

Alignment

One of the main causes of handling problems is incorrect alignment – whether it developed slowly over time or as the result of a sudden impact. Therefore, another good preliminary check is, while walking around the vehicle to check tire pressure and condition, also taking a look at how the vehicle is sitting. Incorrect ride height can indicate problems that affect vehicle alignment. Manufacturers' directions for checking ride height varies from vehicle to vehicle, but the left and right sides of the vehicle should be the same height whether you're measuring in inches, fingers, points on your knee, or whatever method you use to guesstimate that ride height is the same from



Sometimes rough tire wear patterns are really obvious. The edge of this tire feels like it looks: rough.



This mount looks OK, but the only way to know for sure is to test it under the conditions the complaint occurs.

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Check the struts for broken springs, leaks, and components that aren't where they should be.

cause the condition, but still leave the angles within the manufacturer's specified range. If so, even if the suspension components might be functionally okay, the alignment might need to be set up to correct the results of the impact.

It's also important to remember that a vehicle's alignment angles can be within specification and still cause a vehicle to pull or wander. Manufacturers leave a range of tolerances for alignment angles, but even within that range there's enough room to make a vehicle drive abnormally if the adjustments are at the extremes rather than closer to the middle of the range. Just because everything's within specification does not mean the vehicle won't pull or wander.

Incorrect toe angles can not only cause handling problems, they can cause a vehicle to ruin its tires quickly. Improper toe adjustment on the rear of the vehicle could cause directional stability issues for the vehicle. Unless the manufacturer says other-

side to side. If it's not, it's important to find out why – usually broken or worn suspension components.

Also determine if the vehicle has been in any type of impact or acci-

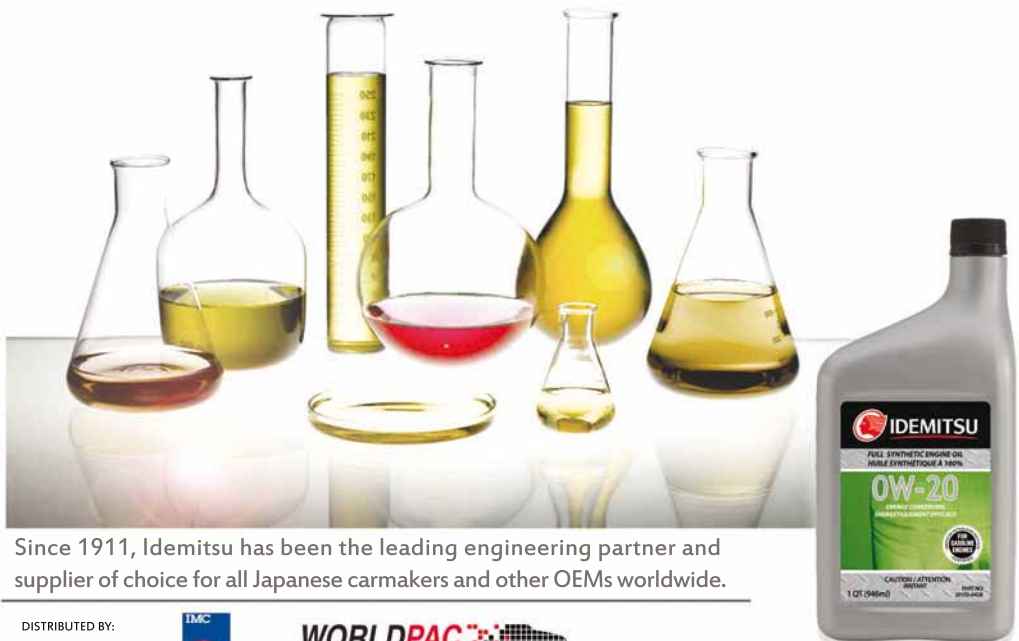
dent, if it hit a curb or parking stone, or had some other alignment-altering interaction.

Any such impact could have tweaked the alignment enough to



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wise, all toe adjustments should be equal from side to side on the axle.

Offsetting camber by 0.5 degree from side to side can cause slight pulls, drifts or wandering. Offsetting by a full degree can cause more extreme pulls and concerns. Fortunately, camber usually is adjustable and usually can be corrected without replacing components.

Caster, however, usually is not adjustable, and it can easily cause a drift, pull or wander when out of specifications from left to right. But correcting this usually involves replacing suspension components.

Look at the total effect the values have on handling and proceed from there. Always remember to take into account tire wear and the manufacturers' recommended range of alignment angles for the particular adjustment.

One important note: If the customer regularly carries heavy loads (such as tool boxes) on one side of the vehicle (or is heavy himself), that can affect handling characteristics and the solution may well be performing the align-



Vehicles are coming from the factories with larger wheels than ever before.

ment with the load (or even the customer) in the vehicle to correct for the weight imbalance.

Vibrations

Vibrations can be tricky to diagnose since they can be caused by so many

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(Left) Winter tires used in the summer can cause handling complaints. (Right) In the real world if one tire is considerably lower than the others it's important to find out why.

things. Determining if the vibration is related to either speed or load can be really helpful.

If a vibration occurs at a particular speed, regardless of the gear range selected, chances are the vehicle has a wheel-rim-driveline issue that can be positively located by closely inspecting the components or with a roadforce-type wheel balancer. A bent rim or belt shifted tire will show up on the road force machine's measurements, even if not obvious to the naked eye. Driveline issues can be caused by wheel bearings, driveshafts, leaking (not "sweating") shocks or struts, broken springs or worn or damaged suspension components.

If the vibration occurs at a particular rpm range, regardless of vehicle speed, then chances are it's a powertrain issue. These issues can be a little tougher to diagnose, because anything from a faulty mount, poor running engine or even a transmission with internal problems can cause them. I've found it's usually best to begin by visually inspecting of all engine and trans-

mission mounts, while the engine is at that rpm if possible, to check for excess play or contact with the body. Then repair, replace or retorque the mounts as necessary and verify the repair by road testing again.

If the mounts are OK, an intensive diagnostic road test might be required. This might mean an overnight road test if your shop is located in a congested urban area. One of my very wise colleagues performs these diagnostic road tests by driving the vehicle until the condition is happening and then, when it's safe to do so, shifting the transmission manually into another gear range (third to fourth or third to second; you want to change rpm, not blow up the engine) to change the engine rpm. In his experience, if the condition occurs with the rpm in a different range while still maintaining the same speed, then the problem likely is transmission-related. If the condition stops when the engine's in a different rpm range, then the problem likely has to do with the engine and he rechecks the mounts and the engine's actual running condition for things such as intermittent misfires.

As an example, one vehicle came into my colleague's bay with a vibration through the body on acceleration from a stop. He road-tested it extensively and figured out that the vehicle drove perfectly fine under all conditions except for a vibration on acceleration from a stop. He watched the mounts while an assistant loaded up the engine. The problem was indeed an engine mount, even though it had looked just fine. The front engine mount on the passen-

ger-side frame rail was traveling too far and transferring engine vibration through the body because the rubber insulator was weak and allowed excessive movement. Replacing the mount fixed the problem.

Another vehicle had a slight vibration at highway speeds and the vehicle had been to other shops for various unsuccessful repairs. The problem was fixed by replacing a faulty spark plug that was causing an intermittent misfire under load.

Conclusion

One of the nice things about diagnosing handling complaints is that they usually are constantly present. Intermittent handling concerns are really rare which makes diagnosing these complaints much easier. Even if you're convinced that it is indeed a pattern, confirm your suspicions so you don't look waste time and money. With a bit of practice you'll learn to quickly identify the common causes of handling complaints and you'll be able to repair them quickly and profitably to keep both you and your customers happy. *MA*

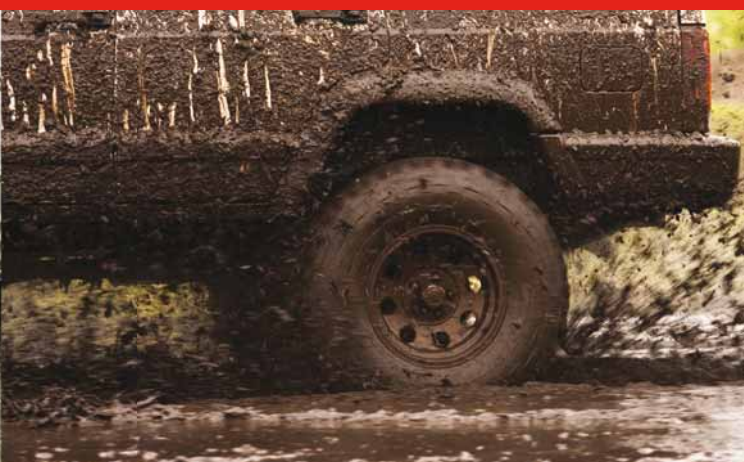
VANESSA ATTWELL CONTRIBUTING EDITOR

Vanessa Attwell is a Master Technician for two major manufacturers and has also worked on the bench of an independent shop. She has developed and delivered training for both vehicle manufacturers and independents, and helped develop government training and regulations standards.



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THREE IMPORTANT CASE STUDY EXAMPLES

THIS MONTH, WE SHARE A NUMBER OF REPAIR CHALLENGES BROUGHT IN TO TST MEMBER SHOPS. JUST ANOTHER DAY AT WORK, RIGHT?

BY JERRY "G" TRUGLIA | CONTRIBUTING EDITOR

Case study No. 1 is a 2001 Mazda Protegé that had a bunch of transmission P07XX Diagnostic Trouble Codes (DTCs) and a problem with a hard shift. This vehicle uses a Powertrain Control Module (PCM) that controls both the engine and transmission functions. Using our most important tool (our head!) we know when there are so many DTCs, the first thing to check is the PCM.

With the covers hiding the PCM removed, we were surprised to see transmission fluid oozing from the wiring harness leading up to the control module. Our next step was unplugging the PCM connectors to see if there was any fluid there. We weren't too surprised to see the connector pins coated with the red stuff and even found traces of fluid inside the module.

Sensors and output devices, both on the engine and in the transmission, are very low current devices. It doesn't take much to add enough resistance to make them act funny or even fail completely. And fluids entering the wiring harness are also not unusual. A single failed seal at the point where the harness enters the transmission is all it takes on some models to allow the fluid to work its way up the harness.

Other common sources of fluid damage to wiring come from coolant



(Left) Not an every day occurrence, but not uncommon either. Failed seals can allow fluids to wick up wiring harnesses for a surprisingly long way. (Right) A professional remote starter installation – or maybe not.

leaks (in or outside of the cabin) and water leaks (from the evaporator drain or failed weather seals allowing rain water in).

The fix for this? The Protegé needed a new PCM and we cleaned up the wiring and repaired the source of the leak.

Nissan up Next

Case Study No.2 is a 2002 Nissan Maxima with electronic motor mounts. This vehicle came in to the shop with a Malfunction Indicator Lamp (MIL) illumination caused by a motor mount problem. The shop that was working on this vehicle used the "plug and play" diagnostic method, replacing the PCM only to get the same results...another blown PCM. Perhaps they should rename their method "plug and pay."

Remember that the PCM is the most expensive fuse on the vehicle, so don't guess why it failed but test and know why it failed! The shop decided to install yet another new PCM thinking the used PCM they tried the first time was the problem but they yielded the same results. After smoking a few

PCMs, they knew that they were in over their heads. They decided to call TST board member Rich Peterson, who is a mobile technician who just diagnoses and repairs electrical problems.

Peterson told me that he had not seen this electronically controlled motor mount system before. Reading the description in ALLDATA provided some information on the operation of the electronically controlled motor mounts, covering only the electrical side of the system. After studying the wiring diagrams, Peterson learned that each mount had two separate coils, one coil to activate "hard" mode and one coil to activate "soft" mode, with a mount on each side of the engine.

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Can you believe what you see in this photo? I'm sure most of you have seen the same.

Battery power (B+) is fed to each coil and drivers in the PCM independently ground the coils.

Because the problem was on only one side of the engine, it was easy to use the comparison test by measuring the resistance from the known good coil and comparing it against the bad one. Using an ohmmeter to measure the static resistance of both, Rich found the set of coils on the good mount to be 75 ohms (baseline) while

the other set read 7 ohms (too low). Looking at the test results revealed the obvious problem; low resistance in the shorted coils caused a high amperage draw that resulted in the fried driver in the PCM. The defective mount was replaced and a new PCM was installed, solving both the mount problem and the shop's headache.

Finally the Infiniti

Case Study No. 3 is on a 2007 Infiniti G35 Sedan that came in with a complaint of the horn blowing at random times. The first thing I like to look for after performing some basic checks is the addition of any aftermarket devices installed on the vehicle. Because this vehicle came from a used car lot there was no telling what was done prior.

The vehicle had a remote starter installed. This system is the most likely cause of the horn blowing complaint because all of the components involved with the horn circuit checked out. Without having information on how this system operates, and with the car lot's permission, we disconnected it.

As we were taking a careful look under the dash determining on how best to proceed, we found wires that had stripped insulation with wires twisted to open copper strands. As any good technician would know this is not the recommended procedure for making electrical connections or splices.

There was only one wire that we found that was properly crimped and heat shrunk. We disconnected the remote start system and repaired all the wires using heat shrink solder connectors. No more reports of a blowing horn. *TZ*



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

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CHANGES IN DIAGNOSTIC STRATEGIES

HOW WE ADDRESS THE INEVITABLE CHANGES THAT OCCUR IN AUTOMOTIVE DIAGNOSTICS IS INFLUENCED MOSTLY BY OUR ATTITUDE TOWARD CHANGE ITSELF.

BY **JAIME LAZARUS** | CONTRIBUTING EDITOR

Some say the definition of insanity is doing the same thing over and over, yet expecting different results. When we technicians employ a test procedure that works well, we don't change it and we don't expect different results when we use it. That would just be crazy, right? Well, what happens when the vehicles change but we don't?

We work in an industry where change itself is prevalent. As an automotive technician, I've sometimes

wondered who the engineer was that decided to do "such-and-such" when the way it was done before worked just fine. (Almost every technician can fill in the blank for "such-and-such.") On more than one occasion, I've tilted my head, perked my ears and raised an eyebrow all at the same time while asking aloud "Why didn't they do so-and-so instead?" Sometimes though, I asked that even when no one was around to hear the question. Proof positive the engineers were temporarily driving me nuts trying to figure out their logic.

I understand. It's human nature to resist change. But it seems as if the auto manufacturers detest keeping things the same, even when things work well already. I abhor changes done simply for the sake of change. I hate change worse if I'm unprepared for it. I hate change because I have to change. I have to change my attitude and try to consider the benefits of this latest change (whew, what a bunch of "changes").

I recognized early in my career that the auto repair industry is dynamic. By that I mean it has never not changed, at least not since I joined it. It seems that almost daily new technologies

are developed therefore new diagnostic strategies and techniques must be developed as well. Due to that inherent nature of the business, I'm committed to embracing change because of the exciting learning experiences we gain from it. Once I get over the initial despising the changes response, I look at it as an opportunity to expand my knowledge in other ways of doing things and as a way of viewing circumstances from a different perspective.

Here's an example of a design change I encountered recently which took quite some time before I changed my attitude.

Feeling Powerless

I was asked to come to a shop to help them diagnose a vehicle whose owner complained it "lacked power." This vehicle was a 2006 Ford F-250



BEYOND BASICS

2006 FORD F-250

Vehicle Year/Make/Model

5.4 LITER

Engine

6-SPEED

Transmission

108,506

Mileage

LACK OF POWER

Vehicle complaint



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with a 5.4L with 108,506 miles on the odometer. Before calling me, the shop already had performed “all the basics,” but hadn’t come to any conclusion for a cause of the complaint.



The customer first authorized performing the maintenance that the manufacturer recommended based on the vehicle age and mileage, including replacement of the spark plugs, a new air filter and fuel filter, oil and filter change, etc. The shop also did a fuel injector flush and an air induction system cleaning. When the maintenance was complete and the vehicle ran no differently, the shop was authorized to perform an initial assessment including fuel and exhaust back-pressure tests and scanning the powertrain systems. They performed other tests, none of which answered the question of why this truck lacked power.

This is the point when they called me. Just as you interview your customers, I did the same with the technician and the shop owner to ensure no steps had been skipped and nothing obvious was overlooked. I’d made a few other suggestions over the phone for them to try, but their test results were inconclusive.

I went to work immediately after receiving the Vehicle Identification Number (VIN). First, I researched the important information I keep on hand. That’s stuff that I’ve encountered in my mobile diagnostic business and throughout my career. Whether it was me or it was the technician in the shop contracting my services who came across the findings, a magazine article I thought might be helpful in the future, or anything my customers might have shared with me about a car that nearly drove them nuts, any and all “diagnostic dilemmas” tests and results (cause of complaints) I’ve saved for future use, such as at a time like this. I have an extensive collection that can even be cross-referenced where I store the details of those hard-earned victories. It’s like having my own database — and I feel all techs should have one of their own.

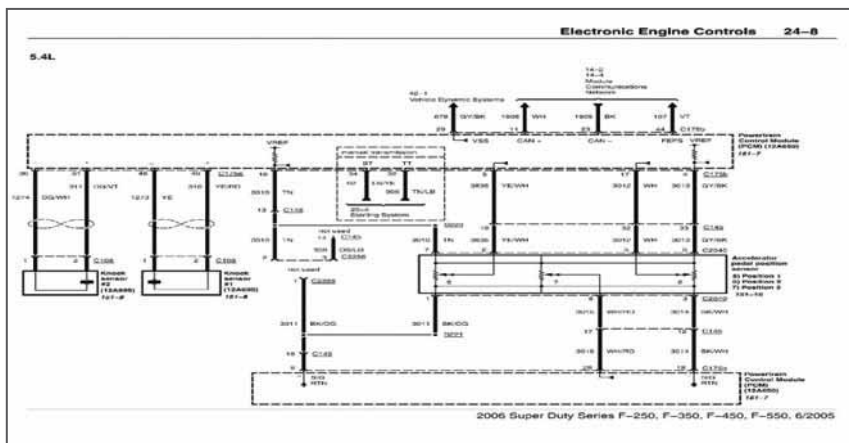
I didn’t find anything pertinent in my own information, so I performed a sys-

tematic and extensive web-based search. I started by searching the archives and forums on the International Automotive Technician’s Network (iATN, www.iATN.net). There one can broaden or narrow their search query and read through the results in hopes of seeing a common cause of a problem. I also use the search results to remind me of what I may have forgotten to check, too. In fact, there are many uses for searching the iATN archives, but in this case, I was focused on this one problem vehi-

cle so I didn’t need to use the extensive capabilities it offered.

I then searched for possible solutions in the information available for members of the Ford Truck Enthusiasts forum and the Mobile Diagnostic Group, and I looked at suggestions from Identifix. I even subscribed to the Ford service information site in hopes there was a TSB or other piece of information (possibly an internal memo) that might give me ideas about what to look for on this vehicle. No such luck.

By the way, this research — this time spent before wrenching — is all necessary when the “basics” don’t properly address the customer’s complaint. The procedure I follow is similar every time no matter the vehicle problem I’m addressing, but I’ve found most



The Wiring Diagram includes, among other things, both Knock Sensors, the PCM and their connecting circuits.

No Diagnostic Trouble Codes (DTCs) Present Symptom Charts

Note: For applications with a KS, a lack of power may result if the engine has developed an abnormal noise. The KS may interpret some abnormal noise as detonation and retard spark timing.

| SYSTEM/COMPONENT | REFERENCE (Section 5 Pinpoint Test unless noted) |
|--|---|
| Automatic Transmission Fluid | Visual |
| Throttle Linkage | Visual |
| Air Cleaner Element | Visual |
| Check the following PIDS: — LONGFT1/LONGFT2 (value between -20 and +20%) — IMTVF (if equipped): For both ignition ON, engine OFF and ignition ON, engine running with the transmission in PARK/NEUTRAL and the engine RPM greater than 3,000 RPM, the PID should indicate no fault (or NO) in both | <p>LONGFT1/LONGFT2 value low (-): Continue diagnosis. Concentrate checks in areas that would cause the engine to run rich.</p> <p>LONGFT1/LONGFT2 value high (+): Continue diagnosis. Concentrate checks in areas that would cause the engine to run lean.</p> <p>IMTVF PID indicates a fault: GO to Pinpoint Test HU.</p> |

The “Lacks Power” Symptom Chart mentions abnormal engine noise as a possible culprit for causing this complaint, but offers no dynamic component testing procedure.

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BOOTH #31268

| P0325 - Knock Sensor 1 Circuit (Bank 1). | | | |
|---|-------------------|-------------------------|-------------------------|
| Description: The knock sensor (KS) detects vibrations upon increase and decrease in engine RPM. The knock sensor generates a voltage based on this vibration. A DTC is set if the voltage goes outside a calibrated level. | | | |
| Possible Causes: <ul style="list-style-type: none"> • KS circuit short to GND • KS sensor circuit short to voltage • KS circuit open • Damaged KS | | | |
| Diagnostic Aids: A knock sensor voltage greater than 0.5 volt with the ignition ON engine OFF indicates a concern is present. | | | |
| Application | Key On Engine Off | Key On Engine Running | Continuous Memory |
| All | — | GO to Pinpoint Test DG. | GO to Pinpoint Test DG. |
| P0326 - Knock Sensor 1 Circuit Range/Performance (Bank 1) | | | |
| Description: See the description for DTC P0325. | | | |
| Possible Causes: See the possible causes for DTC P0325. | | | |
| Diagnostic Aids: See the diagnostic aids for DTC P0325. | | | |
| Application | Key On Engine Off | Key On Engine Running | Continuous Memory |
| All | — | GO to Pinpoint Test DG. | GO to Pinpoint Test DG. |

Although this vehicle did not set any DTCs, I looked at the Knock Sensor Diagnostic Troubleshooting chart(s) to see if I would learn what signal these would produce if a spark knock was detected. Unfortunately, I didn't learn what I'd hoped.

of the time, someone else might have already "been there and done that." Therefore, I suggest everyone associate themselves with however many forum(s) you feel will help you diagnose problems. You'll most likely find not only a lot of company in your misery, but sometimes your misery is greatly reduced due to someone else's efforts.

Going in Armed

So, after researching this complaint, I was ready to approach the vehicle armed with some possible causes and some testing ideas I'll use to try to prove or disprove each one. As I do with every diagnostic routine, the first step is to duplicate the customer's complaint. A short test drive was all that it took for me to agree with the owner. This truck was almost scary to drive away from a stop and into the flow of traffic. After returning to the shop, I reviewed what tests they had already done and verified the results so that I was sure I wouldn't duplicate any efforts.

I've learned the importance of making sure the PCM has the latest calibrations loaded in it because so many problems can be resolved with a flash and sometimes there's no amount of wrenching you can do to fix them. I found this PCM had revisions available that were newer than what was presently loaded

and received permission to reprogram the PCM. Ford doesn't inform us what they are adjusting with their flashes, like some other manufacturers do, so I wasn't sure programming the module was going to resolve the owner's complaint until it was done. It didn't.

I then recorded the data stream (the Ford IDS software calls it "Datalogger") while attempting to accelerate. During playback I noticed the variable camshaft timing phasers were slow to return to a zero degree position on deceleration. I also noted the spark timing PIDs showed negative numbers at any throttle position that was not closed throttle. I decided it was time for a visual inspection and maybe a functional test.

Upon arriving back at the shop, we opened the hood and I immediately heard noises coming from the front

of the engine. I heard tapping around the right front valve cover area and I heard some sort of knocking from the front of the motor. Funny, I thought, there's been no mention of engine noises when I asked if there were any other symptoms.

The crankshaft pulley (balancer) key was known to shear on these trucks, which would cause the CKP signal to be generated at a different time than originally intended. When that occurs the engine becomes lethargic. It's relatively easy to determine if this happened by using an oscilloscope to show both the CKP and CMP relationships at the same time and comparing this image with one that is a known good image. This one looked textbook perfect. To be 100 percent sure it had not sheared, the shop owner insisted his tech remove the pulley assembly and visually inspect it. No Problem Found (NPF) here.

The next test was done to see if the camshaft timing phasers worked as designed. I was able to monitor their actual position on the scanner while controlling them. The only indication of a problem during this test was an unusually slow response when I commanded less pulse width modulation. The camshaft position was slow to return, which can be attributed to sludge build-up.

But the rattling noise was hardly noticeable while the phasers were commanded on, so this helped us determine the cause of some of the noise. I couldn't help but wonder if the negative timing PIDs I saw were caused by



(Left) The PCM connectors have unique purposes. The connector on the far right is called Connector "E" (Engine), the center one is called "B/C" (Body/Cowl) and the far Left connector is called "T" (Transmission). (Right) In order to test the Knock Sensor(s) and their circuits, one must back-probe the PCM Engine connector after disconnecting it from the PCM, then read the resistance between pins E48 and E49 (KS1) or pins E30 and E31 (KS2). Resistance tests are the only component tests found for these sensors. There wasn't much room for the back-probes as seen in this image.

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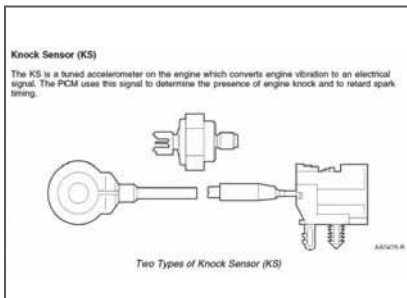
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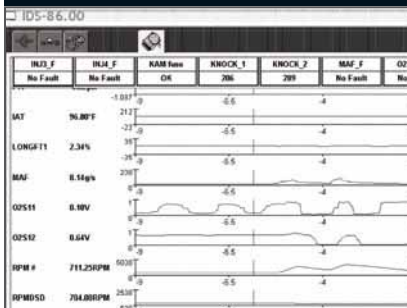
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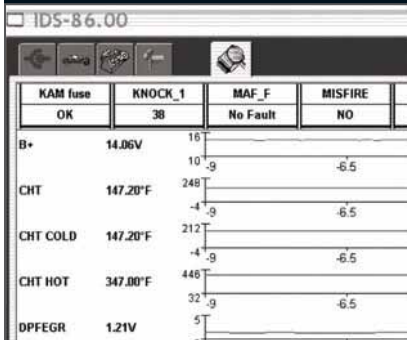
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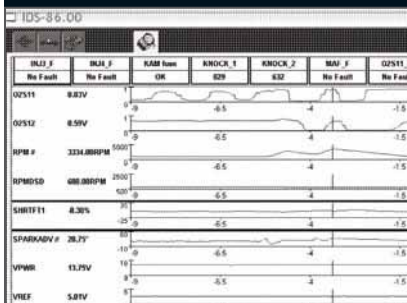
When learning of newly designed components, one should consider reading the Description and Operation section of the manual. Unfortunately in this case, that section was not very helpful.



This capture of the IDS Datalogger at idle shows excessive KS activity.



As seen on another vehicle's IDS Datalogger, this vehicle's KS activity was well below 100 off idle, indicating no engine noise was detected.



Under a load, this IDS Datalogger capture shows a great deal of excessive KS activity.

the cam phaser rattle being detected by the knock sensor so I tried controlling them while the technician drove the vehicle. We soon knew those noises, and maybe some of the others, contributed to the PCMs decision to retard the spark timing which resulted in poor performance.

Here's where it should have been an easy confirmation, that is had the engineers not changed the design. I would have grabbed my scope, back-probed the KS signal wire at the PCM, monitored the spark timing PID whilst tapping the block near the sensor with a long socket extension at the same time watching the PCM's timing control response. That's the standard procedure I've used for "ever."

Upon looking up the wiring diagram I realized this system of knock detection was different from previous versions. This vehicle not only has two knock sensors (no big deal – lots of carlines have that setup, I thought) but each of these sensors has two wires! Back-probing any of the four wires and tapping near the sensor produced no signal! Yikes, I better read up on this, I thought.

Wrapping it Up

I won't get into too much detail about how many methods I used researching these new-fangled knock sensors. But, after many frustrating hours, I ended up not knowing any more about the proper way to test their performance than when I began. I do know there are KS PIDs in the datalogger and I'm aware when those PIDs show an increase above a certain number then the timing gets retarded. But I never found any accurate (dynamic) component testing procedures or specifications, even in the Ford OE service information. All I ever found were resistance specifications.

I read the 2006 F-250 PC-ED Manual from front to back, I looked through all of Ford's KS DTC and Symptom charts, I researched part manufacturer's sites for knock sensor information, read numerous articles written by renowned diagnostic authorities, re-read the pertinent manuals I received in the training classes I've attended and even tried the incorrect method of testing listed on a particular auto parts supplier's site intended to help techs. I challenge you who want to occupy your spare time

productively, to find the accurate information I was unable to find. I want to know, when a knock is sensed, what kind of signal is generated by these knock sensors and what should my oscilloscope show me?

Since I wasn't able to use conclusive testing methods, the only way of knowing with certainty that the engine noises contributed to the poor performance complaint was to get the vehicle owner's permission to repair the mechanical faults and see how well the truck runs afterwards. How easy is it for you to sell a customer a costly repair that may not address his complaint? Well, this shop owner was able to convince the customer the noises would only get worse over time and that the truck had many years of service left if we can get it running correctly. So we replaced both camshaft phasers, all timing components and one rocker arm. With the engine noises gone, the truck ran like new.

Our jobs are sometimes frustrating enough - even with complete and accurate information. I've learned many things on this job - mostly because of how long my research took in an attempt to thoroughly understand what I was seeing. I learned we now use "smart" knock sensors that will only produce a signal when a SPECIFIC noise is detected so therefore, the tried and true method I've used for decades won't work on these systems. I've also learned my trusty diagnostic routine, the one I've followed forever has to change. I no longer can include the component test every time when there isn't one published.

What is the end result? I found that doing tests on these smart knock sensors the same way we always have — and expecting the same results — will just about drive one insane. **ZZ**



JAIME LAZARUS
CONTRIBUTING EDITOR

Jaime Lazarus is an ASE Master Technician with L-1 certification. He has regularly presented technical seminars since 1985. He recently taught instructors at the North American Council of Automotive Teachers conference and the NASCAR Technical Institute.

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Photos: Ford Motor Co.

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BRAKE SHOES

Bosch has added Bosch Brake Shoes to its line of braking products. The company notes features of Bosch Brake Shoes include full line coverage of domestic, Asian and European applications, matching OE-style design to guarantee proper fit, 100 percent asbestos-free friction formulations that ensure extended wear, consistent braking performance and long life, rust-prevention coating that enhances durability, bonded and riveted coverage on most domestic and commercial applications that matches OE method of attachment, 100 percent all new steel shoe makes for durable construction and long life. Pins and levers are included where necessary.

For more information, visit
www.boschautoparts.com.

Bosch

RATCHETING SCREWDRIVER

GearWrench releases the new 2-Position Ratcheting Screwdriver with LED light technology. The new screwdriver (SKU No. 82788) has two LED lights that help illuminate a work area, the company says. The 2-Position Ratcheting Screwdriver with LED lights has a 45-tooth ratcheting mechanism with forward, reverse and locked positions to quickly tighten or loosen fasteners. The screwdriver features a stainless steel collar that magnetizes the bit tip to help hold fasteners on the tool, resulting in fewer dropped and lost fasteners. With the two-position handle, users can choose the position that is the most comfortable and provides the best leverage.

For more information, visit
www.apextoolgroup.com.
Apex Tools Co.



COMPRESSOR DRIVE TOOL

With the new Four Seasons CLT1 EVC Compressor Drive Tool (part No. 69635), technicians will have an easier way to analyze the root cause and conduct the correct diagnosis of a clutchless technique to make sure the valve is reacting properly to steering signals, before opening the AC-loop, the manufacturer states. The CLT1 provides answers to questions such as, is the malfunction dependant on the electronics or the AC-Loop? CLT1 was developed to simplify the diagnosis, as well as to test the system after conducting the repair. It does not require any dismantling; simply disconnect the compressor cable and connect the tester.

For more information, visit
www.4s.com.

Four Seasons



BATTERY CLEANER/PROTECTOR

Keeping your battery looking like new and lasting longer is easy with PlastiKote Battery Cleaner and PlastiKote Battery Terminal Protector. The company states that for easy care of storage batteries, battery boxes, trays and cables in automotive applications, PlastiKote Battery Cleaner acts fast to loosen dirt and lift corrosion that can be flushed away with water. PlastiKote Battery Terminal Protector neutralizes acid and removes grease and oil from battery terminals, providing a protective barrier to inhibit corrosion.

For more information, visit
www.plastikote.com.
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FUEL ADDITIVES



Rislone's six new super-concentrated fuel additives treat a wide variety of vehicle problems. They are in stores now, accompanied by an online selection guide to help customers find the right products for their vehicles. The selection guide includes information about all Rislone and Bar's Leaks premium performance chemicals. Vehicle owners simply visit www.barsproducts.com/product-selection to find their vehicle's problems and identify the suggested remedies. The site is optimized for viewing on computers and mobile devices, according to the company. Rislone's super-concentrated additives are packaged in six-ounce bottles featuring the patent-pending EZ Nozzle delivery system. EZ Nozzle works with any vehicle, including the approximately 15 million in North America equipped with capless or obstructed fuel systems.

www.barsproducts.com
Bar's Products

CAMBER PLATES



Hotchkis Camber Plates give enthusiasts the ability to set their camber anywhere from stock to three degrees negative while also adding an extra degree of caster for enhanced straight-line stability and an improved camber curve during cornering. These camber plates are CNC-machined from 6061 T6 billet aluminum and feature a Type-3 hard anodized finish for years of durability and performance, the company states. Each plate is loaded with a high quality PTFE-lined spherical bearing and is designed to be easily serviced. Designed as a direct replacement to the factory upper strut mount, these plates do not change the ride height of the vehicle and require no modifications for installation. Hotchkis Sport Suspension camber/caster plates for the Scion FR-S, Subaru BRZ and Toyota GT-86 are manufactured in the USA, come with all necessary hardware for a complete installation.

www.hotchkis.new
Hotchkis Performance

REAR WIPER BLADES

Bosch has expanded its wiper blade portfolio with new rear wiper blades for OE (original equipment) and the independent aftermarket with a total of 31 part numbers. These rear wiper blade part numbers cover 32 million vehicles in the U.S. and Canada and provide 92 percent total market coverage for the most popular domestic, Asian and European vehicles. Features of the new Bosch rear wiper blades include wear-resistant natural rubber that ensures smooth and quiet operation as well as a specialty coated wiping edge that contributes to a long service life, the company states. Bosch now has rear wiper blades that feature the same quality and performance as OE blades, and suit the most popular makes and models including Ford, Toyota, Chevrolet, Jeep, Honda, Chrysler, Dodge, Nissan, Hyundai, Audi, VW, BMW, Mercedes Benz and more.



www.boschautoparts.com
Bosch

SPRAY GREASE

AMSOIL INC. introduces AMSOIL Spray Grease, designed to effectively reduce friction and wear while keeping components running clean and trouble-free for outstanding performance and long life. Its quick, convenient spray enables users to grease hard-to-reach spaces while reducing the amount of mess, the company states. AMSOIL Spray Grease might be used on hinges, latches, overhead door tracks, nuts/bolts and any other pivot point or external moving part. AMSOIL Spray Grease adheres to metal surfaces for long-lasting performance and protects against wear and corrosion, all while lubricating moving parts for smooth and squeak-free operation. AMSOIL Spray Grease is quick and convenient, and is available for purchase individually or by the case.



www.amsoil.com
AMSOIL

HEAVY DUTY GASKETS AND SEALS

MSI (Modern Silicone Technologies Inc.) has added 99 new individually boxed Heavy Duty Gaskets and Seals for popular Class 3 to Class 8 diesel truck engines. Coverage for Magnum Heavy Duty Gaskets includes Dodge/Ram Cummins, Ford Powerstroke, GM Duramax, Navistar DT466, Caterpillar C7 through C15, Detroit Diesel Series 60 and a range of Cummins engines, the manufacturer reports.



www.magnumgaskets.com
Modern Silicone Technologies, Inc./MSI

FULL SYNTHETIC MOTOR OIL

Quaker State is introducing the new, reformulated Quaker State Ultimate Durability Full Synthetic Motor Oil, which provides protection against friction-related wear. Using a moly formulation, the new full-synthetic additive package of Quaker State Ultimate Durability helps to keep oil fresh, benefitting fuel economy. The new Ultimate Durability motor oil contains additional anti-oxidation additives to help fight engine oil aging and fight against thermal and viscosity breakdown, helping to increase the overall length of an engine's life, the company reports. Quaker State Ultimate Durability is ideal for use in both low and high temperatures, providing superior lubrication and protection against wear, especially as temperatures begin to rise.

www.rotella.com
Shell



FOUR-POST ALIGNMENT LIFT

The new AR18 four-post alignment lift is one of the most versatile products offered by Rotary Lift, easily adaptable to meet the needs of car dealers, truck dealers, independent repair shops and mixed fleets. According to the manufacturer, the lift features two stainless steel turning radius



gauges for use when performing alignments and is compatible with all brands and types of alignment instrumentation. The AR18 has a rated capacity of 18,000 pounds, enough to service everything up to and including Class 5 trucks. One runway is adjustable by three inches to allow the lift to be narrowed or widened depending on the vehicle being serviced. The hydraulic cylinder and lifting mechanism on the AR18 are tucked under one of the lift's runways, eliminating a potentially vehicle-damaging overhead obstruction. Two 9,000 pound-capacity rolling jacks are included as standard equipment to enable wheels-free brake, tire, alignment and suspension work.

www.rotarylif.com
Rotary Lift

BOLT/SCREW EXTRACTORS

KNIPLEX Tools introduces a new, extensive line of double-edged bolt and screw extractors. The Rennsteig double-edged bolt extractors represent a new generation



of tools for easily removing damaged screws and bolts. The key feature of the new extractors is four, double-edged cutting and gripping edges that equal eight points of contact. Designed for both left- and right-hand threaded screws, the extractor's cutting edges provide non-slip engagement allowing users to remove the toughest, frozen bolts, according to the company. The new extractors feature a center point so no additional tools are required to mark the center point for the drill hole. Along with eight points of contact, the high-alloy, German chrome vanadium steel extractors feature a hexagonal driving flat that provides optimum torque and a 58-percent larger size for a better wrench grip compared to square-head styles.

www.knipex-tools.com
Knipex Tools

MOBILE WORK STATION

Snap-on offers a new mobile work station (KRSC332PC) featuring the VERDICT Diagnostic and Information system. This versatile cart will allow service technicians to use their VERDICT anywhere in the service bay much more quickly and productively. The Snap-on VERDICT Mobile Work Station (KRSC332PC) is welded, not bolted, for superior strength. It is equipped with a mounting plate inside the lid with pre-set weld nuts to attach the monitor permanently and securely for viewing from a distance when the lid is open, according to the company. The system is fully enclosed and easy to open and shut; the monitor and the VERDICT stay in position, ready to use. Pre-cut foam is designed to accommodate the VERDICT diagnostic system with all its accessories and adaptors for easy accessibility and also aids in quickly identifying any missing accessories or adaptors. The mobile work station is also protected by Snap-on's tough powder coat paint with XMR, providing extra chemical and scratch resistance, to keep it looking great.



www.snapon.com
Snap-on

12-INCH FANS

The Jetstreme II dual 12-inch fan from Maradyne High Performance Fans is ideal for cooling high-performance engines. Maradyne's Jetstreme II features the company's quiet S-blade design and a rubber seal to eliminate vibration contact and increase airflow. Fitting 26-inch to 29-inch radiator cores, this low-profile fan has dual sealed motors that are IP68-certified dustproof and waterproof, the company reports. There are three options in the Jetstreme II product line with different wattage, cubic feet per minute (CFM) airflows, amp draws and depth measurements.



www.maradyne.com
Maradyne High Performance Fans

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Induction Innovations

AUTOENGINUITY RELEASES SCANTOOL 11.2

AutoEnginuity has released ScanTool® 11.2 for the Windows® platform. The ScanTool 11.2 release adds new features and improves coverage for U.S., Asian and European enhanced. Key features include added late-model BMW diesel system functions, improved GM light trucks 2000 to '05 bitmapped sensors coverage, added Jaguar XF 10+ diesel system functions, added late-model Nissan diesel support for European models and improved Toyota sensor and actuation coverage matrixes by using the updated method of reading coverage from the vehicle's memory.



AutoEnginuity

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Advance Auto Parts Professional

STANDARD MOTOR PRODUCTS EXPANDS CLONE-ABLE TPMS LINE

Standard Motor Products (SMP®) has added eight new clone-able sensors to its TPMS line. The Standard® and Intermotor® part numbers, which match the original for fit, form and function, cover an additional 6 million VIO for Buick, Chevrolet, Dodge Ram, Hyundai, Jeep, Kia, Saturn, Toyota, Toyota truck and Volvo through 2013.



Standard Motor Products

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NEW TECHNOLOGY SOLUTIONS

NUCAP continues to deliver innovative technology solutions to the automotive aftermarket with its NRS mechanical attachment system for brake pad backing plates. "Research shows that the adhesive (glue) bonded brake pad backing plate is a leading cause of most premature braking system noise, vibration and wear-out issues, and an accident waiting to happen," according to Jayson Keever VP Global Marketing NUCAP Industries. "Our NRS technology was developed to help our customers eliminate brake system comebacks and warranty returns." Said Keever, "Pads manufactured with our NRS Mechanical Bond, last up to 30 percent longer, by avoiding the most common causes of pad failures — like rust jacking, edge lift and friction material delamination. They will not fail."



Nucap

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Moving Targets

NEW MIRRORS FEATURE SIGNAL LIGHTS

DEPO introduces 335-5409L/R3EFH1, the side view mirrors for Chevrolet Silverado/GMC Sierra 07-10 with signal lights. With knowledge and experience in auto lamp industry, DEPO has redesigned the internal components of the signal light and applied for a patent. In addition, the appearance of the signal light on the mirror surface is changed to DEPO logo. See more information on www.maxzone.com.



Maxzone

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Gabriel

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The Innova PRO 31603 expert diagnostic tool allows technicians to quickly retrieve vital information in order to diagnose OBD2, ABS and SRS issues. Extended Asian and European ABS and SRS coverage is available so technicians can complete more repairs more efficiently. Shop management software reports manage vehicle diagnostics. Visit www.pro.innova.com.



Innova

DENSO WIPER BLADES

DENSO's First Time Fit Wiper Blade program offers a wide range of wiper blades to meet your needs. The program offers conventional, beam and designer styles, allowing a direct replacement of your original equipment blades. DENSO's wiper blades provide quiet, streak-free performance with its durable design. Quick and easy installation makes replacing your wiper blades a snap. Bottom line — DENSO First Time Fit Wiper Blades deliver the engineering, quality and performance that makes them the best choice when it's time to see clearly.



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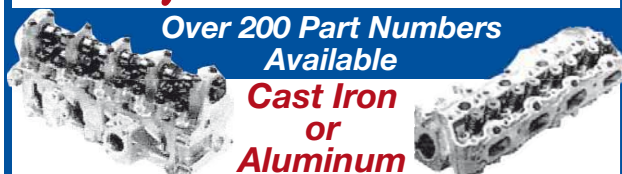
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TOOLS & EQUIPMENT

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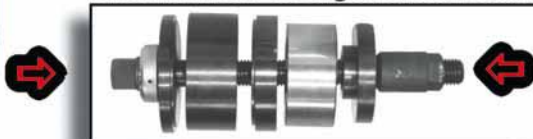
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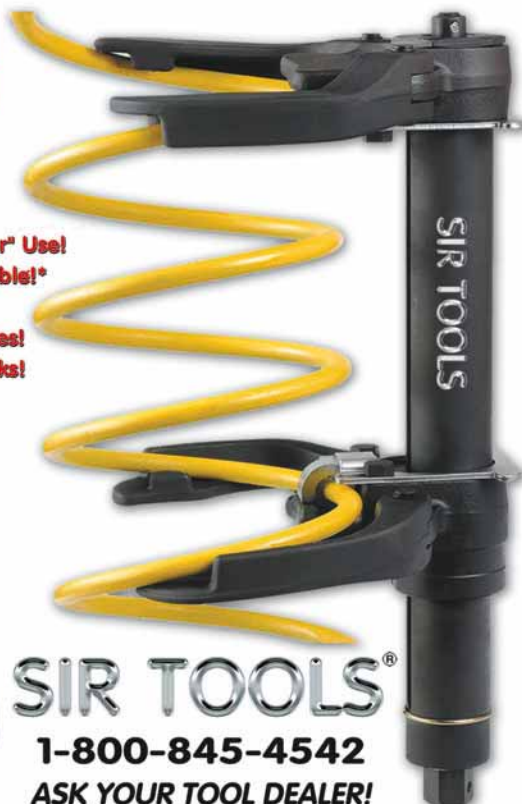
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A CASE OF THE 'MOANS'

AIR IN THE POWER STEERING SYSTEM CAN CAUSE MORE THAN NOISE ISSUES.

BY **PETE MEIER**
Technical Editor

Scenario No. 1: The new power steering pump is installed, and the system has been flushed with clean fluid and filled with the correct fluid for the car. So far, you've done everything right. Now it's time to bleed the air out of the system. You start the engine and begin turning the steering wheel lock-to-lock, just as you have always done, but the moans and groans from the steering system aren't going away.

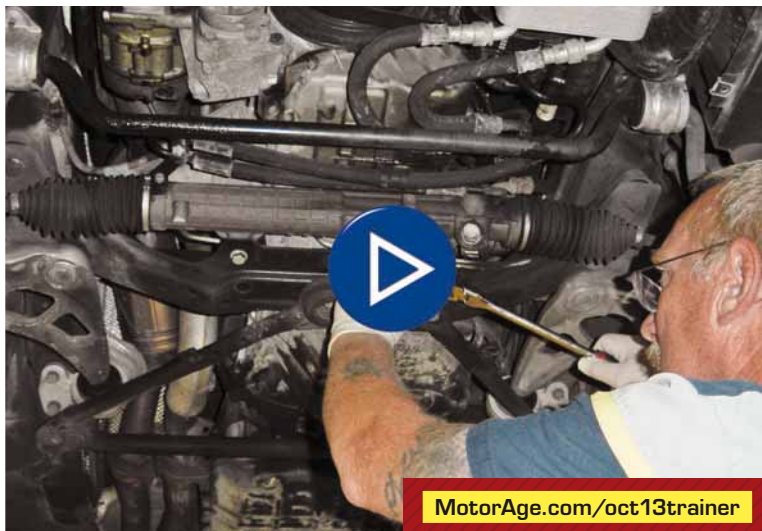
You might have just destroyed the new pump.

Scenario No. 2: Your customer is complaining of a whining noise when they steer the car. You inspect the fluid in the power steering pump reservoir and find the fluid is at the proper level and appears in good condition. You look over the system lines and hoses and find no visible signs of leakage.

Would you suspect the pump is failed? Would you consider recommending a replacement rack assembly?

If you did either, you'd be wrong and potentially facing a comeback!

The real cause of the failures in both scenarios is air trapped in the system. I first stumbled on this when dealing with a Saturn that seemed to be eating pump assemblies, and found a Technical Service Bulletin (TSB) requiring the air to be removed from the system prior to engine start up after the system has been opened





for repair. I since have found other OEMs that recommend the same thing. Failure to do so can lead to cavitation in the pump and cause nearly instantaneous damage.

Air also can enter the system through weak low-side hose connections or failing O-ring seals with no outward fluid loss apparent and no visible foaming of the fluid. This, too, was the topic of a TSB from Acura that since has proven itself on other brands. The technique I learned in solving both of these issues (and others) is now a part of my standard service procedure when repairing power steering complaints.

What is the technique? You will have to watch this edition of The Trainer to find out.

The Trainer is our monthly how-to video series targeted at every level of technician. Let us know if you have a topic you'd like us to cover. info@motorage.com

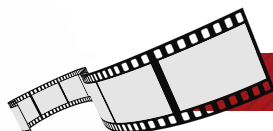
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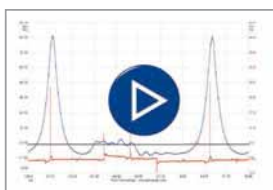


[VIDEOS]



Reading a wiring diagram

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A peek at in-cylinder pressure tests

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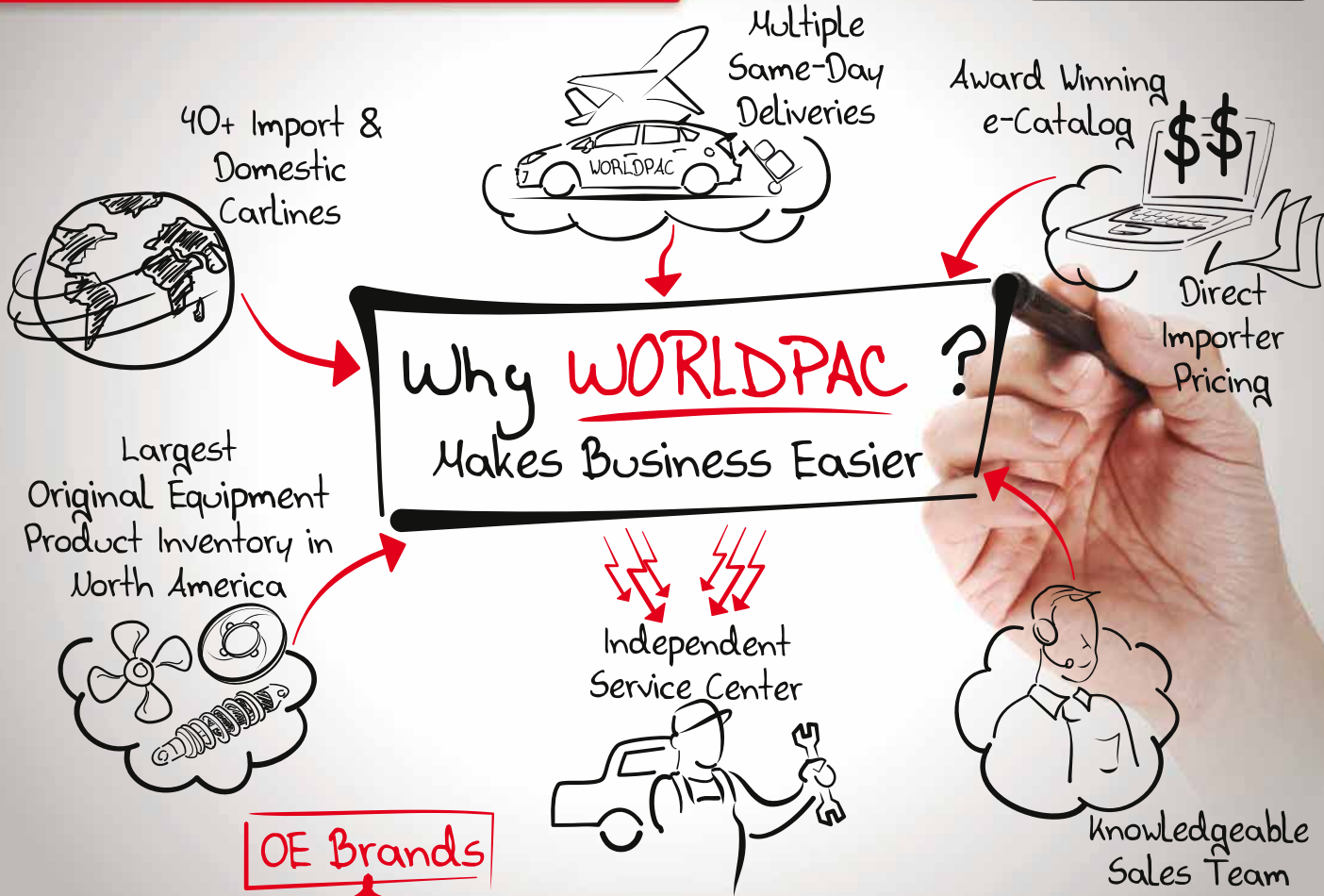
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