COMMITMENT TO TRAINING
ADDRESSING COMMON REPAIR CHALLENGES 22

JULY 2016
VOL. 135, NO. 7 // MOTORAGE.COM

Motor Age®

ADVANCING THE AUTOMOTIVE SERVICE PROFESSIONAL SINCE 1899

UBM

A NEW LOOK:
MOTOR AGE GETS A FACE-LIFT!
CHECK IT OUT INSIDE

TACKLING TIMING BELTS 46

AVOID COMMON PROBLEMS AND KEEP EVERY JOB PROFITABLE.

THE TWO TIMES TO ADVERTISE 10
Fight what your gut might be telling you to maximize your advertising impact.

GET THE MOST OUT OF MOST 56
Dissect the infamous GM U2098 Diagnostic Trouble Code and be the best at MOST.

TECH CORNER: FINDING THE RIGHT PATH 66


Our normal is **500°.**
For more than 40 years, we've poured the energy and science into Mobil 1™ synthetic motor oil to keep your engine running like new. We've tested it in some of the most extreme conditions you could encounter — to help protect engines in temperatures up to 500° Fahrenheit. Because our normal is anything but. Learn more about our product development at **mobil1.us/ournormal**
Energy lives here™
Mobil 1™
Performance by ExxonMobil
Copyright © 2015 Exxon Mobil Corporation. All rights reserved. All trademarks used herein are trademarks or registered trademarks of Exxon Mobil Corporation or one of its subsidiaries unless otherwise noted.

Motor Age

ADVANCING THE AUTOMOTIVE SERVICE PROFESSIONAL SINCE 1899

Talk Shop Anytime

AUTOPRO WORKSHOP

JULY 2016

VOL. 135, NO. 7 // MOTORAGE.COM

OPERATIONS

10 THE TWO TIMES YOU NEED TO ADVERTISE
Fight what your gut might be telling you to maximize your advertising impact.
DAVID ROGERS // Contributing Editor

PROFIT MATTERS

14 THE IMPORTANCE OF JOB DESCRIPTIONS IN YOUR SHOP
Employees will do their job and make yours easier if you don't leave these tasks blank.
CHRIS "CHUBBY" FREDERICK // Contributing Editor

FINANCIAL FIGURES

17 ADJUSTING TO TODAY'S ECONOMIC CHALLENGES
Times are changing and, in turn, so must our business.
BOB GREENWOOD // Contributing Editor

18 THE SHOP PROFILE
DAVE'S CAR CARE
Show owner relies on processes to drive profits.
ROBERT BRAVENDER // Contributing Editor

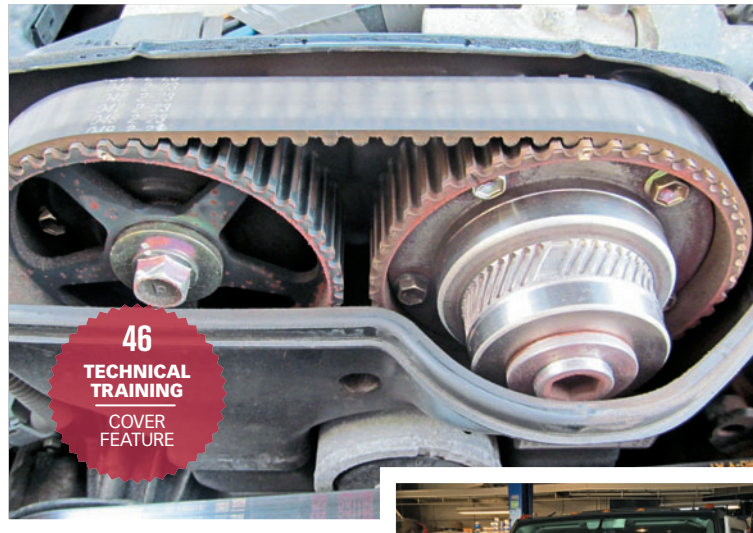
automechanika CHICAGO

COMMITMENT TO TRAINING

22 TECH COMMUNITY TACKLES COMMON REPAIR CHALLENGES
The ALLDATA Tech-Assist Team shares trending questions from its community members.

29 GET WITH THE PROGRAM
Smart shops are taking advantage of the service opportunities that reprogramming offers.
ERIC ZIEGLER // Contributing Editor

+ **SOCIAL INSIGHTS, WATCH & LEARN, TRAINING EVENTS**



TECHNICAL

36 MASTERING GAS DIRECT INJECTION
Learn about the revolutionary fuel system that is here to stay.
DAVE HOBBS // Contributing Editor

46 TACKLING TIMING BELTS
Avoid common problems and keep every job profitable.
VANESSA ATTWELL // Contributing Editor

56 GET MORE OUT OF MOST PROTOCOL
Dissecting the infamous GM U2098 DTC.
KEN ZANDERS // Contributing Editor

61 OLD DOES NOT MEAN EASY
Older model vehicles are not immune to being difficult.
WAYNE COLONNA // POWERTRAIN PRO Publisher

66 YOU CAN'T GET THERE FROM HERE
To reach a successful diagnostic conclusion, you have to follow the right diagnostic path.
PETE MEIER // Director of Training

69 THE CASE OF THE AUTOMOTIVE CHIA PET
I thought I had seen everything as a mobile diagnostic specialist, but one car really stands out.
JOHN ANELLO // Contributing Editor

IN EVERY ISSUE

4 INDUSTRY NEWS

COMMITMENT TO TRAINING EVENT TRAINS 100+ AUTOMOTIVE PROFESSIONALS: Inaugural live event a success at Washtenaw Community College.
TSCHANEN BRANDYBERRY // Special Projects Editor

PROTECT TECHS WITH THE RIGHT CLEANER: The most important tools in your shop are by far your hands — make sure to keep them in good condition.
ANDREAS KLOTZ // Contributing Editor

77 MARKETPLACE

79 AD INDEX

80 THE TRAINER
Come on in, the water is fine! Time to jump into the reprogramming pool.
PETE MEIER // Director of Training

WEB EXCLUSIVES // MOTORAGE.COM

TELEMATICS WHITEPAPER
Learn how telematics can provide you new ways to improve customer service, open new avenues to educate your customers and create broader customer reach.
MOTORAGE.COM/TELEMATICS

SOP WHITEPAPER
Creating and implementing Standard Operating Procedures (SOPs) are the best ways to ensure employees know the right way to perform tasks. Read more in this free whitepaper.
MOTORAGE.COM/SOPS

ELECTRICAL TROUBLESHOOTING
In this recorded webinar, Pete Meier and G. Jerry Truglia cover essential testing techniques to speed up your electrical diagnosis and find disguised problems.
MOTORAGE.COM/ELECTRICALTROUBLESHOOTING

Motor Age

MOTORAGE.COM
24950 Country Club Blvd., Suite 200 // North Olmsted, OH 44070
Phone: (440) 243-8100 // Fax: (440) 891-2675

EDITORIAL STAFF

MICHAEL WILLINS
GROUP CONTENT DIRECTOR
mwillins@advanstar.com
(440) 891-2604

KRISTA MCNAMARA
CONTENT CHANNEL DIRECTOR
kmcnamara@advanstar.com
(440) 891-2646

CHELSEA FREY
SENIOR ASSOCIATE EDITOR
cfrey@advanstar.com
(440) 891-2645

PETE MEIER ASE
TECHNICAL EDITOR
pmeier@advanstar.com

STEPH BENTZ
ART DIRECTOR

STALIN ANNADURAI
SENIOR DESIGNER

JAMES HWANG
EDITORIAL DIRECTOR, ASE STUDY GUIDES
jhwang@advanstar.com
(714) 513-8473

CONTRIBUTORS

VANESSA ATTWELL
BRIAN CANNING
MARK DEKOSTER
CHRIS FREDERICK
BILL HAAS
DAVE HOBBS
TONY MARTIN
TIM JANELLO
JOHN D. KELLY
DAVE MACHOLZ
RICHARD MCCUISTIAN
MIKE MILLER
ALBIN MOORE
MARK QUARTO
G. JERRY TRUGLIA

PRINTED IN U.S.A.

SUBMISSIONS:
Motor Age welcomes unsolicited articles manuscripts, photographs, illustrations and other materials but cannot be held responsible for their safekeeping or return.

MEMBER OF:

BUSINESS STAFF

JIM SAVAS
VICE PRESIDENT/GENERAL MANAGER

TERRI MCMENAMIN
GROUP PUBLISHER
tmcmenamin@advanstar.com
(610) 397-1667

NANCY GRAMMATICO
BUSINESS MANAGER

JILLENE WILLIAMS
SALES COORDINATOR

KAREN LENZEN
SR. PRODUCTION MANAGER
(218) 740-6371

KRISTINA BILDEAUX
CIRCULATION DIRECTOR

TRACY WHITE
CIRCULATION MANAGER
(218) 740-6540

BORIS CHERNIN
MARKETING DIRECTOR
bchernin@advanstar.com
(310) 857-7632

BALA VISHAL
DIRECTOR OF VISUAL MARKETING

TSCHANEN BRANDYBERRY
SPECIAL PROJECTS EDITOR

DANIEL MELKONYAN
SEO ANALYST/WEB MASTER

DOMESTIC SALES

MIDWEST & WESTERN STATES
MICHAEL PARRA
mparra@advanstar.com
(704) 919-1931

ILLINOIS, EASTERN & SOUTHERN STATES
PAUL ROPSKI
propski@advanstar.com
(312) 566-9885
Fax: (312) 566-9884

OHIO, MICHIGAN & CALIFORNIA
LISA MEND
lmend@advanstar.com
(773) 866-1514
Fax: (773) 866-1314

ACCOUNT EXEC./CLASSIFIED SALES
KEITH HAVEMANN
khavemann@advanstar.com
(818) 227-4469
Fax: (818) 227-4023

CUSTOMER SERVICE

SUBSCRIPTION CHANGES
(888) 527-7008
(218) 740-6395

PERMISSIONS/INTERNATIONAL LICENSING
MAUREEN CANNON
(440) 891-2742

REPRINT SERVICES
877-652-5295 ext. 121
bkolb@wrightsmedia.com
Outside US, UK, direct dial:
281-419-5725. Ext. 121

Motor Age (Print ISSN: 1520-9385, Digital ISSN: 1558-2892) is published monthly, by UBM 131 W. 1st Street, Duluth, MN 55802-2065. Periodicals postage paid at Duluth, MN 55806 and additional mailing offices. POSTMASTER: Send address changes to Motor Age, P.O. Box 6019, Duluth, MN 55806-6019. Please address subscription mail to Motor Age, 131 W. 1st Street, Duluth, MN 55802-2065. Canadian G.T.S. number: R-124213133RT001. Publications Mail Agreement Number 40612608. Return Undeliverable Canadian Addresses to: IMEX Global Solutions PO Box 25542 London, ON N6C 6B2 CANADA One-year rates for non-qualified subscriptions: U.S. $70.00; Canada/Mexico $106.00; International surface $106.00. For information please call (866) 529-2922 (Domestic inquiries); (218) 740-6395 (Canadian/Foreign). Printed in the U.S.A.

AD DEADLINES: Insertion orders–1st of month preceding issue date. Ad materials–5th of month preceding issue date.

To subscribe, call toll-free 888-527-7008. Outside the U.S. call 218-740-6477.

Inventing the Future

From know-it-all windows to vehicles with minds of their own to new uses for tried-and-true tech, developers are working toward a brave new world of transportation.

3

Because when it comes to getting here, there and everywhere, the future will belong to those willing to build it. And sometimes, to those willing to invent it.

1. AUTONOMOUS DRIVING

A car with a mind of its own may be too futuristic for some, but automakers are working to bring the efficiency, safety and sustainability potential of driverless cars to the mass market. In 2017, Cadillac plans to introduce Super Cruise, which automatically switches to autopilot mode when its camera detects the driver's eyes aren't on the road.

2. LIGHTWEIGHTING

Aluminum is the third most abundant element, but No. 1 with automakers looking to get fit. More new vehicles will dump weight to gain efficiency and performance, largely thanks to aluminum. The Cadillac CT6 platform, for instance, blends high-strength steel and aluminum parts, including 13 aluminum casings that shave nearly 200 pounds combined.

2

3. GAMIFICATION

Gaming is a big deal online, and it may soon be in cars. Automakers are developing ways to potentially augment the driving experience through greater interaction. The 2016 Chevrolet Bolt takes advantage of OnStar 4G Wi-Fi® capability that lets drivers compete with their friends on miles per charge and highest mpg equivalent.

4. SMARTPHONE MANAGEMENT

You can already find and order ACDelco parts on a smartphone, using the CONNECTION app and VIN scanner. But you might soon be able to manage whole vehicles with a few taps and swipes. GM is working on apps that not only control door locks and heated seats, but that also monitor vehicle functions and systems in real time, including fuel economy, battery life and speed.

5. E-MOBILITY

Electric vehicles are going (even more) mainstream. From plug-ins such as the Chevrolet Volt to the Chevrolet Malibu Hybrid, automakers are taking charge of the future of driving with big investments in versatile models that go a greater distance for a lot less money.

5

No matter what the future brings, ACDelco will be there to help you service the vehicles of tomorrow, with more than 700 web-based and instructor-led Learning Management System courses, and the exclusive GM ASEP training program.

Explore available training options at acdelcotechconnect.com/training.

ACDelco | BE CERTAIN.

INNOVATION STARTS WITH THE ORIGINAL

G. JERRY TRUGLIA presents his new critical thinking course to a capacity crowd during the afternoon session at the first live training event, hosted by Washtenaw Community College.

INDUSTRY TRAINING

COMMITMENT TO TRAINING EVENT TRAINS 100-PLUS TECHS

TSCHANEN BRANDYBERRY //
Special Projects Editor

ANN ARBOR, Mich. – Top instructors from both the mechanical and collision repair industries presented their classes to full rooms as the Commitment to Training initiative kicked off with free training for automotive professionals.

More than 100 technicians, estimators, owners and managers attended the first free one-day Commitment to Training event at Washtenaw Community College in Ann Arbor, Mich. The modern facility hosted the inaugural event as part of the initiative aimed at training today's automotive professionals while providing them a network to learn from peers.;

"I'm very excited by the response to the first one-day training event," said Pete Meier, director of training for *Motor Age* and *ABRN*. "The professionals who attended the event really understand the need to continue learning about the changing technology and procedures needed to repair vehicles today. I think they all took away lessons they can use immediately in their shops around the country."

Automotive professionals from as far away as New York, New Hampshire, Virginia and Ontario, Canada, attended the Michigan event. All attendees received certificates toward continuing education credits including AMi and NATEF certifications.

Mike Rowe, a technician at H&I Expert Auto Care in Rochester Hills, Mich., learned about the event through *Motor Age Training* and studying to become ASE certified. "I want to be better at what I'm doing and have answers for questions from customers," he said, adding he was excited to learn from Meier and his electrical and scope class. "I've seen him on YouTube and seeing him in real life was a lot of fun and very informative."

Trainers for the sessions were Meier, Mike Anderson, G. Jerry Truglia, Larry Montanez and Brad Mewes. They

>> CONTINUES ON PAGE 6

BREAKING NEWS

TECHNICIAN CARE

PROTECT TECHS WITH THE RIGHT CLEANER FOR THEIR HANDS

BY ANDREAS KLOTZ //
Contributing Editor

From tool sets to tire changers to alignment racks, your automotive shop is filled with tons of expensive tools and equipment, but they're not the most valuable ones. The most important tools in your shop are your technicians' hands, so it's important to keep them clean and in good condition.

Your techs' hands are in constant contact with all kinds of dirt, ranging from brake pad dust to rust, oil and adhesives. At the same time, manual labor causes additional stress to the skin and wearing gloves is not always an option due to the loss of dexterity. Working in an automotive shop puts a large amount of stress on your hands and skin, resulting in dry skin to more advanced, painful and costly problems such as occupational dermatitis.

Technicians failing to take proper care of their hands can have significant effects on an organization. According to the U.S. Bureau of Labor Statistics (BLS), 50 percent of all working time lost to industrial illness is due to dermatitis. Just one case of occupational dermatitis can cost an employer approximately $3,500 in worker's compensation claims

>> CONTINUES ON PAGE 6

TRAINING THAT WORKS AS WELL AS OUR PARTS.

ACDelco offers a wide variety of training to help you and your employees be your best. Some are full-day, instructor-led seminars with hands-on exercises, while others are quick, online courses and simulations designed to help understand the aspects of various vehicle systems. Many are available 24/7 and require no additional charge for program participants.

From parts specifically designed to fit your vehicles to courses specifically designed to fit your schedules.

Visit acdelcotechconnect.com/training Plus, download the ACDelco CONNECTION app with VIN scan for your mobile device.

ACDelco | BE CERTAIN.

INNOVATION STARTS WITH THE ORIGINAL

>> CONTINUED FROM PAGE 4

covered electrical, diagnostic, material, OEM and financial lessons.

In addition to the two educational sessions, Anderson presented the morning keynote and representatives from the Advanced Transportation Center at Washtenaw Community College introduced attendees to the program that focuses on connected vehicles and the associated infrastructure. Attendees toured the facility following lunch.

But it was the training and staying on top of things for attendees that brought Matt Cerminara, who works at Penney's Auto Body Inc., in Ravenna, Ohio, to the event. "I just wanted to learn more about estimating and make sure that we're getting all of the jobs that we can get," he said. "Continuing education always ensures you're doing the job the right way and for us, getting paid by the insurance companies all that you are to be paid."

Joel Myers and Mike Tumanov with Snapsheet Inc. understand that as being newer in the industry and younger professionals, these training events are a great help.

"Cars and repair procedures are changing and you have to know how to repair back to pre-loss condition," said Myers, from Chicago.

The event at Washtenaw Community College was the first of three no-cost live events scheduled for 2016. Events are scheduled for Oct. 15 at Fox Valley Technical College in Appleton, Wis., and Nov. 19 at Joliet Junior College in Joliet, Ill.

The initiative includes webinars, live events, training videos, newsletters, whitepapers and resource guides all available online, and culminates in Automechanika Chicago 2017, scheduled for July 26-29, 2017, in Chicago. To learn more, sign up for the free email newsletter and learn first when registration for one-day events and Automechanika Chicago 2017 opens.

The Commitment to Training is made possible by support from manufacturer sponsors Carquest Technical Institute, Delphi, Abaris Training, Mitchell 1, PPG, Polyvance, Pico Technology, Schaeffler Automotive Aftermarket, Mitchell International, Motor Age Training, Axalta, Garmat USA and GFS.

>> CONTINUED FROM PAGE 4

and an average disability of 23.9 days, according to the Journal of the American Medical Association.

Often it seems so easy to many to use a shop rag with some thinner to scrub the dirt from their hands, but this tends to make things much worse. The solvent in these thinner products will dry out the skin, making it even easier for dirt to cling to hands and chemicals to easily penetrate the skin. A professional hand cleanser is a better option for cleaning hands in the workplace. Unfortunately, some of the hand cleansers that automotive shops use are not professional.

Choosing a cleaner

The type of hand cleanser selected is vitally important to skin health. Professionals in the automotive industry need a cleanser that can take off the dirt and contaminants they come in contact with daily. A common misconception is that a hand cleanser's performance is measured by its ability to clean hands

aggressively. However, in actuality, most cleansers far surpass the user's actual requirements.

Some hand cleanser products tend to contain pumice as the scrubbing agent, designed specifically to help remove ingrained dirt from the hands. Pumice, a natural volcanic rock that consists of rough volcanic glass, is used in construction, housekeeping, polishes, erasers and beauty salons as an abrasive agent. This common ingredient without a doubt does a good job in these workplace environments to remove contaminants from objects. However, using pumice on your hands will remove the skin, and most people can't afford further damage to their hands.

There are scrubber alternatives available such as corn meal, olive stone or walnut shell. These scrubbers are natural and have the right balance between helping to get dirt off and being gentle to the skin. There are also environmental impacts to using pumice in hand cleansers. In comparison to pumice that will settle in ducts and pipes causing blockages, natural scrubbers are easily rinsed away, not prone to swelling and will therefore not cause plumbing blockage.

It is important to select a hand cleanser that is powerful and effective for the job but does not contain harsh chemicals that dry the skin. As an automotive professional, you and your techs need a cleanser that contains moisturizers that protect your most valuable asset and keep hands healthy and working.

ANDREAS KLOTZ is technical product manager at Deb Group, the world's largest leading away-from-home skin-care company. He holds extensive experience in professional skin care products to prevent work-related occupational skin diseases.

A: YES, SILENCE IS AWKWARD, EXCEPT WHEN IT COMES TO OUR BRAKE PADS.

Carquest® Wearever® Platinum Professional brakes use patented 4-layer HEX Shim Technology® to eliminate noise. So your customers don't have to turn up the radio, unless they want to.

Advance Professional

STRONGER WITH CARQUEST

NEW ATTITUDE. SAME RED BOX.

You know Motorcraft,® right?

Been around a long time? Quality parts for Ford and Lincoln? The guys with the red boxes?

Well, say hello to today's Motorcraft.

We're analyzing dozens of product lines and thousands of parts. No area left untouched. If it isn't bolted to the floor, it's picked up and evaluated. The result is expanded part-line coverage and pricing that's right for your business.

You already knew us for quality and fit. Now enjoy even greater access to the parts you need for Ford and Lincoln vehicles.

Your local distributor or dealer can give you all the details.
So much is changing at Motorcraft. Except the red boxes. We kept those.

Ford Motorcraft

Right part. Priced right.


Motorcraft
4
Spark Plugs
Bougies
Bujías
Recommended by Ford Motor Company.
Recommandé par Ford Motor Company.
Recomendado por Ford Motor Company.
motorcraft.com

THE TWO TIMES YOU NEED TO ADVERTISE

Fight what your gut might be telling you to maximize your advertising impact

DAVID ROGERS // Contributing Editor

Should you follow your gut when it comes to marketing?

Depending on your gut, it might be telling you to scale back now because you're busier at this time of year anyway. Or maybe it's telling you to start marketing again after you shut it down during the winter and spring to save money.

In both cases, going with your gut is a terrible decision! The two worst times to pull back on your marketing are one, when you're slow and two, when you're busy. Here's why.

When you're slow

When the shop is slow, your gut instinct might be to pull back and focus only on the bottom line, to keep those hard-earned dollars close to your chest so you don't risk losing everything. The problem is that in this scenario, your gut is an optimist.

Pulling back on marketing when you're slow means you're assuming that everything will go your way — that your competition will stop marketing, too. Your customers come back to your shop. None of your customers will move away.

But we live in a world where customers move or die, where your competition is trying to take your customers, where top-of-mind awareness is everything. We live in a world where you need a constant stream of new customers to offset the ones who leave. The only way to achieve that is through consistent marketing.

When you shut off your marketing, you are turning off the supply of new customers and letting go of the awareness that keeps your existing customers coming back. Your slow week just turned into a slow month, and unless you do something about it, it won't take long for your customer pipeline to dry up and vanish.

When you're busy

In spring and summer, customers are planning road trips, running more errands and enjoying the warm weather. They're more likely to stop by a shop for a pre-trip inspection or the maintenance they put off during the holidays.

With a steady supply of customers, why should you keep spending on marketing? If you're not trying to stay in front of your best customers and maintain your relationship, you're giving your competition permission to take them away from you.

It happens every year: a desperate shop owner calls me to ask, "Where did all my customers go?" Every year, back-

PHOTO: GETTYIMAGES/TETRA IMAGES

LONG LASTING
DURABILITY

ULTIMA SELECT

100% NEW, NOT REMANUFACTURED

STARTERS

- High-strength armature connections guarantee consistent and reliable starting
- The highest power and cranking torque to handle the toughest starting conditions

ALTERNATORS

- Industry-leading electronics eliminate common failures caused by voltage spikes
- High performance copper windings generate optimal electrical output

O'Reilly PARTS PAYOFF

Parts Payoff rewards you for purchasing and installing the O'Reilly brands you know and trust.

IT'S FAST, SIMPLE AND FREE!

For full program details visit FirstCallOnline.com

AVAILABLE EXCLUSIVELY AT

O'Reilly FIRST CALL

DEDICATED TO THE PROFESSIONAL

FirstCallOnline.com

to-school season brings a fall slowdown, and the steady flow of customers they saw during the summer has vanished. Why? The shop shut off its marketing!

It doesn't happen overnight. At first it's a customer here and there, one car fewer every day. By the time you notice they're missing, it's already too late.

On average it takes seven touches before a marketing message will lead a customer to action. That means you can't send one email and expect every customer who opened the message to come through the door.

The type of marketing that attracts high value, high quality people who become loyal life-long customers also takes time to work its magic. It's not about getting customers through the door with coupons and free services. It is about building trust, establishing authority and fostering a genuine relationship with your customers. It's about educating them on why they should choose you and staying at the top of their mind so they choose you the next time they need repairs.

Marketing should be working year-round to build relationships with customers, keep your shop at the front of their mind and keep customers coming through the door no matter what the season. Which is why creating a seasonal marketing plan is so critical — it means you'll be growing when your competition is following their gut and turning off the flow of customers.

Seasonal market planning

Many shop owners fall into the trap of looking at marketing and advertising as a light switch. They think there's a switch they can flip to turn on marketing when they need new customers and off when they don't. The problem is, while marketing can absolutely be turned off like a light switch, it can't be turned on as easily. Beyond the logistical problems of starting up marketing — it can take six to eight weeks from the time you need customers to the time a direct mail campaign is reaching your customers — there's also the fact that marketing takes repetition.

Instead of a light switch, which provides light the instant the switch is flipped, think of marketing like a faucet. With a few tweaks and turns, you can precisely control the flow of customers into your shop.

You can adjust the type of marketing you do. Online advertising, paid search, email newsletters, direct mail — your shop can use all of these together, individually or in any combination. There's no easy button, but there are proven strategies to create an integrated marketing plan.

You can adjust the customer you target. Even when you're slow, you don't want to target the coupon-clipping drivers that will bring down morale and gross profit. But different marketing resonates with different customers to raise car count when you need it and build relationships in the process.

You can adjust the speed. Shift the balance between fast twitch and slow twitch marketing to match the needs in your shop. Use the right incentive and message to get customers through the door quickly when you need car count. Long-term strategies build relationships and attract high value, and long-term customers require ongoing effort year round to be effective.

You can adjust the calendar. When you know a slowdown is coming, whether it's the back-to-school fall slowdown or the end of year holiday season, plan ahead! Ramp up the marketing before the slowdown hits to fill your pipeline with customers who are ready to buy.

Have you ever met a shop owner who complained about having too many quality customers? I haven't either.

DAVID ROGERS is COO of Keller Bros. Inc., and president of Auto Profit Masters. *contact@autoprofitmasters.com*

PEOPLE WHO BOUGHT THIS *ALSO* BOUGHT THIS

PENNZOIL PLATINUM HE™ OIL FILTER

HOW IT BENEFITS YOUR CUSTOMER

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

HOW IT BENEFITS YOU

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

HOW TO GET STARTED

For more information contact your local Shell sales representative.

MAKE IT A PENNZOIL CHANGE.™

FIND US ON .com

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

The importance of job descriptions in your shop

Running a business would be so simple if everyone just did their job

We have all heard the benefit of working on your business rather than in it. Not only will profits increase but your free time will increase, and staying the best shop in your market forever is a distinct possibility. Let's listen to how shop owner and coach Rick Johnson recommends getting started or staying on this journey.

During my 23 years as a shop owner with an untold number of employees and over eight years of talking to hundreds of shop owners, it finally occurred to me the other day that maybe — just maybe — things would run a lot smoother if our employees would just do their jobs. And, of course, if we as the owners would do our job of being an owner — leading, holding ourselves and our employees accountable and adhering to job descriptions and shop policies. How much better would our business machine run? Where to start?

How about job descriptions? Oh, you don't have job descriptions? You don't have shop policies and standard operating procedures? So maybe your plan is that everyone should just know what you want done by osmosis? Or better yet, maybe you can be heard saying another favorite statement that I hear all the time, "Common sense should let my employees know better than that." Let me ask you: How is all that working for you? In my opinion common sense died in about 1994! Having no job descriptions and no shop policies is just not acceptable today.

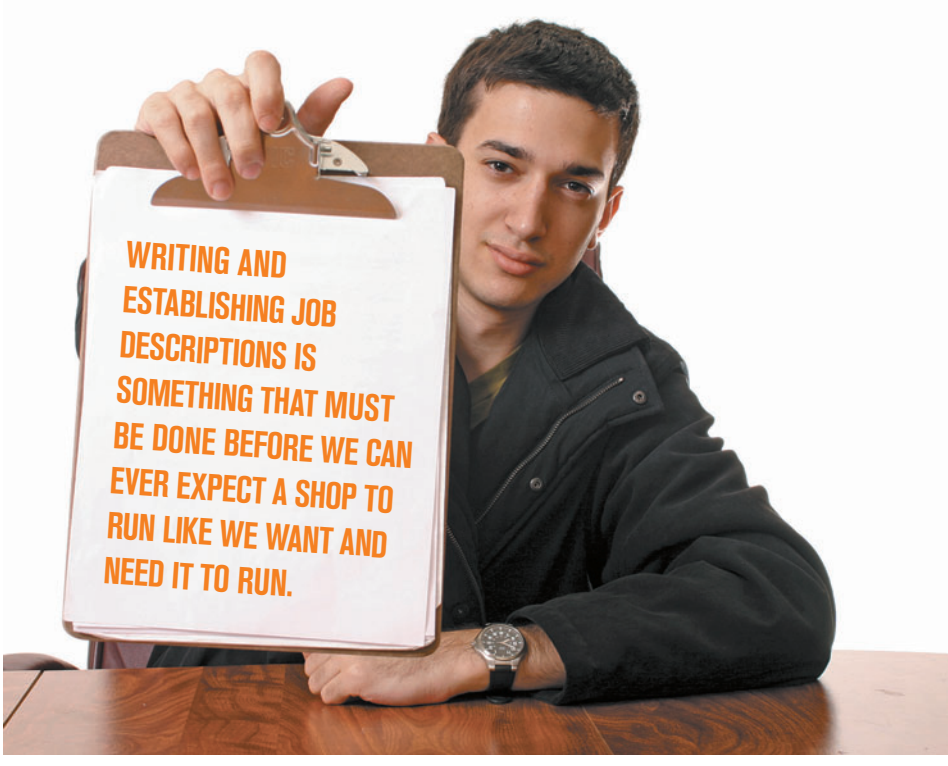


PHOTO: GETTYIMAGES/FILIPK

Start working on the business

Writing up and implementing job descriptions and standard operating procedures is something that needs to be done and established before we can ever expect the shop to run like we want and need it to run. If we want our employees to do their job and do it the way we want, we must first establish what it is that we want. It sounds simple, and for the most part it is, so then why is it so hard for us to get it done?

Maybe the reason is that we are so busy working in the business that we don't take time to work on the business. Maybe we have the disease of "If it's going to be done right, I have to do it myself." We convince ourselves that we need to work harder — put in a few more hours, burn the midnight oil and then somehow it will all come together and everything will be perfect. If that were true, then 99 percent of the shops out there would already be the *Motor Age* top shop of the year every year, because 99 percent of the shops I know already work harder and put in more than a few more hours and burn the midnight oil.

Instead, let's stop the madness, make some changes, decide to work on the business and write up those job descriptions, some shop policies and take control. We need to establish what we want and put what we want in writing. Once we establish what we

CARTER®

Fueling you forward.™

Meet the new Carter at
carterfuelsystems.com.

need, we must hold those employees and ourselves accountable to what our jobs are and follow through. Just imagine with me for a few minutes what this would look like, could look like.

The service advisor's job

For example, the service writer does what a service advisor should do. In my ideal world the service advisor knows that his or her primary job on the phone is to get the customer to set an appointment. He or she knows that they are never to give a price over the phone or to try to diagnose a problem. They have been trained to ask for an appointment and to get the customer on the schedule. That's it, period. That is their job description for phone conversations — man, that's simple.

And once the customer comes into the shop, the service advisor knows that his or her job is to meet the customer, shake their hand, go to the car with the customer, get the mileage, perform a walk-around with the customer and then come back inside and pull up previously recommended services along with a new maintenance schedule.

Then it's the service advisor's job to address the customer's concern, offer a courtesy inspection and assign the correct technician to work on the car. The service advisor knows that his or her job is not to decide if the car is worth spending money on or whether or not the customer has the money to invest in the car. Service advisors must do their job and dispatch the car to the proper tech and wait for the diagnosis and courtesy check results. Then they must write up the estimates and ask for the sale.

The technician's job

The technician knows what he or she is to do because, again, it is in writing what the job is. He or she knows that the job is to properly diagnose the customer's concern and put in writing the correction of the problem, to perform the courtesy inspection and recommend all needed repairs based on what is broken or worn out and maintenance that is due by mileage. The technician knows that it is not his or her job to decide whether or not the car is worth fixing or whether or not the customer has the money to fix the car. The technician just does his or her job and turns in the repair order to the service advisor.

The shop owner's job

Finally, the shop owner does his or her job as well. The shop owner is working on the business and not in it. They are not micro-managing every little detail because they have hired, equipped, trained and delegated great employees to work in the business. He or she has written up and implemented job descriptions and shop policies and holds the staff accountable for results — results that are very predictable in a business that has great employees who know what their jobs are and what is expected from them.

So where do we start? Where do we find the time to work on the business when the business demands so much of our time? How do we turn our focus from working harder to working smarter on the business instead of in the business? Maybe the place to start is with learning what our job is as an owner.

For the most part, most of us started in business with little more thought than just starting a business. Fixing cars for us was the easy part. If just fixing cars was the answer then we would all have a well-run business already. Managing the business is the hard part; it is the part that no one told us about. You can start by turning to trusted sources for information and guides as to what to do as an owner

For a limited time go to www.ationlinetraining.com/2016-07 and we can send you a leader's operation checklist that can get you started down the road to helping you run your business instead of the business running you. Imagine if you will, a business where everyone just does their job — does their job the way you want it done, because you have written up clear and concise job descriptions and held them accountable.

CHRIS "CHUBBY" FREDERICK is the CEO and founder of the Automotive Training Institute. ATI's 115 associates train and coach more than 1,400 shop owners every week across North America to drive profits and dreams home to their families. Our associates love helping shop owners who are having the same struggle as many of them have had, and who are looking for the same answers — and in some cases looking for a lifeline. This month's article was written with the help of former shop owner and current coach Rick Johnson.
Chubby at cfrederick@autotraining.net

Adjusting to today's economic challenges

Times are changing and, in turn, so must our business

The aftermarket is changing, and economic times have dramatically changed in many regions of this country as well. When the economic cycle changes to a downward trend, we must re-examine the business to increase productivity.

Remember the following:

• You cannot discount yourself into prosperity.

• You still require the right staffing level to maximize productivity.

• A slash-and-burn approach to expenses can create service levels to drop, which affects your client satisfaction and business image. We know 95 percent of business expenses within a shop are fixed for common sense expenses required to maximize net income.

These are always three big challenges during tough economic times.

The tendency to lower labor rates or discount jobs in hopes that it will drive more business does not work. Remember, you pay all bills out of gross profit dollars, and working 50 percent harder to create the same dollars can kill the attitude of you and your staff. The math does not lie.

THE TENDENCY TO LOWER LABOR RATES OR DISCOUNT JOBS IN HOPES THAT IT WILL DRIVE MORE BUSINESS DOES NOT WORK IN THE SHORT- OR LONG-TERM.

In the 1970s and '80s when there was an abundance of potential staff; layoffs during slow times were common. If people left, we just brought in others. Today, we must retain competent people every day. Without the right staffing level, you cannot maximize the right productivity level to make the bottom line required.

Slashing expenses is a common trick out-of-touch shops try, and then they wonder why their service levels drop; why they can't afford required equipment, training or important business services; and why customer complaints start to roll in. Expenses can be reviewed to see if a better value for the same service is possible. However, ensure you are comparing apples to apples. Also examine what "relationships" you are leaving behind to spare a few dollars. Take the total money you think you would save and divide it by the monthly average of your last six months of labor hours billed. Then take that answer and divide it by the number of days you are open per month to give you the daily increase in billed hours required.

Solutions are available.

1. With the team, review the shop's reality in productivity terms. What is causing productivity to drop? Is accountability in check? Key in on all of the key shop processes required to maximize productivity.

2. When clients cut back on services or are declining more work, ensure you have the conversation on their vehicle safety and reliability issues and document what you told them. Then when the item does become an issue, you cannot be accused of not informing them. You must maintain their trust in the shop and your credibility. To achieve that, document, document, document!

3. Work to attract new business with a focus on service and quality. When you focus on price, you attract price-focused people. You lose in the end because they are not profitable. You want service and quality at the right price. Distinguish what makes your shop unique in tough economic and changing times.

4. Is your attitude positive and optimistic or are you negative in your language, tone and body language? Have that talk every morning in the mirror about the person you want to be. At night, think of three positive things that happened to you that day. Slow down and take control of your thoughts instead of allowing the negative people to influence you.

Much of working on the business still requires your personal discipline to be in check. Sometimes you must be reminded. It's time to get back and work on your business.

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

By the book

Shop owner relies on systems and processes to drive profits

ROBERT BRAVENDER // Contributing Editor

Last year, Dave's Car Care was able to proudly announce they received the Better Business Bureau's International Torch Award for Ethics. As one of only four companies — in ANY business, mind you — to receive this honor in 2015, how did this Glendale, Ariz., shop achieve this honor? Owner Dave Denmon hit the books.

First there was *In Search of Excellence*, or rather its co-author, Tom Peters. "I was mesmerized by that man back in the late '80s, early '90s," laughs Denmon. "If you saw him speak, he'd get up on the table and jump up and down screaming, 'Image is everything!' and 'A man who can manage technology will manage success!'"

Opening his doors as a tire franchise in 1980, Denmon was receptive to any and all ideas as he began transitioning from retail to full repair. "We went from three working bays to five, then to nine, and finally 12. Same corner, same building, but we grew. That's the evolution of the business," he explains. "I have a real ability to just sit in seminars and bring home something that enhances the business, particularly branding; that became important to me. Who am I — Interstate Batteries or NAPA? No, I'm Dave's Car Care.

"You will know who your best customers are, who your most productive technicians are, what to look for, what not to look for," counsels Denmon. "When we go to hire a technician now, we profile. If an applicant doesn't meet the profile, we won't talk to them. One of the key factors is we won't interview a technician who hasn't been at their last job for five years or more. If he has, he can fix a car right and get along with the staff."

Then in 1995, Denmon read *The E Myth* by Michael Gerber. Subtitled "Why Most Businesses Don't Work and What to Do About It," Denmon contacted a colleague who had retired from the auto repair industry, and together they were inspired to create Automotive Management Systems — essentially creating a book of their own.

"'Systems and processes to profits,'" Denmon says, as he recites their mission statement. "What we did at that point was redefine the business into five key areas: management, technical operations, sales, personnel and marketing. We wrote an operational system for every aspect of our business.

"I grew up in a military family," he relates. "I also served in the military, and they do everything by a standard operating procedure. So back before the age of the computer and computerized inspections, we literally had a printed inspection sheet for every aspect of vehicle repair: air conditioning, brakes, cooling systems, drivability diagnostics, engine replacement, transmission replacement, etc."

They based their inspection process on three key factors: "Concern — what the customer came in for; cause — what's the correction; and then quality control — completion," outlines Denmon. Based on the cause, they would come up with the manufacturer's recommendation of service needs or safety.

"Then we utilized a very simplistic idea of three different color highlighters on the inspection sheet," he continues. "Yellow was the cause, blue was the recommendation and red was the safety issue. When we implemented that program in 1996, we had 9,500 cars come through our facility at an average ticket of $186. Last year we had about 4,500 cars with an average

DAVE'S CAR CARE

Glendale, Ariz. // www.davescarcareaz.com

Dave Denmon Owner	**6,000** Total square footage of shops	**87** No. of customer vehicles per week
1 No. of shops	**12** No. of bays	**$450** Average repair ticket
35 Years in business		

Branding

Training

Digital Inspection

Warranty

Digital Communications

Financing

Promotions

CRM

Business Development

Technology

App

NAPA SERVICE ASSISTANT

Award Winning Digital Animation Tool.

When it comes to helping customers say “yes” to the repair, NAPA AutoCare members across the country choose the educational capabilities of the NAPA Service Assistant.

NAPA Service Assistant

The exclusive NAPA Service Assistant drives business by:

- Including hundreds of detailed videos, animations, and articles on all aspects of vehicle repair.
- Making service recommendations easier to understand.
- Providing a fully customizable website – tailored to your shop – which includes: shop special offers, preferred products and available services.

Become a NAPA AutoCare Center and see how this powerful - and included - tool can benefit you.

“NAPA Service Assistant was instrumental in turning a $10 flat tire into a $1600 ticket! The animations within this tool helped us show the customer exactly why the needed repair was so important to do right away.”

–Jason Marsh, Mike Neukomm,and Jeremy Broad of Azar Automotive, St.Louis, MO

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

NAPA AUTOCARE CENTER

ticket of $450. We got rid of half the vehicles, half the chaos, and increased the net profit from 5 percent to where we consistently run 26 percent to 30 percent."

This color system extends to work orders. "Say a consumer's got a coolant leak or needs an oil change," Denmon explains. "That gets written up on a tan ticket. Someone else schedules an appointment for an oil change and an alignment; that gets written up on a yellow ticket. If you're a brand new customer, never been here before, that gets a blue ticket. Now say you'd gotten your car fixed three days ago — an oil pan gasket, but now it's now leaking. That is written up on a red ticket and analyzed."

To help avert the latter, Denmon has the technicians organized into two-man teams, "the thinking being that by working together everyone achieves more on a daily basis," he reports. "If they're struggling then they all put their heads together. They'll confer on the scope pattern; they'll look at this and that and make a decision. For example, we were all up against the wall last week: a car came in running fine, everything worked; we sold the work, we repaired it, we go to start it — and a weak battery lead to a power surge which burned up the body control module and the ECM. It took us eight hours to figure what was wrong, but we worked together as a team.

"Here's the key," notes Denmon. "I think we're utilizing technology, possibly at the highest level in the country. We have all factory scan tools — Honda, Toyota, GM, Ford, Chrysler — whatever the vehicle's manufacturer is, I've got a scan tool. I've got five technicians versed across the board, and all of them can use all of the scan tools. I bring in drivability diagnostic trainers from Chicago every quarter. They spend two days here at the shop; that allows my technicians to build relationships with these people. (When they're not here) these trainers have the ability to get on Skype with the technician and see live what the car is doing. It works really well."

Dominating the remodeled showroom of Dave's Car Care is a giant flat-screen TV, mounted amidst diamond plate and brushed stainless. As an interactive touch screen, it can access the shop's website, display a three-dimensional car that shows how a vehicle in Dave's system works and even pull up parts prices. "We have a $134 an hour flat rate here in Arizona," Denmon explains. "If you charge that much, you'd better look like $134 an hour."

Maybe it can even pull up a good book.

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. *rbravender@comcast.net*

MY CURE FOR INFORMATION OVERLOAD

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

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

Packed with complete OEM repair information and real-world solutions from professional techs, **ProDemand is the only resource you need to beat information overload.**

For more information:
Call us: 800-896-3126 | Visit us: www.mitchell1.com
Or find your local Mitchell 1 sales representative:
www.mitchellrep.com

repair information | shop management | shop marketing

Mitchell1®
In your shop, at your side

Tech community tackles common repair challenges

ALLDATA COMMUNITY SHARES TRENDING QUESTIONS FROM ITS MEMBERS

ALLDATA TECH-ASSIST TEAM //
Contributors

Every day, technicians from across the country post questions and get helpful answers on ALLDATA Community. Due to the sheer volume of data being entered, recognizable patterns and trends quickly begin to develop. The following Tech Tips have been created from some of the most popular, real-world cases that have been solved on Community. If we've seen these issues occur numerous times with these particular vehicles, there is a good chance you'll see them show up in your shop. For more valuable Tech Tips, visit alldata.com/tech-tips.

Envoy stalls when using left turn signal

Vehicle: 2002 GMC Envoy, 4WD, L6-4.2L, VIN S, Automatic Transmission/Transaxle

Mileage: 136,004

Problem: The vehicle stalled only when activating the left turn signal. The customer also noticed that the left headlight was dim. The customer replaced the headlight but there was no change. The stalling problem began to get progressively worse until it happened constantly.

Details: The technician found only 2.0 volts on the ground circuit of the headlight and the left turn signal. Both components were grounded at the same location (G107), which is located on the engine block. Although the ground looked good and tight, the bolt was corroded and a little rusty. The wiring diagram showed that the fuel pump relay also was grounded at the location.

Confirmed Repair: The technician wire-brushed the contact point on the engine block and replaced the bolt and washer. The headlight was now bright and the stalling problem with the left turn signal was also resolved.

Ram in 'Limp' Mode — No power with DTCs P0335, P0642 & P2122

Vehicle: 2006 Dodge Ram 1500, 4WD, V8-5.7L, VIN 2, Automatic Transmission/Transaxle

Mileage 94,587

Problem: Vehicle had DTC faults P0335 for crankshaft position sensor, P0642 for sensor reference voltage 1 circuit low and P2122 for APP sensor circuit. The engine also lacked power.

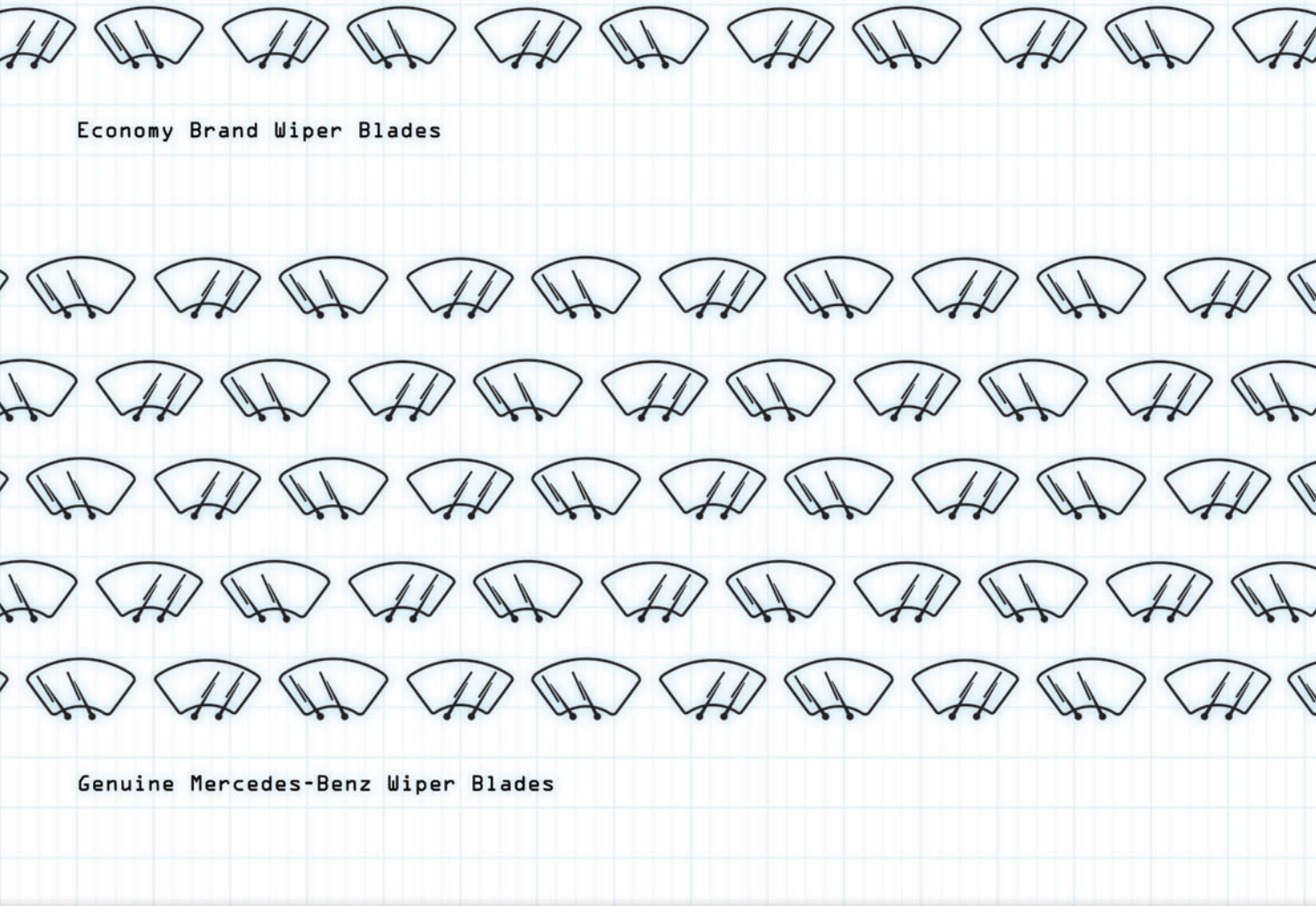
Details: The technician found a wiring diagram included with the P0642 DTC diagnosis chart. All three codes could be set by the sensors residing on the same circuit. The technician tested the circuit to verify a 5-volt reference. The pink/yellow wire was showing only 1.6 volts at the PCM. The technician thought one of the sensors could be shorted, so he disconnected all of them — the wire was still reading 1.6 volts. He then disconnected the pink/yellow wire from the PCM — now 5 volts were coming out of the PCM. Using the wiring diagrams, he located the engine oil pressure sensor that also was powered-up on the same circuit. Once that sensor was disconnected, he finally got 5 volts back at the PCM.

Confirmed Repair: Once the engine oil pressure sensor was replaced, the technician cleared the codes and road tested until all the monitors were complete and the problem was corrected.

Grand Prix lacking EGR flow — DTC P0404

Vehicle: 2001 Pontiac Grand Prix,

>> CONTINUES ON PAGE 24



Some think all wiper blades are the same. This will make it clear.

Genuine Mercedes-Benz Wiper Blades can provide up to 800,000 more wiping cycles than ordinary blades*. Not to mention that every blade has a precise curvature unique to each model, and most have a maintenance indicator on the tip that shows when replacement is necessary. A clear advantage – at a competitive price. This is why you should choose Genuine Mercedes-Benz Wiper Blades. **Contact an authorized Mercedes-Benz dealer or learn more at www.mbwholesaleparts.com.**

MSRP
$58
Part #
A 212 820 19 00

*As compared to economy wiper blades using durability test #PN 103713, which tests wiper durability through 1.5 million wiping cycles.

Mercedes-Benz
The best or nothing.

"To say that the event was a success would be an understatement. Top marks to the instructors chosen."

— AL PLAYTER, CENTENNIAL COLLEGE, ATTENDEE OF WASHTENAW COMM. COLL. EVENT

COUNTDOWN TO
automechanika
CHICAGO

MONTHS 12 WEEKS 03

WATCH + LEARN

Is the coolant still doing its job?

MOTORAGE.COM/Coolant

Manufacturers speak out on training initiative

MOTORAGE.COM/TrainingInitiative

A/C system inspection and testing

MOTORAGE.COM/ACinspection

Exploring dual crankshaft sensor diagnostics

MOTORAGE.COM/Crankshaft

>> CONTINUES FROM PAGE 22

V6-3.8L, VIN K, Automatic Transmission/Transaxle

Mileage: 138,446

Problem: This vehicle came in with DTC P0404, which set right away after clearing. The customer noticed the engine stumbled on mild acceleration.

Details: The EGR valve could be commanded open with a scan tool. The engine stumbled only at idle when commanded to 60 percent. The technician removed the EGR valve and inspected all ports. All ports were clear. Scan tool PID information showed that the EGR position voltage was only 1.75 volts when the valve was commanded to the wide-open position. The voltage at the sensor matched the scan tool data.

Confirmed Repair: The technician replaced the EGR valve. Now the position voltage reached 4.25 volts at wide-open throttle. The DTC was cleared, the vehicle test driven and the problem resolved.

Durability is a four letter word.

No one knows that better than Alan Lambert. He's the guy tasked with making sure MOOG parts are ready for the toughest road conditions. MOOG parts are engineered, tested and built for unmatched durability, but if they don't pass his demanding standards, they don't make it out the door. And while that doesn't always make him the most popular guy in the room, he knows that going the extra mile is always the right thing to do.

Watch Mike and Alan talk durability in our new web series, The Extra Mile, at moogparts.com

#partsmatter

MOOG®

Go the extra mile.™

FEDERAL-MOGUL MOTORPARTS

SOCIAL INSIGHTS

MASTERING IN-CYLINDER PRESSURE TESTING: PART IV

This simple technique has changed the way the internal combustion engine is diagnosed around the world. If you are not aware of the power of this simple truth, read the *Motor Age* articles "Mastering In-Cylinder Pressure Testing" I, II and III. These articles cover the basics of in-cylinder compression waveforms at crank, idle and snap throttle.

Go here to read Part IV: *Motorage.com/InCylinderTesting*

WHAT YOU WANT TO KNOW ABOUT ASE TESTS BUT DON'T KNOW WHO TO ASK

This roundtable discussion gives you access and insight from a working technician (subject matter expert), a director of training and an ASE test administrator. Whether you're ASE-certified or looking to start your certification testing, you'll learn a lot about every aspect of the tests. This is a very powerful look inside the ASE tests that will open your eyes as to what it takes to create the tests and administer them. ***Download the discussion here***: *Motorage.com/ASEpodcast*

WHICH WAY TO GO?

In this article, contributor Jaime Lazarus discusses The steps, tools and redundant tests performed to prove without a doubt what was causing the customer's complaint of recurring MIL illumination. ***Read his story here:*** *Motorage.com/WhichWay*

TRAINING AUTO TECHNICIANS IS KEY TO SERVICE CENTER GROWTH

In his column, "Auto technician training is competitive edge," Aftermarket Business World columnist Larry Silvey says that properly trained auto technicians can provide a competitive advantage to independent shops and dealerships that are trying to boost their service repair business. ***Go here to read more:*** *Motorage.com/KeyToGrowth*

AVOIDING A WHOOPING

"My last butt whooping came from my son's 2007 Toyota Corolla CE," says Technical Editor Pete Meier in this article on tackling tough problems. "Now that I get to tackle problems for fun, it should be even easier. Or so I thought." ***Read the rest of the story here:*** *Motorage.com/AvoidAWhooping*

TRAINING EVENTS

AUGUST 9-13
2016 NACE/CARS Expo; ***Anaheim Convention Center***
Anaheim, California

SEPTEMBER 16-18
2016 CAN Conference; ***Westin Chicago Northwest***
Ithasca, Illinois

OCTOBER 8
AERA Conference; ***Speedway Motors Museum of American Speed***
Lincoln, Nebraska

OCTOBER 15
Automechanika Chicago LIVE — Training Event;
Fox Valley Technical College
Appleton, Wisconsin

NOVEMBER 1-3
AAPEX; ***Sands Convention Center***
Las Vegas, Nevada

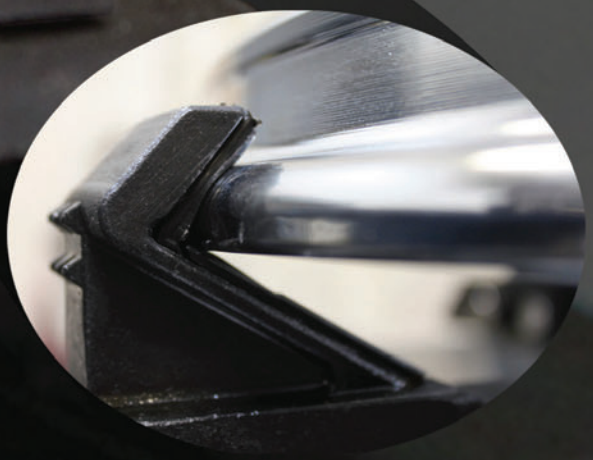
NOVEMBER 1-4
SEMA; ***Las Vegas Convention Center***
Las Vegas, Nevada

NOVEMBER 19
Automechanika Chicago LIVE — Training Event;
Joliet Junior College
Joliet, Illinois

Make an impression without leaving a scratch.

Hello RimGuard

Still afraid to service powder coat wheels and expensive alloy rims? Be scared no more because Ranger tire changers feature non-marring RimGuard™ wheel clamps*. Permantly attached Polymer and Urethane shields protect delicate wheels and are adjustable to accommodate rim sizes ranging from 9" - 30". Put aside your worries - not those expensive wheels. Contact your local BendPak/Ranger dealer or call **1-800-253-2363.**



See it on YouTube Search "Ranger Rimguard"

www.bendpak.com/rimguardwheelclamps

Ranger

This is my BendPak

There are many, But this one's ~~mine~~. Ours

"Having BendPak lifts is a valuable asset to us. It helps us keep our cars the fastest in the nation. No matter what we're doing, BendPak is what we use."

- Bobby Ducote, Kye Kelley & Scott Taylor from TV's "Street Outlaws-New Orleans"

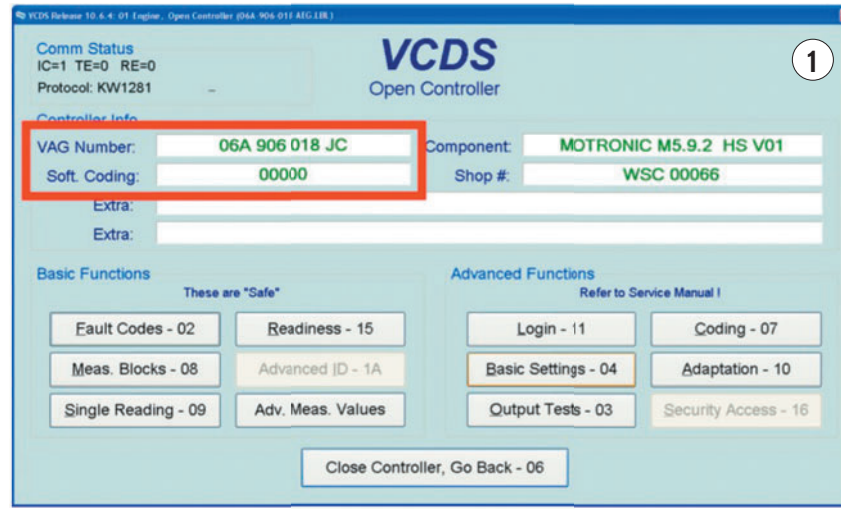
BP BendPak®

For more information on BendPak's entire product line, call 1-800-253-2363 or visit www.bendpak.com

GET WITH THE PROGRAM

SMART SHOPS ARE TAKING ADVANTAGE OF THE SERVICE OPPORTUNITIES THAT REPROGRAMMING OFFERS. ISN'T IT TIME YOU DID THE SAME?

ERIC ZIEGLER // Contributing Editor



Now more than ever, is the time to "get with the program", both figuratively and literally. Almost all modules on most OEMs require some sort of configuration, coding, adaption or programming. Gone are the days of the removable EPROM and here to stay is the Electronic Erasable Programmable Read Only Memory or EEPROM. The EEPROM is the device or chipset that allows manufacturers and repair facilities to write and rewrite programming instructions to a module.

Before we can totally appreciate this technology and have a discussion on how to program, we need to discuss some of the definitions and differences between coding, adaptation and EEPROM flash programming. Moreover, we need to examine what J2534 is and how it applies to us in the independent auto repair world.

Coding refers to the process in which we "tell" the module that is already programmed some of the characteristics or configurations the vehicle has. These could be whether the vehicle is equipped with an automatic or manual transmission or if the vehicle has cruise control or not. In either case the module already is "programmed" with either option; we simply need to "tell" the module the configuration that applies. This procedure has been found on European vehicles for quite some time.

The offline coding process does not require a subscription or programming calibration files to be purchased. The coding process is a fairly simple one that can be carried out with an OE and often times an aftermarket scan tool. The following example is a 1999 VW Jetta in which the PCM (or J220 module) was replaced with a used part. This is the information from the original PCM – note the coding number (**Figure 1**).

Here is the replacement used PCM information. Note the difference in the coding number (**Figure 2**).

The Ross-Tech Wiki provides information on coding this module, including the required log-in (**Figure 3**).

After logging in (a scan tool function, not a subscription based procedure – **Figure 4**) one is able to then manually change the coding or to tell the PCM whether the vehicle is a manual or auto transmission for this example (**Figure 5**).

Selecting "Do it!" after changing the original PCM coding from "00001" to "00000" configured the PCM for a manual transmission rather than the auto transmission vehicle that the donor PCM came out of. No flash files, subscriptions or expensive OE tools were required to perform this procedure.

Adaptation refers to something that we are going to learn or "teach in" to a module. Again, the module is already "programmed" with the instructions the vehicle needs. This could be differ-

PHOTOS: ERIC ZIEGLER

ent values such as key adaptation, where we "teach in" or adapt the number of keys and their associated IDs to a module. Throttle values, such as TP and APP, are often values that require adaptation after a module has been changed. Adaptation in many cases can be performed with a scan tool.

In this example, a 2004 VW New Beetle required that the passenger's seat recognition or passenger presence values to be adapted to the airbag module (address 15). This procedure basically "tares the scale" or sets the zero point for an unoccupied seat in the airbag module (**Figure 6**). This adaptation was done with the very affordable Ross Tech VCDS aftermarket VW/Audi tool.

EEPROM programming is what is generally considered "flashing" or "programming" a module. This is the process by which we can either write the original programming required for a vehicle to run or rewrite or change the original calibration to update the software for some sort of running change the OE would like changed in the instructions the module runs on. This could be something as simple as changing a parameter to keep a code from setting or enhancing how a system works to reduce wear on parts.

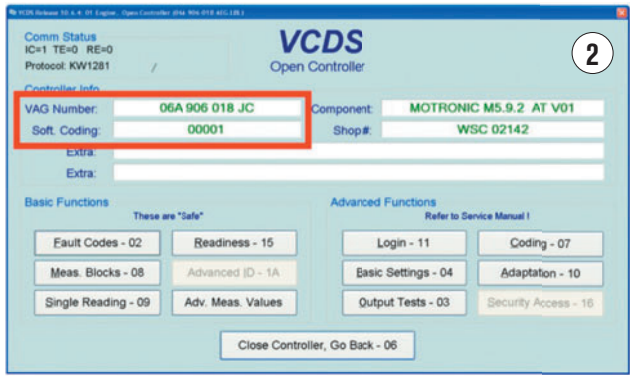
Often a re-calibration can be required when installing updated or redesigned parts. If the parameters of the redesigned part changes, the instructions inside the module have to change as well. For example, if an old TPS on a vehicle operates between .9 and 4.4 volts and the redesigned TPS now functions at a different range, say .5 to 4.9 volts, we need to tell the PCM about this change so that erroneous TPS high or low DTCs do not set due to the changes made to the updated part.

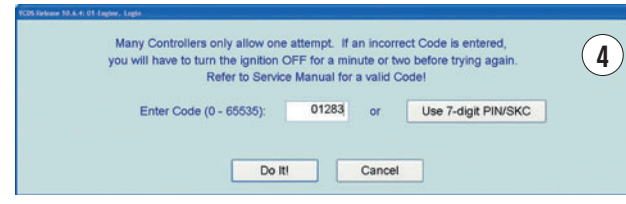
J2534 is the process which allows us in the independent auto repair world to accomplish this. To better understand what J2534 is and how it applies to us we need to examine it a little further.

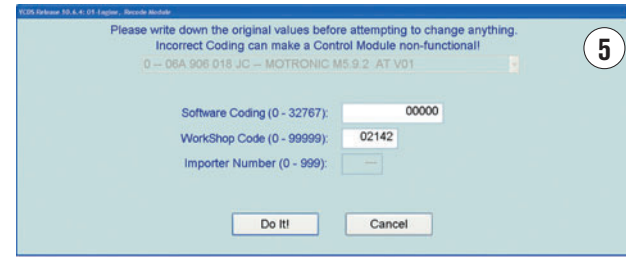
J2534

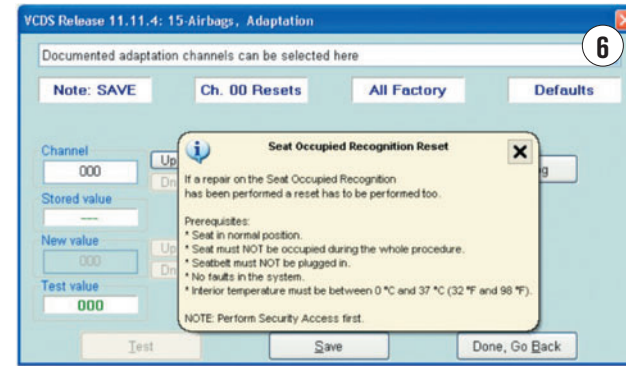
J2534 and its subsequent revisions are an SAE document that set forth the standard for module programming for the independent auto repair industry. It basically was a covenant or agreement that allowed the OEMs to retain ownership and control access to their proprietary software, the 0s and 1s, which control how the vehicle performs and allowed for a universal programming device to perform the programming in lieu of an OE scan tool or interface.

While you may be the owner of a vehicle and the sum of its hardware, you DO NOT own the software or 0s and 1s (binary code) that make their modules function. The OEM is the owner of the software or calibration files. This is why the crash data in a SDM in your vehicle





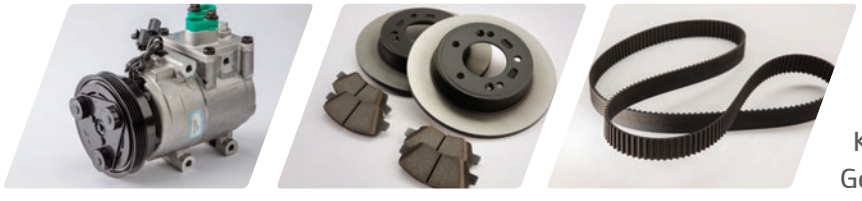




KIA | Genuine Parts

ACCEPT NO IMITATIONS.

You can rely on Kia when it comes to replacement parts. Don't settle for imitations, give them the real deal with Genuine Kia Parts. High Quality and Excellent Fit at a Great Price. CHOOSE KIA!



From headlights to tail lights, to transmissions and compressors, there's just no substitute for genuine. And the ONLY place you can purchase a Genuine Kia Part, backed by the Kia warranty**, is from your local Authorized Kia Dealership. Don't get stuck selling counterfeit and parts not covered by the Kia factory warranty – contact your local Authorized Kia Dealer today for Genuine Kia Parts and Genuine Kia Reman Parts.

WE OFFER NOTHING BUT THE BEST!

Dedicated wholesale staff → **Most parts are in stock** → **Competitive pricing**

Find your local Kia dealer today! **www.kia.com**

** Kia Genuine replacement parts (except battery) sold by an Authorized Kia Dealer under warranty are covered for the greater of (1) the duration of the New Vehicle Limited Warranty or (2) the first 12 months from the date of installation of the Kia Genuine replacement parts or 12,000 miles. Labor charges not included when not installed by an Authorized Kia Dealer. Warranty is limited. See Kia's Replacement Parts and Accessories Limited Warranty for further details.

could be extracted and used against you in a court of law. This matter of proprietorship by the OEMs is what actually drove the SAE J2534 document into being. Simply stated, it allowed the OEMs to retain ownership and control access to the calibration files and granted the aftermarket access, usually for a fee, and called a common device that could be used on many different makes provided the device was validated for the said makes.

For years the cost of programming modules in the independent repair world was cost prohibitive due to the fact that an often expensive OE scan tool and subscription were required. Even in the early years of J2534, subscriptions were annual and not available for purchase in short-term intervals. GM for example, in the early years was only available at an annual cost of more than $1,000. As time progressed, a quarterly option was offered and then a two-day subscription became available.

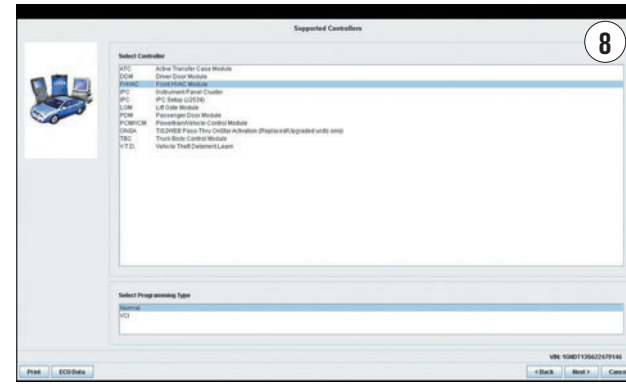
While flashing with a universal J2534 device has been around for more than 10 years now and has made great strides of improvements, there are sometimes limitations to it. The SAE J2534 standard only addressed the programming of the powertrain modules specifically. You might not be able to program modules other than powertrain with a universal J2534 device. Consequently, you may be able to successfully program a module with a universal J2534 device and still have issues that require an OE factory scan tool to complete the task, such as adaptations or immobilizer functions that may keep the vehicle from starting or running correctly.

Reprogramming do's and don'ts

Regardless of whether you are using a J2534 interface or the OE factory tool, some flashing "universals" apply. You should always adhere to these steps to help ensure a successful flash. Make sure to maintain a steady clean source of DC power with a flashing power supply such as a U Maintain (**Figure 7**) from AESwave.com or a Midtronics PSC 550 (DO NOT use a standard battery charger).

Make sure the connections to the battery are clean and tight. Verify that your laptop connections are secure and the laptop is plugged in using the AC power cord. Verify that your

7


8

automatic updates and any screen savers are disabled. Check your computer's power management settings to safeguard the laptop doesn't shut down due to inactivity before the flash completes. Keep Java and Adobe up to date. Most importantly READ and follow all the manufacturer's instructions to the T.

So let's start by examining what is required to do a J2534 module flash. We obviously need a J2534 compliant interface such as a Drew Tech Cardaq Plus II or a Mongoose USB interface. A computer is going to be required, preferably a laptop due to its portability. Be sure you check the OEM's website for computer requirement such as RAM, OS, HDD size and CPU processor speed. The API or unique manufacturer specific application has to be downloaded from the OEM's site, which will install the necessary drivers and protocols that will allow us to program their J2534 compliant modules. A reliable high-speed internet connection is a must. Wireless can be used if it is stable and does not drop out. If you have any doubts regarding your wireless connection, use a wired connection direct to your router. Finally, a steady source of clean DC power is a must, I CANNOT stress this enough! Nothing can "brick" a module or render it permanently unusable faster than low voltage once the flash process has begun.

So how do we get to the point of knowing a flash is required? Many times it may be required with a module replacement. For example, say an injector driver has burned up in a GM PCM and is causing a misfire due to an injector that the PCM can no longer pulse caused by an internal module failure. GM PCMs come blank lacking the operational software required. The new module in most cases will require that we program it before it will work. Other times, in the case of a re-calibration to correct a software issue in a module, we may be directed to do so by a Technical Service Bulletin (TSB).

In the following example the vehicle in question is a 2002 Chevrolet Trailblazer. The A/C is intermittently inoperative, and it seems to manifest itself when the A/C is needed the most at high ambient temperatures. The shop has already replaced the A/C pressure switch per TSB 03-01-39-007. The problem

NOTHING GETS BY YOU. THIS GUY AND HIS DUCT TAPE, NOT SO MUCH.

As a professional, you know cheap fixes and shoddy filters just won't cut it. At Purolator, we're dedicated to providing the quality products you need to get the job done.

PurolatorTECH™ is the new standard in professional grade oil filters with 99% VIO coverage and OE fit, form and function. So you can worry less about your customers' engines and get back to fixing cars the right way.

NOTHING GETS BY US.™

pureoil.com

PUROLATOR

persists when high ambient temps are present. After a little more digging, TSB 02-01-39-005a was discovered, addressing this concern.

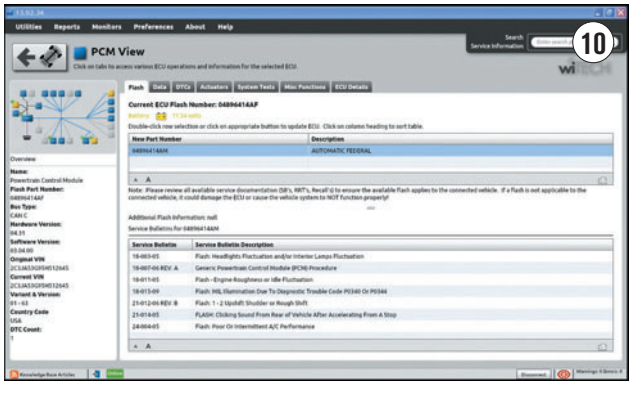
A subscription to TIS2Web will be required and GM's SPS or Service Programming System will be used to update the HVAC module with the latest calibration (**Figure 8**).

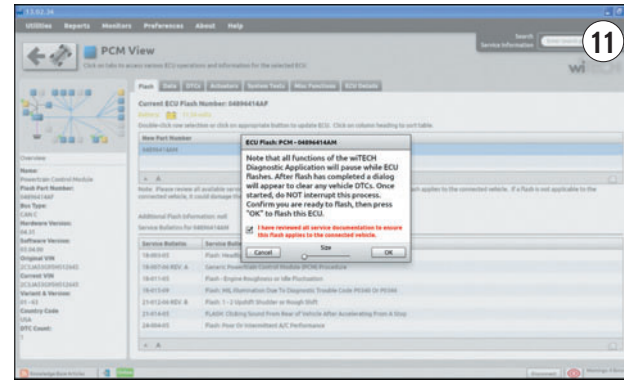
The correction was to re-calibrate the HVAC module with the latest calibration via SPS. If TSBs were not checked as part of the diagnostic process, a great deal of time and money could have been spent on this vehicle.

OE tools — a benefit

The J2534 flash process has come a long way since its introduction and works well on a lot of vehicles, but there are limitations. The OE factory scan tool usually is my tool of choice just because I know that it is what the dealership uses to perform programming options and it is not an adaption of programming software to suit the independent repair market's needs. Oftentimes the OE tool is more intuitive, more reliable and simpler to use, which is definitely the case for Dodge/Chrysler/Jeep products. The wiTECH scan tool platform makes it very simple to see if there is a flash available for a module and the process of updating it is explained step by step to the user.

The following example is a 2005 Chrysler 300 with an issue with the interior lighting flickering at times that TSB 18-003-05 addresses. The wiTECH session is started and all the modules





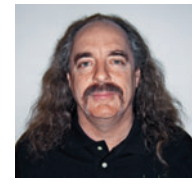
are shown on the home screen along with the network topology. Note the "lightning bolt" symbol (**Figure 9**) on some of the modules — this indicates that a flash is available to correct an issue.

Clicking on the PCM icon opens the functions for the PCM. Selecting the "Flash" tab will not only tell me the calibration number that is in the PCM but will give me the most current calibration number and the corresponding TSB that goes along with it (**Figure 10**). At the top of the list is the TSB 18-003-05 for interior and exterior lamp flickering. Note all the other TSBs and corrections that the updated PCM calibration addresses as well.

The flash process is started. Special instructions are given and are to be reviewed and the box checked before the actual downloading can occur (**Figure 11**).

The calibration update procedure successfully completes and codes are cleared. Note the status of the modules are now blue, indicating no codes are present, and the lightning bolt is no longer present, as the PCM now has the most current calibration installed in it.

There are countless examples I could give for vehicles that require coding, adaptation, configuration or EEPROM flash programming. The question is not should you as a repair professional be performing these procedures, but rather why are you not performing this necessary and profitable service? While programming requires a little attention to detail and following instructions, so does installing a timing belt or timing chain on an expensive "zero clearance" multi-cam overhead valve engine. Our industry has always been evolving and changing with the technology of the times. Programming is no different. Flashing modules is not going to go away and there has never been a better time "to get with the program" of flashing modules.



ERIC ZIEGLER is an ASE Certified Master Tech who specializes in module programming, drivability, electrical and network systems diagnostics. He owns and operates EZ Diagnostic Solutions Inc.
eric@diagnosticsolutions.com

With today's telematics technology and diagnostic equipment, automobiles have the ability to speak their minds and tell us what they need. This newly opened line of communication is revolutionizing the entire automotive aftermarket world.

AAPEX 2016 will come equipped with all the latest training and tools to help you keep up with the conversation and improve your bottom line.

Cars are talking telematics. We should too.

To learn more, visit www.aapexshow.com/adv

aapex
ahead of the curve

#AAPEX16

AAPEX 2016, Nov. 1–3, at the Sands Expo in Las Vegas. AAPEXedu sessions begin on Oct. 31, 2016.

MASTERING GAS DIRECT INJECTION

DIRECT INJECTION, OF COURSE, means the injector sprays INSIDE the cylinder. Note the position of the injector straight across the head from the spark plug. What will keep the valves clean? Fuel certainly won't be doing that job as was the case with MPI/SFI.

LEARN MORE ABOUT THE REVOLUTIONARY FUEL SYSTEM THAT IS HERE TO STAY

DAVE HOBBS // Contributing Editor

Gas Direct Injection (GDI) is sometimes referred to as Direct Injection (DI). Placing a fuel injector directly into the combustion chamber and bumping fuel system pressures into the thousands of PSI makes a lot of difference in both vehicle operation and how we approach diagnostics. GDI engines have compression ratios up to 12:1 (vs. 10:1 for most engines) and can deliver A/F ratios ranging from 14.7:1 to as lean as 40:1. For many years, GDI was an oddity on a very small number of cars dating back decades. It has become so common now, however, that if you purchase a new vehicle there's a very good chance you'll own your first GDI-equipped ride. We'll cover some operational and diagnostic highlights for GM and Ford in this article.

Injector: Fast and furious

Electrically, a typical GDI Engine Control Module (ECM) controls the injector by providing a ground along with high-side driver activation. The PCM amplifies the 12-volt supply by using a capacitor to store and discharge a 50- to 90-volt pulse of stepped up power. GDI injector coils are typically around 1.5 ohms and can be pulsed quite quickly — as fast as 2ms between pulses. Doing the Ohms law math or simply connecting an amp clamp to an injector circuit will indicate a very quick pulse or series of pulses that are as high as 10 amps. Pulse widths (injector on time) for GDI are much lower (0.4 to 5ms) compared to MPI / SFIs 3.5 to 20ms. Multiple injection events can occur during the exhaust stroke, intake stroke, compression stroke or even during the power stroke. The number of sprays along with the exact timing of the sprays is determined by the ECM based on engine load, throttle angle delta, coolant/air temperature and rpm, along with the desired spray mode.

PHOTOS: DAVE HOBBS

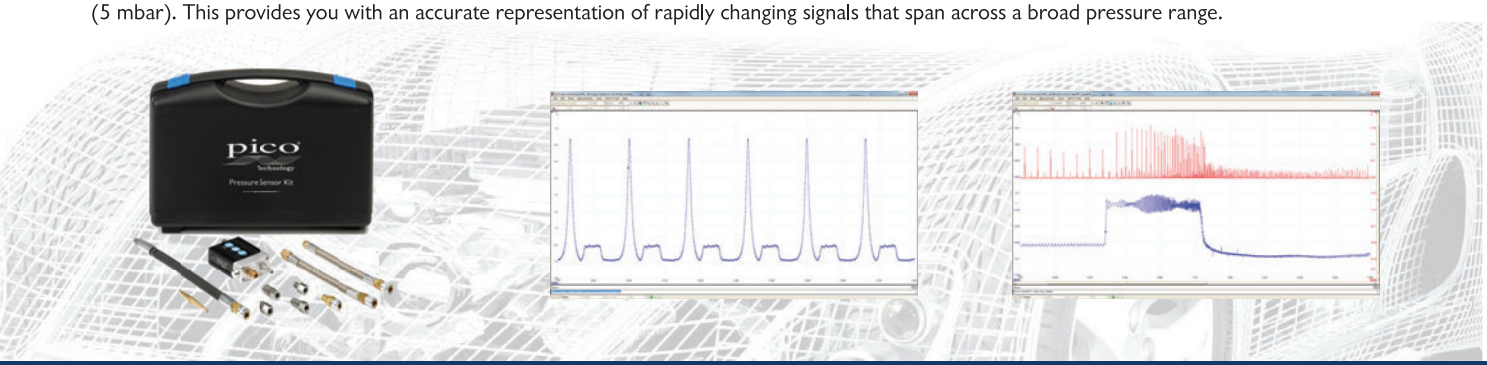
Pressure Sensor

With the uncompromising resolution and accuracy of the WPS500X Automotive Pressure Transducer you can perform quick and accurate pressure analysis of many automotive systems.

- Accurately measure up to 500 psi
- Ultra-fast 100 µs response time
- Zoom function for enhanced analysis capabilities
- Rechargeable LiPo battery
- Integrated pressure relief / bleed-off valve
- Auto zeroing
- High noise immunity
- Temperature compensated

Replace several tools with one!

The WPS5000X features an extremely fast 100 µs response rate from 0% to 90% of full scale and sensitivity down to about 0.07 psi (5 mbar). This provides you with an accurate representation of rapidly changing signals that span across a broad pressure range.



WPS500X Automotive Pressure Transducer

PicoScope®

pico Technology

THE NEXT GENERATION OF PICOSCOPE

See more
With 12-bit resolution
to capture every detail

Do more
By fixing it right first time

Be more
With the most advanced
automotive scope to date

OSCILLOSCOPE DIAGNOSTICS

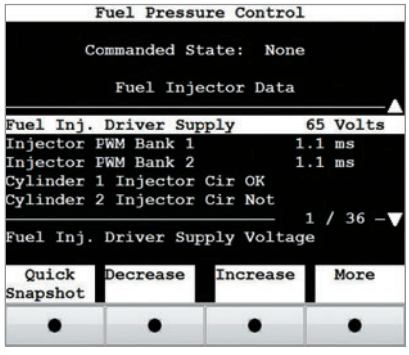
For more information call us at: 1-800-591-2796 or visit www.picoauto.com

IMPORTANT SAFETY NOTE: Both diesel common rail and GDI injectors have voltage and current levels that could be injurious or lethal (over 60 volts). Treat them like an orange cable on a hybrid or electric vehicle — don't touch! When applying a back probe pin, for example, do it with the engine off and don't touch when running.

Homogenous and stratified: The modes of injection

Homogenous means well mixed/consistent A/F ratio, while stratified means layered or uneven A/F mixture throughout the cylinder. With a typical Bosch GDI system used in a late-model GM vehicle, those main injection modes are broken down into six subtypes:

BETTER FUEL ATOMIZATION is the goal. The shape of the piston dome and locations/angle of injector location help to determine if the spray is wall guided, air guided or spray guided.



THE VOLTAGE OF GDI INJECTION is similar to many high pressure diesel common rail injectors. Fifth to 65 volts combined with currents of up to 10 amps could prove injurious or even fatal if conditions are right. Treat back probing GDI and Diesel injectors like hybrid electric vehicle high voltage components — don't touch when live!

1. Homogenous Mode

This mode sprays a very even air fuel ratio throughout the combustion chamber. If the A/F is 14.7:1 (Lambda 1), then you'll find that A/F under the spark plug and at the outer wall of the cylinder. This type of spray typically is used during high speed/high torque conditions and is accomplished with a single spray.

2. Homogenous Lean Mode

This mode is similar to homogenous mode with the main difference being an A/F > Lambda 1. In other words, the A/F is higher (leaner) than 14.7:1.

3. Stratified mode

This mode allows for a leaner mixture and is usually used during WOT and occurs just before the spark event during the compression stroke. The good news is lower fuel consumption, with the bad news being limited torque and the production of soot. Think soot and then think about engine oil. We'll address an ugly topic associated with that later.

4. Homogenous/Stratified Mode

This mode is used during lower rpm acceleration giving a double injection — one spray during the intake stroke (homogenous) and the other during the compression stoke (stratified). This mode gives the best of both modes — higher economy/lower emissions coupled with smooth torque.

5. Homogenous Knock Protection Mode

This mode occurs during lower RPM acceleration and uses two injections – one during intake and the second during the power stroke. The latter lowers the combustion temperature, thereby limiting knock (and NO_x production) without the need for spark retard. Emissions and economy gains are realized.

6. Stratified Catalyst Heating Mode

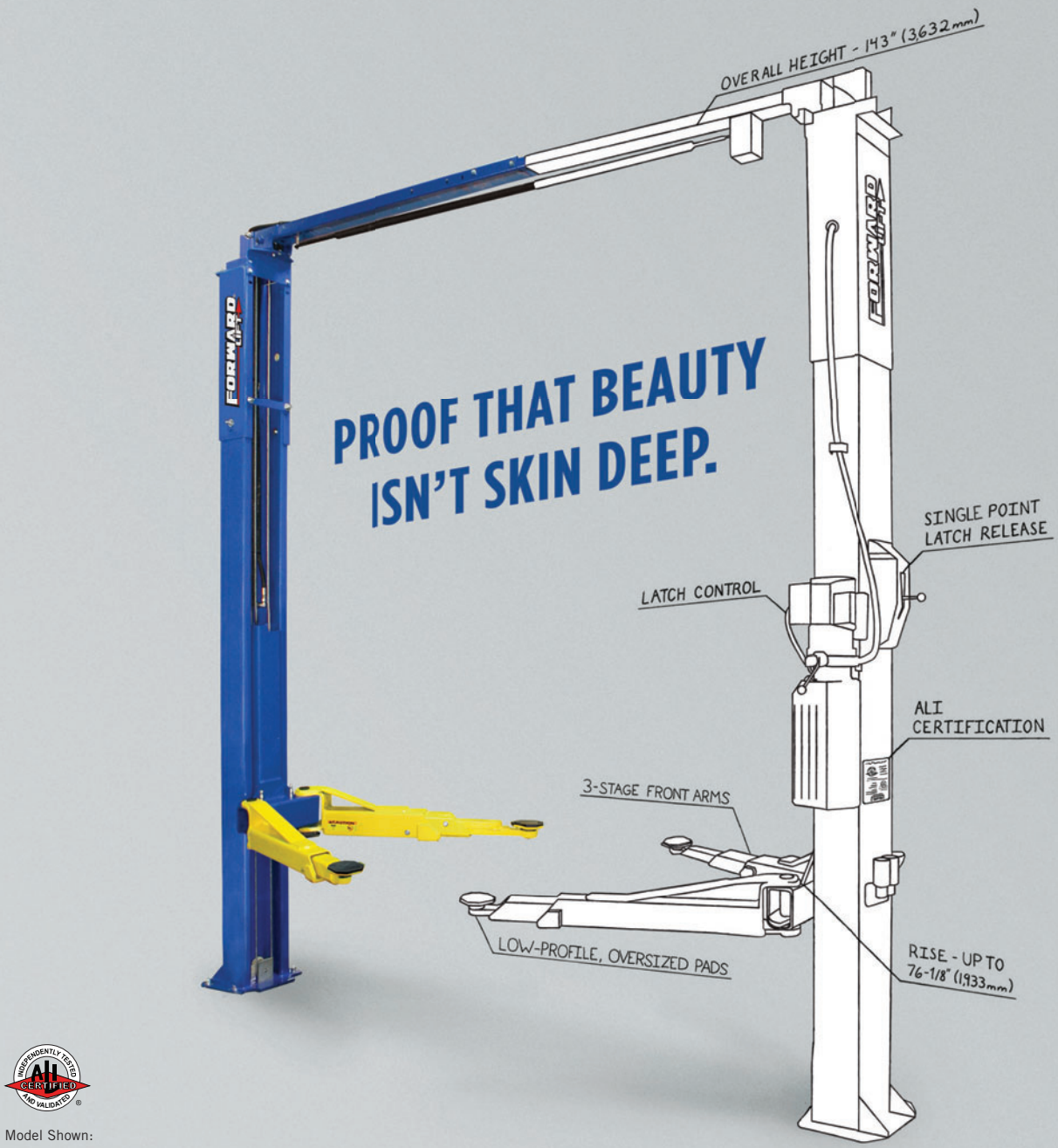
Spraying fuel into the cylinder that late in the game is the equivalent of killing spark — the cat will heat up to 1,300 degrees F. This mode fires two injection sprays — one just before the power stroke and the other just after the power stroke. For early cold start cat light off, this proves to be desirable.

Enter the GDI spoiler — Intake carbon deposits

Soot production along with blow-by gasses (PCV) and internal EGR (via variable valve timing) all are factors for not only emissions but also the engine oil's condition. The breakdown and contamination of engine oil then has an effect on the intake valve carbon deposit issue that these engines are becoming (sadly) well known for. Compounding the situation is the habit of many customers to follow their less-than-accurate oil life monitor when deciding when to change their oil.

Adding to that issue are the various synthetic and semi-synthetic (GM Dexos) oils that give customers a false sense of "I almost never need to change my oil." This means everything from sludged-up variable valve timing oil control solenoids to high-pressure fuel pump cam followers wearing out. The follower has been known to stick to the high-pressure pump due to oil sludging. If the pump is being replaced, watch out for this so you won't make the mistake of installing a new pump without the follower. A very noisy and poor running engine will be the result.

Remember the fuel injector in a GDI engine is not spraying fuel against the back of the intake valves as in the case with MPI/SFI. When the correct fuel and fuel additives were used with MPI/GDI, the valves stayed clean. In the early 1990s, detergents added to gasoline to reduce injector clogging sometimes had a side effect of creating deposits on the back of intake valves. Before the gasoline industry could react with additives such as Techron to prevent this, technicians working



Model Shown:
FWD I10N100MBL
10,000 lbs. capacity

It's okay if we caught you looking. Because the same lift that you can't stop staring at is also intelligently engineered with all the bells and whistles of higher-priced models. So not only is Forward Lift dependable, but it can save you a pretty penny.

See our full line of products at forwardlift.com/ma

FORWARD LIFT

Engineered to perform...Built to last!

RANSHU

JOHN DEERE
10PA17C
14-0076NC

ISUZU
DKS15D
14-0403NC

JOHN DEERE
10PA15C
14-0275NC

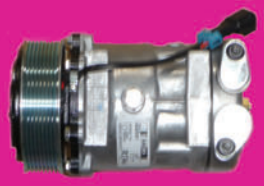
TRUCKS
YORK
14-2125N

HEAVY DUTY COMPRESSORS FOR H. D. EQUIPMENT

PETERBILT
SANDEN
14-SD4039NC

CATERPILLAR
SANDEN 24V
14-SD4604NC

KENWORTH
SANDEN
14-SD4667NC



FREIGHTLINER
SANDEN
14-SD4418NC

SPRINTER
7SB16C
14-2986NIP

STERLING
SANDEN
14-SD7804NC

800-628-0474 OR **RANSHU.COM**

on MPI vehicles with hesitations and cold-start stalling had to take the cylinder head(s) off the engine so the valves could be removed and cleaned with a wire wheel.

A device used on pre-WWII German aircraft engines (yes, carbon deposits on intake valves really date back that far) was resurrected for re-adaptation on early '90s automobile engines. That device was known as the carbon blaster. It uses shop air and a fine media of ground-up walnut shells.

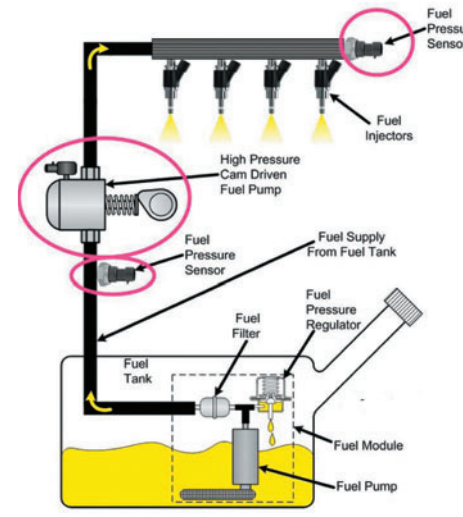
Blasting against the closed intake valves one cylinder at a time (TDC compression) though the injector bore in the intake manifold (fuel rail removed) caused carbon to dislodge from the backs of the closed intake valves. A shop vac was part of the system to draw out the media (and dislodged carbon) to complete the job for that cylinder. Walnut shells are the same media used to polish brass casings when reloading ammunition and can be purchased at large shooting supply/sporting goods stores.

Early adopters of GDI (VW, Audi, etc.) seem to have the worst record of the carbon problem, while later adopters have had time to change the injector position and spray timing in order to reduce intake valve carbon deposits. Lean tip-in hesitations and cold engine misfires are typical symptoms of the problem. Running a Volumetric Efficiency test on the engine can be useful to determine how bad the deposits are on a particular vehicle. They can coat up so heavy that air has a hard time getting into the combustion chamber. Otherwise, unless you have a fully articulating borescope that allows you to bend the camera 180 degrees once it enters the cylinder through the spark plug hole, you are going to have to remove the upper intake and take a peek at the valves.

Injector R&R

Injector replacement can range from easy to tricky. Besides the lack of ease of access to the rail and injectors, there may be a carbon ring around the injector tip (think Ford Triton engine spark plugs) requiring the factory tool to evenly pull the rail from the head or yank them out with the factory adapter and a slide hammer. GDI injectors use a traditional O ring on the top and a Teflon seal on the bottom side that fits in the cylinder head, the latter of which will require replacement when the injector is pulled prior to returning it to the head. A special tool allows for the stretching of new Teflon seals in order to slip them over the injector tips prior to installation.

IMPORTANT SAFETY NOTE: Always depressurize the high pressure fuel system prior to servicing to avoid the potential for personal injury.



THE ITEMS CIRCLED IN RED are electrical PIDs you can see with your scan tool. Rail pressure, high pressure pump control valve solenoid and low pressure fuel supply. All of those variables combine with injector pulse duration, pulse count (how many times it sprays) and injection timing (exactly when during the four strokes) combine for precision fuel control. Quite a bit more complex than SFI? You bet!

Both diesel common rail and GDI systems use high pressures. With GDI, these pressures can range from as low as 500 PSI to as high as 3,000 PSI. That's as high as a pressure washer. If a GDI high-pressure line is cracked loose and you have a hand, arm or eye near a tiny high-pressure stream of fuel, that high pressure stream of fuel can act like a pressure washer with a cutting tip. The difference being the GDI system will inject gasoline into your body via a severe laceration instead of water. The laceration can be stitched up at the hospital. The ensuing blood poisoning from the gasoline could result in anything from an extremely painful recovery to limb amputation or even death.

Methods to depressurize GDI fuel systems

First, just read the manual and do what the OEM says. You can never go wrong with that. Otherwise, logic says you could do any of the following to accomplish a high pressure fuel system bleed off.

1. Disconnect the fuel pump fuse (for the low pressure in tank electric pump) and run the engine until it stalls from running out of fuel. Observe the scan tool PID for actual rail pressure. Begin your service of the fuel system when the pressure PID reads 0 PSI.

2. Use a scan tool to command the in tank electric pump off and run the engine out of fuel. Make sure the scan tool shows 0 PSI for actual fuel rail pressure.

3. No Scan Tool PID available? Let the vehicle sit for two hours for the system to naturally bleed off pressure prior to fuel system service.

High and low sides — just like A/C systems

LOW SIDE: GDI systems use a low pressure side to move fuel from the tank to an engine mounted mechanical high pressure pump. GM uses a fuel pump control module that is CAN bus controlled. Some Fords use a fuel pump control module that receives commands from the PCM via a dedicated pair of digital

FEELS LIKE THE FIRST TIME

Wagner QuickStop™ brake pads are designed, tested and certified to ensure a vehicle's braking system is restored to original equipment performance. All Wagner QS pads undergo our OE post-curing process to deliver the most consistent braking and stopping power, no matter where the road takes you. Find out more at ***wagnerbrake.com.***

#partsmatter

WAGNER QS™

FEDERAL-MOGUL MOTORPARTS

signal circuits. One circuit has a pulse-width modulated signal from the PCM to the fuel pump control module with the pump speed/low pressure request. The other signal is from the module back to the PCM to report module status. The power supplied from either the OE's fuel pump control module to the in tank modular fuel pump is usually PWM at a frequency of several thousand hertz. Typical low side pressures run between 50 and 60 PSI.

HIGH SIDE: The high-pressure pump is the heart of a GDI system. A cam lobe at the back of a cam (cam in block or overhead) is dedicated to actuating the high-pressure pump. There are variations of lobe designs. GM uses three lobes. The cam's position is correlated with activating a pressure-control solenoid mounted on the pump. GM calls this solenoid a Fuel Rail Pressure Regulator while Ford refers to it as a Fuel Volume Regulator.

The solenoid allows the incoming low pressure from the low-pressure electric fuel pump to either be pressurized by the mechanical pump and applied to the common rail or spilled back to the incoming source. The low-pressure fuel source can open a mechanical check valve inside the pump to be applied to the rail in the event the solenoid is non-operational. This limp home pressure is strictly from the in tank pump.

I have tested GM systems by disconnecting the high-pressure pump regulator connector and the vehicle had a hard time even starting. Driving was out of the question. I've also tested some Asian vehicles with the same disconnect and the vehicle ran great until you tried to accelerate. The lack of high pressure resulted in a severe power loss (and high fuel trim numbers) that mimicked a plugged catalytic converter. When removing the HP mechanical pump, the steel lines connecting the high-pressure pump's output to the fuel rail should not be reused due to the potential for a future leak. So remember to order new connection lines/fittings when placing a HP mechanical pump.

TECH TIP – A quick way to determine if a vehicle has GDI? If you can't see the injectors without some engine disassembly, it's probably GDI. This GM V8 hides the pump as well as the injectors and rail. Lots of thick foam insulation covering some of these components can help prevent unwanted sounds that some swear is lifter tick. Don't forget to put it back when you perform service on these engines.

Diagnostics and scan tool PIDs

What should you watch for on a scan tool when diagnosing a GDI problem?

1. DTCs (of course)
2. Low-side fuel pressure PID. Is it within specs?
3. High-side desired pressure vs. actual. Are they very close?
4. Fuel Trims. Fuel is still fuel and O_2 sensors still help the ECM make A/F corrections regardless of how complex the fuel system is.
5. The duty cycle sent out from the fuel pump control module to the low-pressure electric pump. A case I observed on iATN forums showed how the mechanical wear of the GDI pump/cam follower resulted in a slight error in HP rail desired pressure vs. actual. The ECM took the opportunity to increase the low-pressure fuel supply via a higher duty cycle output from the fuel pump control module. This resulted in covering up the problem with the HP pump until the low pressure in tank electric fuel pump could not put out any more pressure to assist in compensating for a weak HP mechanical pump.
6. Check the current ECM calibration level against what's in TSBs and in the case of GM, what's in the GM CAL ID look up website as well. A calibration update is sometimes the only way to fix a problem!

GDI PUMPS USE A CAM FOLLOWER that are either roller (shown) or flat design. It is located between the pump piston/spring and cam lobe. This can be a high failure item. The flat design can even wear to the point of wearing a hole through the top. Sometimes this failure will make a sound you swear is a rod knock when the engine is fully warmed up.

The bottom line with GDI

Funny thing — I've worked on GDI vehicles, developed training on GDI and even owned two, both of which had problems. The more I research this fascinating new type of fuel injection system, the more I realize how much I still have to learn regarding the details and variations from one GDI system to the next.

For example, Lexus uses a set of GDI injectors and another set of MPI/SFI injectors on the same engine to give the customer the best of both worlds. Much like MPI/SFI in the mid- to late-1980s when those systems first started to replace TBI, the learning curve now with GDI seems just as steep or maybe even steeper.

DAVE HOBBS is a field trainer and training product developer for Delphi Product & Service Solutions. He holds ASE CMAT/L1 and EPA 609 certifications and is an experienced hybrid instructor. Dave has been featured as an instructor in more than 15 automotive training videos.
david.a.hobbs@delphi.com

Open Your Window to Awesome!

TYC™ window regulators feature anti-pinch safety mechanisms to prevent windows from pinching fingers, arms and necks. The window will auto-stop when met with any obstruction.

- Application-specific (non-universal) motors for optimal fit and operation
- OE-comparable structural configurations and connector designs
- OE-comparable anti-pinch safety mechanism (where applicable)
- OE-comparable designs provide unsurpassed interchange-ability and convenience in repairs

To learn more about features & benefits of TYC™ Window Regulators, please contact your local TYC authorized distributor.

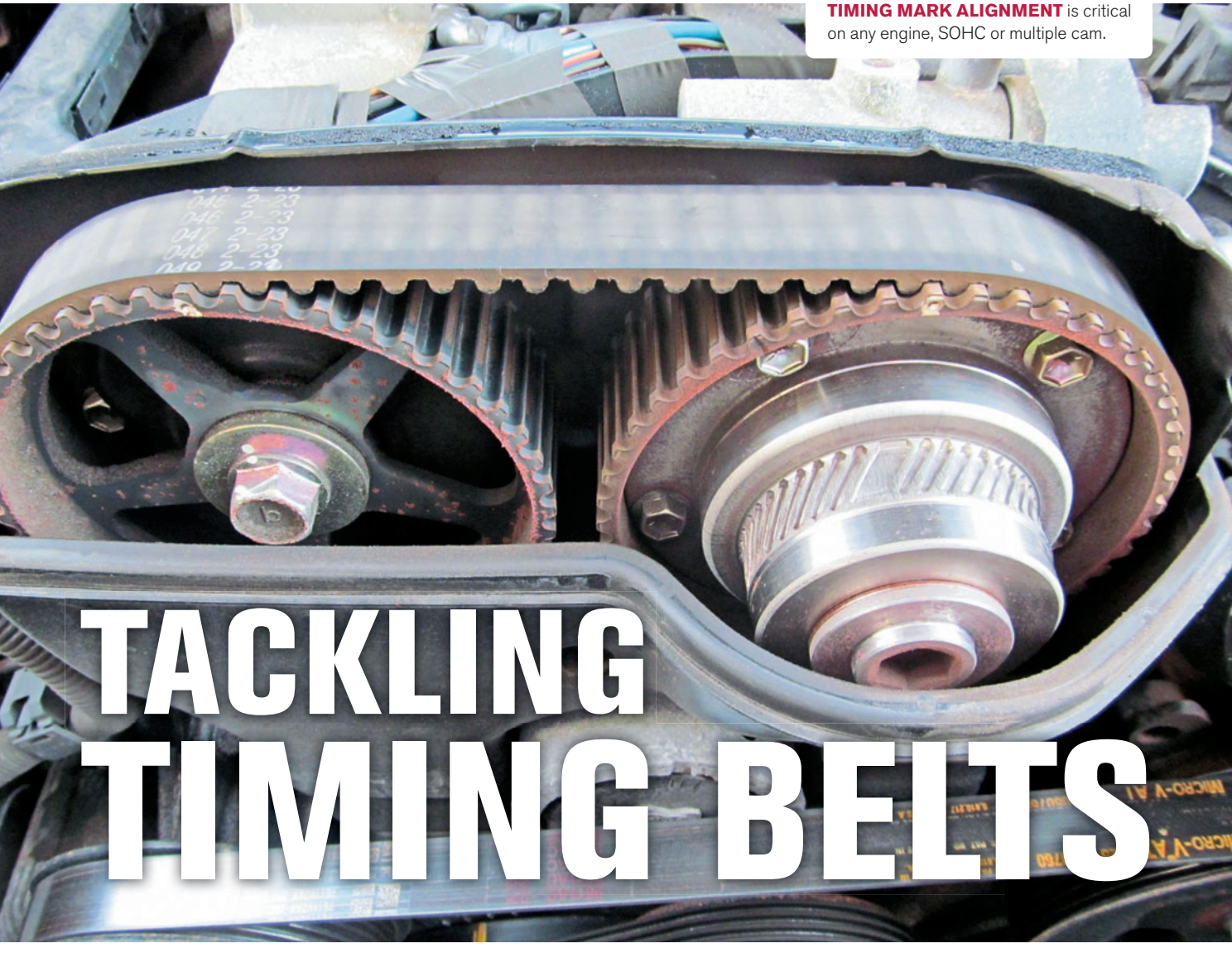
ISO-9001:2000 CERTIFIED QS9000

SYSTEM CERTIFICATION ISO 9001 SGS

TYC®

Expect More. Expect TYC.

tycusa.com



TIMING MARK ALIGNMENT is critical on any engine, SOHC or multiple cam.

TACKLING TIMING BELTS

AVOID COMMON PROBLEMS AND KEEP EVERY JOB PROFITABLE

VANESSA ATWELL // Contributing Editor

Editor's Note: This is the first in a two-part series on timing belt service.

In theory, replacing a timing belt is pretty straightforward: remove everything in the way, line up the components, replace the belt, set the tension, top up any fluids lost during the procedure and then neatly reinstall everything that came off — no problem, in theory.

In reality, one mistake or oversight can cause drivability concerns or damage a very expensive engine, and it's quite easy to make a mistake or forget something critical during routine timing belt replacement.

The job is usually labor-intensive and actually can be quite complicated with many small, critical steps along the way. Additionally, aligning timing marks and setting tension correctly is critical because catastrophic engine failure can result from tiny errors. And it's not uncommon for the job to take the better part of a day, especially if any mounts need to be removed or bolts are seized in place — and it's certainly not fun or profitable to have to disassemble everything a second time to fix a problem that you may have inadvertently caused.

PHOTO: G. JERRY TRUGLIA

DON'T JUST RAISE THEIR CARS. RAISE YOUR IMAGE.

What does your uniform say about your shop?

Customers have options about where to take their car. So when they're deciding whether to trust you with a repair, tip the balance in your favor with the professional look that Aramark provides with Dickies® Automotive Workwear. Let Aramark's convenience and service work for you — and a clean, ready-to-impress uniform work on your customers.

Engineered for first impressions.

Raise your image at **aramarkuniform.com/dickies**
or call **800-ARAMARK**

aramark | Dickies

Thus, it makes sense to avoid the common problems and pitfalls associated with routine timing belt replacement whenever possible. Surprisingly, even though engine designs and replacement intervals vary among manufacturers, there definitely are some problems and pitfalls common to all vehicles. It's important to understand them and plan ahead before anything is disassembled.

Additionally, it's important to know a few tips to make the job go smoothly and efficiently so you don't waste time or cause any new problems.

It definitely is possible to make good money changing timing belts without any unnecessary stress — if you know how.

So here's how to do it the right way. Following are a few quick things to know to make the job go smoothly and leave your customers with a great impression of your work so everyone stays happy and stress-free. Keep in mind that this is the first of a two-part series on replacing timing belts. We will pick up in August with the second piece in the series.

PHOTO: GATES CORP.

MOST AFTERMARKET SOURCES offer timing belt kits, providing the technician with everything they need to do a professional timing belt service.

Replacement intervals

Timing belts are typically replaced every 60,000 to 100,000 miles depending on the manufacturers' recommendations and also depending on how the vehicle is used. There may be the odd engine that requires a shorter or longer replacement interval (as with most maintenance items nowadays), so it's always best to refer to the manufacturer's recommendations and then go from there. Also, it's usually worth replacing any other related components that have reached the end of their service life when the belt is replaced (e.g. The water pump should be replaced if it's driven by the timing belt because it can damage the timing belt when it fails.) so that the job doesn't need to be done again before it's due.

Some manufacturers, however, don't actually have a recommended replacement interval. Rather, they recommend inspecting the belt for cracks, loose, damaged or missing teeth (and for other damage or wear) every few thousand miles and replacing the belt if required. This really isn't very helpful because (from experience) it might be too late to prevent engine damage if the belt has stretched out or has missing or separating teeth since any of those problems can affect engine timing and cause serious problems. It's just not worth taking a risk to save the cus-

PHOTO: VANESSA ATTWELL

THIS 2000 HONDA CIVIC has 160,000 miles on it, so it's ready for a timing belt and water pump replacement. The customer just bought this vehicle (used) and doesn't know if the belt was ever changed. It certainly doesn't look like it.

life *happens...*

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

RED ANGEL® A/C Stop Leak & Conditioner

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

- Repairs leak points in condensers, evaporators, connection hoses, gaskets, and o-rings
- Contains no solid or particulate matter that will clog the A/C system or harm the recovery unit
- Contains 2.5 ounces of Freon
- Easy to use, intended for R-134a systems only

BlueDevil® PRODUCTS

STOP LEAKS PERMANENTLY. *MAXIMIZE PERFORMANCE.*

1.888.863.0426

www.gobdp.com

tomer money. From experience, timing belts don't tend to last much past that 100,000-mile interval. It's best to replace the belt if there's any doubt rather than guess at its remaining life. This is definitely a case where saving money can end up being very expensive.

Whatever interval is recommended, it's important to keep in mind that as with any belt, contamination from oil or coolant dramatically shortens the belt's useful life — and the timing belt is not one to just clean off and take a chance with in the hope of saving some money.

Don't guess, check

No matter what type of vehicle or engine you're working on, it's really important to avoid a few common pitfalls that seem to apply to all timing belt replacement jobs. One of the best ways to do this is by test driving the vehicle before work begins, specifically to ensure there are no pre-existing engine or drivability concerns.

In other words, drive the vehicle and check for any hesitation or pinging noises on hard acceleration, check for any DTCs that may be stored, and listen for any strange noises coming from the engine area since problems like those can be (and often are) caused by a timing belt replacement job gone wrong — possibly by the timing being "off a tooth" or because the tension wasn't set properly. You really don't want to be guessing at whether or not the problem was there before you did anything.

A short drive that includes some hard acceleration can save hours of headaches later on.

Another tip to prevent problems is to check any leaks in the timing belt area before disassembly. Unlike the timing chains that seem to have replaced them, timing belts need to operate in a dry, lubricant-free environment, so anything that's leaking oil or coolant onto the belt should be repaired or replaced before the new belt is installed since it can drastically shorten the belt's lifespan.

Also be sure to check the protective covers for any signs of cracks and damage from previous repairs (maybe even photographing anything major) in case additional parts need to be ordered or authorized. Noticing anything wrong with the vehicle beforehand can prevent problems later.

THE MOUNT IS IN THE WAY, so the engine will need to be carefully supported when the mount is removed.

Preliminary pitfalls prevented

When the preliminary inspections are complete, there are a few ways to make sure the rest of the job goes smoothly.

For one thing, my former shop

TRUE, SOME PEOPLE TAKE A short cut and pry the top section of the cover from under the valve cover, but taking the time to remove the valve cover and install a new seal is worth the extra effort and fixes the leak.

IT'S IMPORTANT TO MAKE SURE the engine splash shields are free from oil and coolant after the timing belt is replaced so that customers don't mistakenly think their vehicle has developed a leak. Even the smallest amount like this could cause problems.

PHOTOS: VANESSA ATTWELL

INSPECT

60

- K -

REPLACE

90

- K -

SM

BE SYSTEM SMART

All parts in a system are engineered to work in concert and wear at about the same rate. Combine belts and tensioners, water pumps and hoses, and use timing component kits for a complete system repair. The best way to prevent costly system failure is to remember the Car Care Council's recommendation. Start **inspecting** the serpentine, cooling and timing systems at 60K miles, and **replacing** worn components by 90K miles, or as advised by the manufacturer.

THINK I-60 & R-90

Gates

Know Your Parts AASA

Be Car Care Aware®

BeSystemSmart.com | CarCare.org

teacher will be very upset if using clean fender covers isn't mentioned. It's particularly important for a job like this because you'll likely be bent over the fender for quite a while, and it's important to keep the customer's vehicle clean.

Along those basics-are-important lines, taking a few moments to review service information, search for Technical Service Bulletins (TSBs) and check for tech tips before disassembling anything is absolutely critical.

In particular, you need to understand which components must be removed to access the timing belt, what holds tension on the belt and how the tension is released, where all of the timing marks are located, whether or not the camshafts or other components need to be locked in place (and how to do that) and also to be aware of any other timed and indexed components besides the camshafts and crankshafts themselves. True, some engines aren't interference-style and can freewheel, but many engines are and need extra care to prevent causing problems during service.

Checking service information is also critical since there may be specific steps you'll need to take that protect the internal engine components from being damaged during service. There might be updated parts or components available for various reasons. Don't guess; check and be sure.

When you know the critical steps and you've got the correct parts you need, proceed to disassembly with a few things in mind.

Disassembly done right

One of the first steps you'll likely do (as directed by service information) is remove any serpentine belts on the vehicle. Here's a tip: To prevent problems from developing (such as odd noises in the engine compartment) mark the direction of rotation for any belts that are removed but are not being replaced (for whatever reason). Belts that suddenly reverse direction after thousands of miles of use might not be happy with the change. There's never shame in taking a few photos to remind yourself of how something was routed or aligned.

Also, if you need to raise the engine and support it (such as when a mount is removed or to improve access to the belt or pulleys) it's important to protect the oil pan from dents and damage. A very common way of doing this is with a block of wood and a jack or axle stand, in particular by using a wide piece of wood to spread the load over a larger surface area.

There are two important things to be aware of as you do this to prevent problems.

NEW

Target 3D PRO
Wheel Alignment

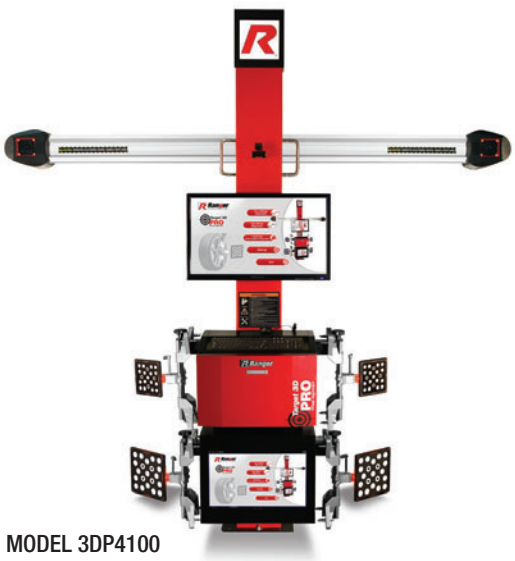
KEEP 'EM STRAIGHT

MRP $12,780
(Aligner Only)

MRP $14,780

PRICE INCLUDES:
- ✓ *FREE SHIPPING!
- ✓ FREE INSTALLATION!
- ✓ FREE ON-SITE TRAINING!

(Lift sold separately)



MODEL 3DP4100

INTRODUCING THE ALL NEW 3D IMAGING WHEEL ALIGNER

ADVANCED IMAGING TECHNOLOGY THAT DELIVERS FAST AND ACCURATE ALIGNMENTS

The model 3DP4100 Target 3DPro™ is an extremely accurate wheel alignment system thanks to advanced imaging technology that delivers fast, industry-standard alignments. It streamlines the entire alignment process delivering critical readings in less than two minutes. With minimal investment and reduced training, the Ranger Target 3DPro aligner expands your service potential and sends more profit to your bottom line.

Call **1-800-253-2363** or Visit **bendpak.com/3DAligner**

*Free shipping on all Ranger Products to most areas in the 48 contiguous states.

Ranger

DELIGHTFULLY SOUND-FREE

Model# RS7580H-603
MSRP: $4250*

HUSH Quiet™
ROTARY-SCREW AIR COMPRESSOR

Engineered for high performance, efficiency and reliability, BendPak's Hush-Quiet RS7580H-603 rotary screw air compressor can meet the compressed air demands of high volume tire shops, general maintenance and fleet shops, vehicle body and paint facilities or busy automotive dealerships. Our exclusive Hush-Quiet technology makes it the perfect compressor to install in noise conscious service areas.

For more info visit www.bendpak.com/hushquiet or call 1-805-933-9970

*Valid at participating dealers. Prices subject to change after September 30, 2016

BendPak®

First, avoid putting any pressure at all on rusty or weak oil pans —find another way to support the engine. And second, be careful not to damage any components that are still attached to the vehicle when the engine is forced upwards at a strange angle. Exhaust manifolds can be driven into soft or brittle components if you're not careful (or the exhaust system itself can be damaged) so be sure to keep an eye out for problems as you support the engine.

Damaging something this early on in the job is definitely a pitfall you want to avoid.

Progressing along

As the job progresses and the bolts and components start to come off, here's a tip to make things go smoothly and avoid problems during reassembly. As each fastener or bolt is removed, be sure to inspect it closely to see if it's identical to the others or if there are slight differences in length or pitch, which would mean it needs to go back exactly where it came from. This is the time to find out, not later during reassembly.

Even if the fasteners do seem identical, group them with the component they're associated with as they are removed and store any easy-to-mix-up components on the bench when possible, not along the cowling at the windshield or on the strut mounts where they can easily be lost. One apprentice here lines the bench with paper floor mats so he can scribble notes next to components as required — smart kid, indeed.

And one more tip to ease reassembly: When you do remove the timing belt cover itself, see if the rubber seals along the edges are securely in place —if there was an oil leak they may have swollen up or become loose. If they're loose, it might be wise to actually glue them back into place instead of just pushing them onto the cover. If the seal gets inside the cover during reassembly it may bind and cause problems with the timing belt or gears; this is definitely not good since it can easily be prevented.

Starting in the second part of this two-part series, we will lead off with more on replacing the timing belt once components and covers are off and once you can access the timing belt itself.

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.

GET MORE OUT OF MOST PROTOCOL

DISSECTING THE INFAMOUS GM U2098 DTC

KEN ZANDERS // Contributing Editor

This article will document the infamous U2098 (MOST Communication Enable Circuit Short to Ground) but before we discuss the MOST protocol, let's discuss a slight bit of GM protocol history — namely, GMLAN. Let's choose a 2008 Chevrolet Impala for our review.

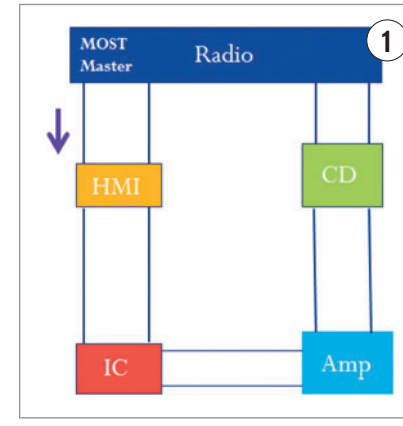
GMLAN

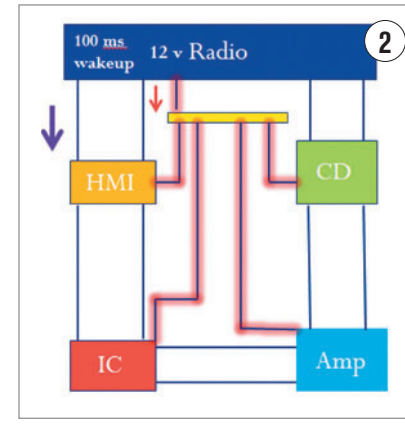
The data link connector (DLC) allows a scan tool to communicate with the high speed GMLAN serial data circuit. The serial data is transmitted on two twisted wires that allow speeds up to 500 Kb/s. The twisted pair is terminated with two 120 ohm resistors, one located inside the engine control module (ECM) and the other located after the vehicle communication interface module (VCIM). The VCIM is considered a DLC termination point of the link even though it does not contain the resistor and can be used as a diagnostic reference point. The high speed GMLAN is a differential bus. The high speed GMLAN serial data bus (+) and high speed GMLAN serial data bus (–) are driven to opposite extremes from a rest or idle level. The idle level, which is approximately 2.5 volts, is considered recessive transmitted data and is interpreted as a digital logic 1. Driving the lines to their extremes, it adds one volt to the high speed GMLAN serial data bus (+) and then subtracts one volt from the high speed GMLAN serial data bus (–) wire. If one is open to opinion, these communication lines are best diagnosed with an automotive lab scope. It allows for a direct visual of the activity that is present for analysis..

Let's now begin our discussion of MOST (Media Oriented Systems Transport) protocol.

The MOST infotainment network is a dedicated high-speed multimedia streaming data bus independent of GMLAN. The MOST protocol requires one module to be a bus communication "Master." The MOST Master is the radio. The radio has the function to initiate communication and to monitor MOST frames (as they are called) that are used for communication among the other communication bus modules. The communication is transmitted on a twisted wire pair that can obtain speeds up to 500MB/s, 100 times faster than GMLAN. The data on the bus travels in one direction only throughout the network. Let's first define each player in the infotainment system.

The radio receives both stereo and mono audio from multiple audio circuits at the Navigation Control Module and also receives audio from the Human Machine Interface per the MOST bus. The radio then outputs this audio per the MOST bus. The radio is the MOST bus master. The radio also communicates with other components and systems within the vehicle per GMLAN.





Infotainment systems are those components that provide a combination of information and entertainment. In GM's case, they include:

- HMI Module: The Human Machine Interface (HMI) module is responsible for

PHOTOS: KEN ZANDERS

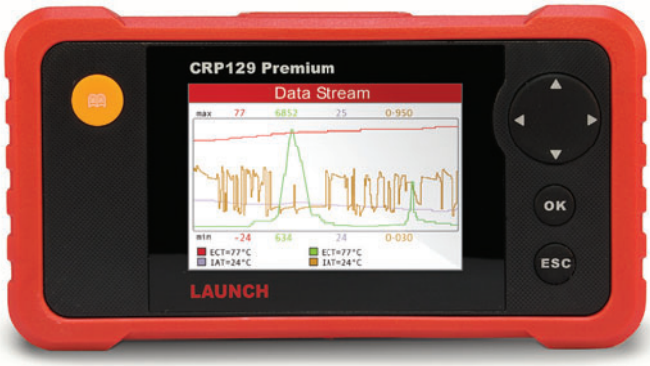
NEW

UPDATED TOOLS FROM LAUNCH

CRP 123P

- Check Engine
- Anti-lock Brake System
- Air Bag Reset
- Transmission Resets

CRP 129P



- Anti-lock Brake System
- Air Bag Reset
- Transmission Resets
- Electronic Parking Brake
- Steering Angle Reset
- Check Engine
- Oil Light Resets
- Battery reset

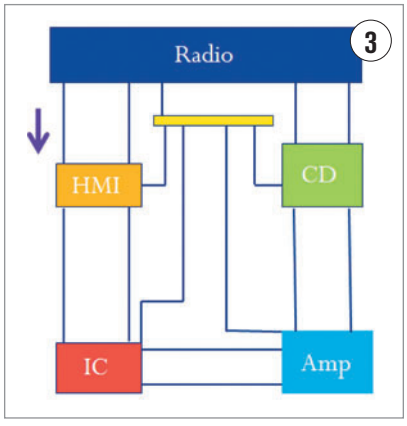
BIGGER SCREENS & FASTER DOWNLOADS

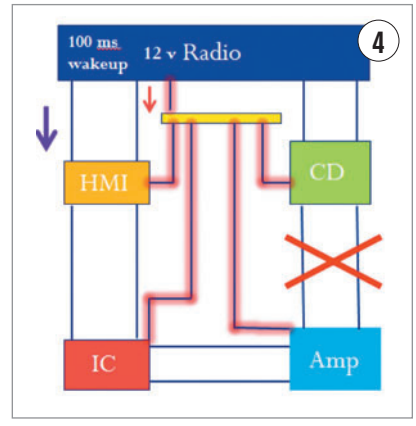
LIVE DATA STREAM

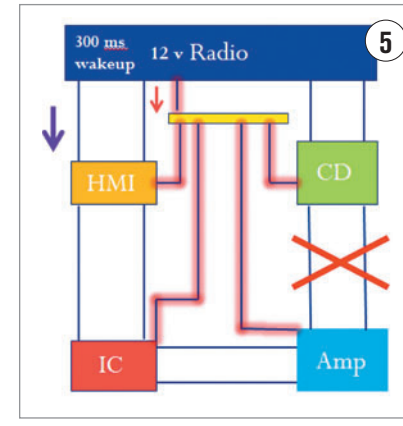
ABS, SRS, TCM & ENGINE

LAUNCH TECH USA

1820 S. Milliken Ave • Ontario, CA 91761
ph: 1-877-528-6249
www.launchtechusa.com







video for the infotainment system, Bluetooth®, USB and speech recognition.

The HMI communicates with the Info display and Navigation Control modules per the LIN bus for control information, touch communications and dimming level. Digital video data is sent to the Info display through a dedicated video cable. The HMI also receives USB data as well as a MIC (microphone) input from a Navigation Control module when needed.

• IC: The instrument cluster (IC) is a multifunction module that provides the vehicle operator with information that is important for vehicle operation. This includes vehicle speed, engine rpm and coolant temperature, using analog gauges. The instrument cluster also provides the operator with operational warnings and messages through various indicators and the driver information center. The driver information center is a full color multifunction display that is located in the instrument cluster. The driver information center is also tightly integrated with the vehicle's infotainment system and is highly reconfigurable.

• Amp: The purpose of the amplifier is to increase the power of a voltage or current signal. The output signal of an amplifier may consist of the same frequencies as the input signal or it may consist of only a portion of the frequencies as in the case of a subwoofer or midrange speaker. The audio amplifier amplifies the signal and sends it to the appropriate speakers.

Each of the audio output channel circuits (+) and (–) at the audio amplifier have a DC bias voltage that is approximately one-half of the battery voltage. When using a DMM, each of the audio output channel circuits will measure approximately 6.5V DC. The audio played on the system is produced by a varying AC voltage that is centered around the DC bias voltage on the same circuit. The AC voltage is what causes the speaker cone to move and produce sound. Both the DC bias voltage and the AC voltage signals are needed for the audio system to properly produce sound that is needed.

The audio amplifier is also responsible for operation of active noise cancellation. Refer to Active Noise Cancellation Description and Operation for more information.

MOST operation

Figures 1 through 5 serve as a means of understanding the MOST protocol under normal operating conditions.

The radio is the MOST master; please note that the data will travel in one direction only. The data direction is noted by the arrow in **Figure 1**, modules are connected together with a two wire twisted pair in what is called a ring format.

The rest state for the modules is 12 volts, and the MOST master (radio) will pull this value low for 100ms to wake up the modules. Once awake, the modules will initiate communication over the MOST Protocol in a CCW direction as shown in **Figure 2**.

Once awake, each module sends segments of data packs in a CCW motion. This is a commonly called a continuous loop.

• Data will flow from one module to the next.

• Data flow will always begin at the radio, each module is considered downstream (CCW) from the previous one before it as shown in **Figure 3**.

Let's now take a look at the operation when a fault is present.

If all of the modules do not respond to the 100ms wake-up call, the radio will re-send the signal up to three times with a two-second delay between each one of the attempts. If an abnormal response is received after three attempts, the radio sets a Diagnostic Trouble Code (DTC) for the MOST Bus (**Figure 4**).

Once a DTC is set, diagnostics (CW) begins and a 300ms low signal is sent

over the MOST protocol (**Figure 5**).

• All modules will try to respond by transmitting data over the MOST protocol.

• The responding module furthest upstream of the radio becomes the Surrogate MOST master.

• The entire process takes about 10 seconds to complete.

Real World Example

Let's now take a look at our subject vehicle: A 2015 Cadillac ATS. The system has stored a U2098-02 (MOST communication circuit shorted to ground) in memory for the MOST protocol. Please note that the system has assigned for diagnostics the following IDs for the modules. This will be used to find the fault in the system.

Please make a mental note of the number assignment, and please remember that the goal is to use the diagnostics to find where the short is located.

- Radio — 0
- CD — 1
- AMP — 2
- IC — 3
- HMI — 4

Figure 6 shows the interior of the vehicle we are working on. The HMI screen is blank.

If you were to run this procedure in your own shop, you would see the data from the MDI scan tool showing the code information and data retrieved from the system. Please note that this is radio data. A review of RPO codes shows that this vehicle does not have a media disc player.

Please again keep in mind the numbers assigned to the modules; radio=node 0, HMI=node 1, IC=node 2, AMP=node 3 obtain this assignment by going CCW (upstream) around the loop (this is for diagnostics). The data on the scan tool will be based on going CW (downstream) around the loop — namely, radio=node 1, AMP=node 2, IC=node 3, HMI=node 4 (this is normal operation).

When a code is set per the radio, the diagnostics of the system will first select a surrogate module; this is the module that indicates it did not receive communication from the module that is upstream from it. The surrogate chosen by the radio in this situation is node 0 (radio). The module that is upstream from the surrogate is where the fault will lie in the system. In this case, it could be wiring, connections or the module upstream, which in this case is the HMI module.

The break is denoted as being between Node 0 and Node 1. The diagnostics will choose a surrogate; the fault will be upstream of the surrogate module. This can be understood by always viewing the schematic for the system and working in a CCW (upstream) direction. The final analysis on this vehicle showed a wire that was pinched to ground between these two modules.

I hope this example of diagnosing the MOST U2098 code will help you tackle similar problems in the future. Like most communications related concerns, spending time familiarizing yourself with the network protocol and the related schematics will help you isolate the fault more quickly — and that means a happier customer and a happier you.

KEN ZANDERS is an ASE Master Certified Automotive Technician with L1 Advanced Engine Performance. He has extensive traning with various OEMs.
carlton196100@yahoo.com

OLD DOES NOT MEAN EASY

OLDER MODEL VEHICLES ARE NOT IMMUNE TO BEING DIFFICULT

WAYNE COLONNA // Powertrain Pro Publisher

The majority of calls we receive on our technical help line are with vehicles 15 years old and newer. With the complexity of newer vehicles, these calls have become increasingly more difficult to do. Suffice it to say that when a call comes in for a vehicle that is from the 1990s or the early 2000s, it usually becomes a break against the brain burners we normally receive.

That doesn't mean the older vehicles are immune to being difficult, though. There are plenty of times when those seemingly "easier" calls come in and end up being a "lunch eater." These problems may arise due to maintenance not being in the owner's vocabulary. Or, when previous work was performed with incorrect parts, or a non-sophisticated operational system is not completely understood. Such was the case with a 2001 Isuzu NPR 4.8 diesel using the Aisin 450-43LE transmission. After many failed attempts at fixing a TPS code 21 from a variety of shops, it eventually found its way to Lorenzo Ortiz at Phillips Transmissions in Arizona.

Ortiz questioned the owner of the truck. He learned that both the TPS and the TCM had already been replaced. His initial diagnosis verified that TPS code 21 was stored (**Figure 1**), yet the TPS was functioning correctly at the TCM. Power and grounds at the TCM were checked and determined to be good. After clearing the code and test driving the vehicle, it is noticed that the PID for the engine rpm read nothing and the idle switch read "engine is NOT at idle" when in fact it was (**Figure 2**). By punching the throttle to see if a change would occur, an 800-plus rpm suddenly appeared near wide open throttle at which time code 21 for the TPS set.

Ortiz referred to a wiring diagram in preparation for inspecting the engine rpm sensor and idle switch. It was then discovered that this vehicle does not have an "actual idle switch" and the tachometer sensor is the signal source for engine rpm. It is the ECM that determines an idle signal, which is presented in the scan tool as an idle switch.

The way this works is that there is a 12-volt wire fed from the TCM to the ECM. The ECM determines idle speed from the tachometer sensor and will ground this wire when it determines that the engine is at idle speed. Idle speed is 790 to 870 rpm. When engine speed increases above 870 rpm, the ECM will release the ground on the signal wire from the TCM (**see Figure 3**).

- Lead	+ Lead	DC Volts	Condition
B231-2 (B) or B231-8 (B)	B230-16 (B/G)	10-16	Engine speed more than 880 RPM
		Less than 1.0	Accelerator pedal closed. Engine speed 400-880 RPM

B229												B230							B231					
13	12	11	10	9	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	6	5	4	3	2	1
26	25	24	23	22	21	20	19	18	17	16	15	14	16	15	14	13	12	11	10	9	12	11	10	9	8	7

TCM located under the dash left hand side of the steering column
Connectors point to the floor. May have a protective tin cover over the TCM
(ECM's are typically located behind the radio)

3

PHOTOS: WAYNE COLONNA

Select TYC™ replacement External Transmission Oil Coolers, Charge Air Coolers, Evaporators and Heater Cores to help keep your vehicle cool.

Transmission Oil Coolers and Charge Air Coolers are designed to be application-specific (non-universal) for drop-in fit and include additional hoses (where applicable), adding convenience and value.

Heater Cores use premium grade aluminum with Nokolok furnace brazing and tested for leakage, vibration and corrosion, while our Evaporators are rigid and long lasting due to precision construction. Installation is trouble-free with OE-comparable fitment.

For more information about TYC™ replacement auto parts, please consult your local TYC sales representative.

ISO-9001:2000 CERTIFIED QS9000

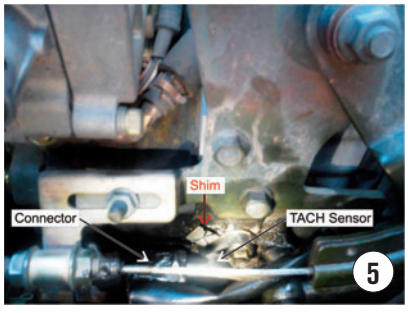
SYSTEM CERTIFICATION ISO 9001 SGS

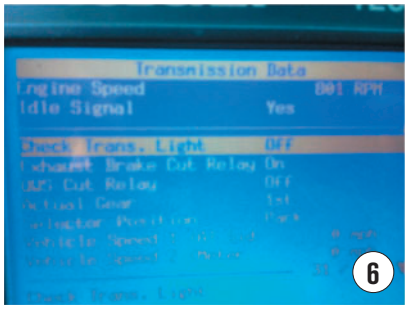
TYC®

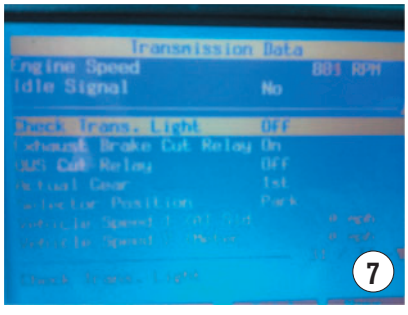
Expect More. Expect TYC.

tycusa.com

The reason for setting the TPS code is that without an rpm signal due to the defective tachometer sensor, the ECM will not ground the signal wire to inform the TCM of an actual idle condition. When the engine was revved up, an rpm signal finally registered at 800 rpm, at which time the ECM grounded the signal wire to indicate an idle condition. Meanwhile, the TPS voltage is showing that the driver is deep into the throttle. With the TPS voltage being a different value than what the idle signal indicates, code 21 for the TPS is set.







Example: TPS value at idle should be 4.0 to 4.9 DC volts and engine rpm should be between 790-870 rpm. The Idle signal in the scan tool will be "yes."

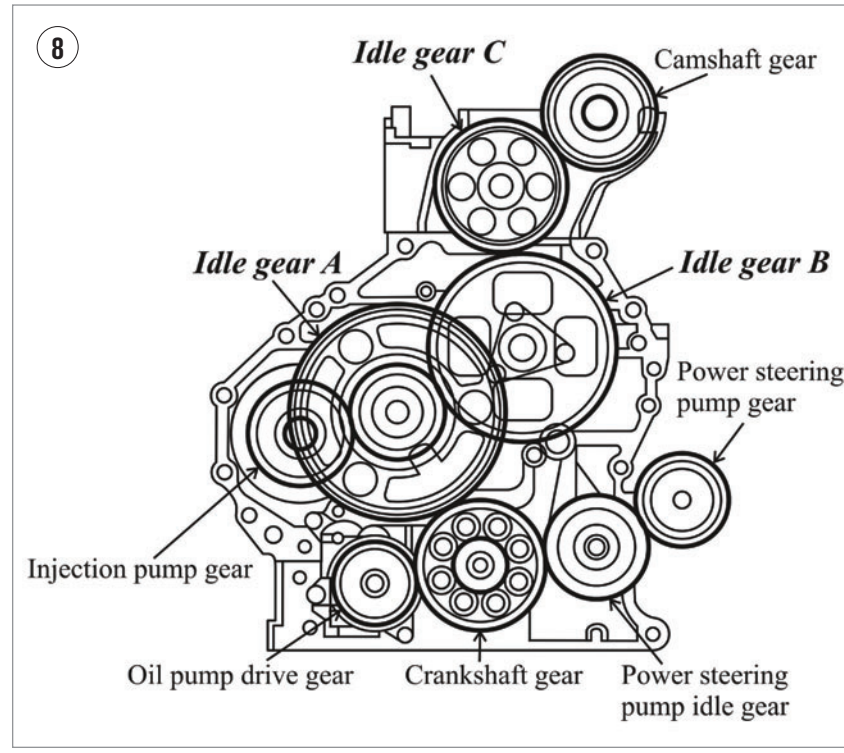
In this scenario, there was no engine rpm at idle and the idle switch in the scan tool said "no." TPS voltage was between 4.0 and 4.9. When the throttle was depressed, a false 800 rpm signal was generated by the tachometer sensor while TPS voltage dropped appropriately to 3.0 volts. When the ECM saw 800 rpm, it grounded the TCM signal wire to indicate and idle condition.

Not knowing the way this unique system operates certainly will cause some head scratching. But what brings this head scratching to the point of balding is that there are no codes assigned to the tachometer or for an idle switch signal fault. This means that when these signals malfunction, the TPS will always be blamed as the offending component. Additionally, the defective tachometer sensor did not produce any other drivability complaints, as one might think.

The part number for this sensor is 8-97214325-0 (**Figure 4**). Use caution when replacing the sensor. There is an air gap spacer shim located under the sensor that could fall away unnoticed. This shim needs to be installed with the new sensor for it to function correctly (**Figure 5**). Once the shim and tachometer were replaced, engine rpm in the scan tool displayed 800 rpm and the idle signal said "yes" (**Figure 6**). When engine rpms were brought up past 870, idle signal said "no" (**Figure 7**). Problem solved.

Rolando Farradas from Rainbow Trans & Auto Center in Hialeah, Fla., knows well of another cause for TPS code 21 to set that will drive you beyond balding. It has to do with using incorrect parts. In this case, an engine exchange or rebuilt with the wrong parts or, an incorrect computer was used.

1999 NPR vehicles using a diesel engine with the 450-43LE transmission use only fine-pitched idler gears.



FORD **PARTS**

Original standards. Remanufactured.

Ford is your source for remanufactured gas engines. Each one is built to original performance specs, including the latest Ford engineering enhancements. And since every remanufactured gas engine is built with parts that keep it specific to make, model, year and emissions calibration, you'll get the right fit every time. No guesswork. That's the power of original.

GAS ENGINES & TRANSMISSIONS

3 YEAR UNLIMITED MILE WARRANTY

NO COMMERCIAL EXCEPTIONS

FORD PARTS

Contact the Ford Powertrain Assistance Center at 800-392-7946 or visit FordParts.com.

See dealer for warranty details.

Ford

Go Further

The crank shaft drives idler gear A's larger gear. The inner gear on idler gear A, which is fine pitch, drives the injector pump and idler gear B. Idler gear B then drives idler gear C, which drives the cam shaft (**Figure 8**).

2000 and later vehicles use coarse-pitched idler gears (**Figure 9**). If these engines are swapped or the wrong idler gears are used when rebuilding the engine, the engine rpm sensor will provide an incorrect signal to the ECM, causing TPS code 21 to set.

Note that 1999 TCMs have an orange connector programmed to properly read fine-pitched gears, while 2000 and later have a green connector programmed to properly read coarse-pitched gears (**Figure 10**).

There are two different size TCMs with green connectors, which will interchange with any 2000 to 2006 vehicle using the 450-43LE transmission (**Figure 11**).

All ECMs have a green color connector, and they vary, matching the type of engine used (4HE1TC, 4HE1-XN, 4HF1, 4HG1T, 4HK1-TCN, 4HK1-TCC, 4HK1-TCS, 4HJ1, 4HJ1, etc.).

If an error has been made by rebuilding the engine with the wrong idler gears or from swapping out the engines incorrectly, there is some good news. For example, if a 2000 engine has been installed in a 1999 vehicle, which is now producing code 21, the matching ECM and TCM can be installed to correct this condition. The harness connector configurations are all the same, allowing for these computers to be interchanged.

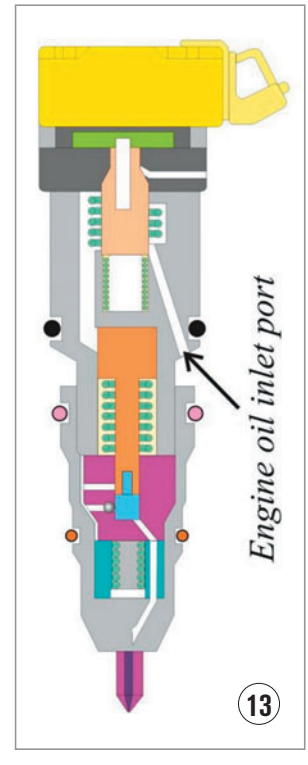
Another entirely different scenario that is nearly always misdiagnosed has to do with Ford trucks using the 7.3L Powerstoke engine. The scenario goes like this: A 2001 F-350 Super Duty 7.3L vehicle with a 4R100 transmission comes in to your shop with a customer complaint of what is perceived to be a bind-up or a holding-back sensation. This problem occurs when the vehicle is carrying a load backing up a hill or on flat ground with aggressive rearward acceleration. The transmission fluid level and condition does not reveal a transmission problem. The transmission may have been disassembled for inspection, but nothing is discovered that would cause such a complaint. No diagnostic codes are stored in the system either. The transmission can be swapped out with another, yet the bind up feeling in reverse remains.


9


10


11


12



13

The 7.3L Powerstroke engine has a capacity to hold 15 quarts of oil (14.2L). Besides the engine oil being a lubricant, it is also part of the fuel system. For engine techs, this is "old hat" (covering the balding from years of head scratching). For most transmission techs, this fuel system is called the hydraulically activated, electronically controlled, unit injector fuel system (HEUI – **Figure 12**). The system uses a high-pressure volume pump by Bosch to transfer engine oil through the poppet valve to the top side of the intensifier piston inside the fuel injector (**Figure 13**).

The surface area of this piston is seven times greater than that of its plunger. So, if there was 1,000 psi of injection control pressure (ICP) across the intensifier piston, this would convert to 7,000 psi of fuel injector pressure. If engine oil level is low, the injectors do not work properly, affecting fuel delivery to the combustion chamber. In the case of this complaint, engine oil was down approximately 5 quarts. When the vehicle was backing up a hill with a heavy load, low oil level became lower, compromising the high-pressure pump's ability to deliver the necessary ICP to the injector, which in turn affected fuel delivery. The lack of fuel pressure caused a bogging-down sensation simulating what was perceived as a binding-up or a holding-back sensation originating from the transmission while in reverse.

The real fix needed here is to inspect and correct any engine oil leaks and bring the level up to specifications using SAE 15W-40 Super Duty Motor Oil XO-15W40-QSD or equivalent. As a side note, the 6.0L Powerstroke engine nearly doubles the high-pressure system using a more complex injector than that of the 7.3L. Being a more complex injector seems to have made it a more problematic injector. A common complaint when these begin to fail is the vehicle has a difficult time starting when cold.

Low engine oil can affect the transmission and occurs with Chevrolet Cobalt vehicles equipped with the 2.4L engine (Variable Valve Timing) and the 4T45E transaxle. The vehicle comes in to the shop exhibiting very harsh shifts. The check engine light is on and when checked, a P0010 for an intake Camshaft Position Actuator Solenoid Control Circuit fault is set or a P0011 for an intake Camshaft Position Actuator Solenoid System performance fault is set.

The cause again can be low engine oil, but it also could be a faulty Intake CMP actuator causing a performance problem with the actuator. Both of these codes will raise line pressure, causing the shifts to be harsh. This is not mentioned in the code explanation for P0010 and P0011 under the heading called "Action Taken When the DTC Sets." This can cause one to think a transmission problem is also at play when it is not.

To correct this condition, clear diagnostic trouble codes and verify that the engine oil level is correct. This is the first step in the diagnostic tree, as low engine oil can cause improper control of the Intake CMP Actuator. Drive the vehicle to see if the code resets. If the P0010 resets, refer to the appropriate factory manual to check the electrical circuit of the actuator.

These are a sampling of some of the problems that can catch you off guard as these vehicles get older. Just because it's old and familiar doesn't mean diagnosing the problem will be quick and easy.

WAYNE COLONNA is the president of the Automatic Transmission Service Group in Cutler Bay, Fla.
wayne@atsg.us

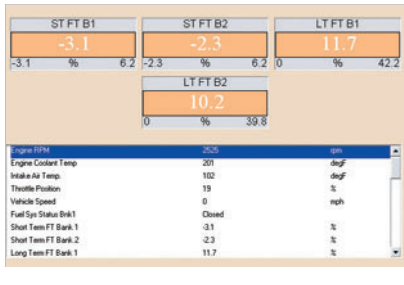
YOU CAN'T GET THERE FROM HERE

TO REACH A SUCCESSFUL DIAGNOSTIC CONCLUSION, YOU HAVE TO FOLLOW THE RIGHT DIAGNOSTIC PATH

PETE MEIER // Director of Training

It seems like yesterday when you graduated with your associate's degree in automotive technology but it's been three months, and you've successfully landed a job at ABC Auto Repair in your hometown. The boss, though, has been slow in cutting you loose, feeding you a stream of oil changes and tire repairs as you become accustomed to the workflow and your fellow technicians.

Then the day comes! The boss hands you your first diagnostic ticket — a customer concern that the "Check Engine light is on" — and he tells you he wants to see what you can do. You're excited about the opportunity to show what you've learned over the last two (or more) years of study and you've handled more than a few Check Engine light complaints under your teacher's guidance. This should be a piece of cake!



FUEL TRIMS CAN PROVIDE information on a variety of drivability causes and help you narrow down your search quickly and efficiently.

Four hours later and you still have no clue why the light is on or what to do about it. Now you're feeling discouraged and you're wondering if you've chosen the right career. Before you cry "Uncle" and throw in the towel, let's talk about the process you're using in your diagnostic method. That is, if you're using one at all.

Don't run before you walk

How should you proceed when you get a ticket with a Check Engine light concern? Often, that's all the information you're going to get and unless the car is totally running like — well, you know — you may not know right away whether or not there are any drivability concerns to go along with it.

My first step after bringing the car into the shop is to connect a scan tool using the Global OBDII option. The standardized format makes navigating through the data I want easy, no matter the make, and all "live" data is actual data free from substitute values that you may see in a more manufacturer-specific mode. The first stop, of course, is to see what codes are stored or pending and you'll find that in Modes $03 and $07. I'll record all the code designators I find and then move over to the "Freeze Frame" records to learn a bit more about the conditions the car was being operated under at the time the code(s) set.

A word, though, on Freeze Frame data. If the code is part of a continuous monitor (Comprehensive Component, Misfire or Fuel Control), then the data I find there is relevant to my diagnostic approach. Looking for the cause of a misfire at idle is different than one that occurs only under load. However, if the code is part of a non-continuous monitor (pretty much all the others), I'm not going to be as concerned about the data. In these cases, it is only telling me about the test conditions required and not so much about the conditions leading to the fault.

To clear or not to clear

I'm guessing that many of you reading this follow a similar process up to this point. And I'm also guessing that most of you clear the codes right about now, too.

That, my friends, could be a mistake. When you clear the codes, you remove all traces of the problem and you may want to go back later to check on data that no longer exists. Once you hit that "enter" key, you wipe out not only the codes and related Freeze Frame data, you also clear and reset the Mode $06 data and the monitors.

So wait until you've completed the repair before you clear the codes.

Another common mistake is to rely on the code description to provide your diagnostic direction. Most code descrip-

PHOTOS: PETE MEIER

tions are pretty good, but they don't tell you what failed or why, only what component and/or circuit is involved. Once you've retrieved the codes, your next stop is your service information system. Time to do a little reading.

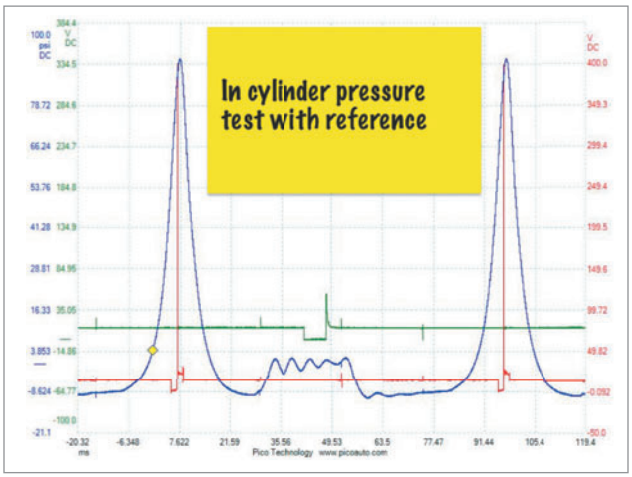
Research before you wrench

Even the simplest services today require interaction with an onboard computer. Tire pressure monitoring systems and battery replacements come immediately to mind, and oil life monitor resets have been around for even longer. So thinking you can apply the same operational knowledge across the OEM lines is a serious mistake that will lead to frustration, comebacks and lots of lost effort.

To avoid all of that, invest the time up front to learn all you can about the code(s) and the system(s) affected. Start by reading the code description, focusing on the criteria required before the ECM can record the fault. Often, multiple codes will set when only one code is the actual culprit. The reverse also can be true. If some codes are recorded, other tests may be suspended until the fault is corrected. And that means that you could have a new code pop up after you've made your repairs! If you've already sent the customer home, they'll be back and they won't be happy.

In addition to learning about the codes and systems, check the service information for any factory Technical Service Bulletins (TSBs) related to the code or problem. Forty percent or more of drivability problems are related to ECM programming, and the only cure is to reflash and update the control module. If that's the cause in your case, it's something you'll never figure out on your own, leaving you chasing your tail in a never-ending circle. In addition, TSBs are often a great source of tips that can speed up your diagnostic time.

Don't overlook other resources either. Many service information systems now offer databases of known problems you can research and you've heard me mention iATN and Identifix more than once. Today, even Google can be a source of good information as long as you take the time to screen and most importantly, verify the source.

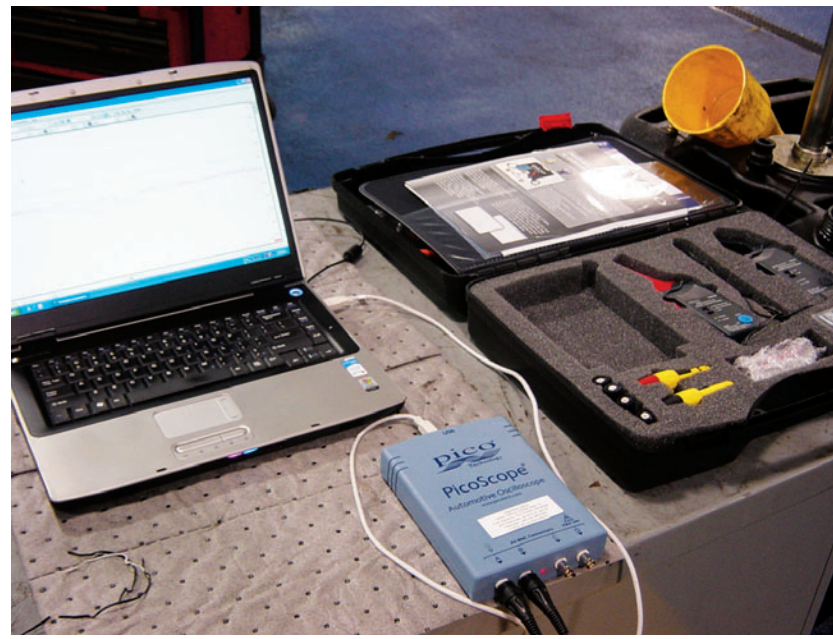


IN-CYLINDER PRESSURE TESTING is another great general test that will help you eliminate (or catch) a host of internal engine issues like cam timing, exhaust blockage and more.

After the homework is done

Once you're armed with the data and knowledge you need, it's time to decide on your next step. How do you proceed with your testing from here depends on the particulars of the fault you are chasing down. But, as our own Albin Moore likes to point out, the key to good troubleshooting is to use a testing method that brings the fault to you.

I like to start my testing by basing my tests on two factors: One, I have an



A SCOPE CAN BE A powerful diagnostic tool, especially when coupled with a few potent accessories.

idea of what I think is the most likely cause of the problem so I want my test to either prove or disprove that idea and two, I want to perform a test that is both easy and general in nature so that I can test for multiple causes at a time. An example of such a test is the relative compression test I perform on each and every drivability problem I tackle. With a second channel referenced to the ignition event, I can gauge the overall mechanical health of the engine as well as verify that ignition timing is correct (if not, it could indicate a cam timing or synch issue). And it beats doing a mechanical compression check!

Once I've used general tests to narrow the realm of possibilities, I'll move on to more precise system tests to home in on the culprit. In many instances, the testing process takes very little time because I've already taken the effort to consider all the things the cause can't be. Once the cause is identified, I make the repair and then verify that the repair is the only repair needed by retesting or rerunning the system monitors.

Stick to the plan

A good diagnostic approach is applicable to any troubleshooting situation you find yourself in. The key, for me anyway, is to follow the same approach regardless of the problem I'm faced with. Initial data first (including a visual inspection), research of the problem and the systems involved, general testing to narrow the field and then focused testing to hone in on the cause. Last, but certainly not least, verify the repair before it's returned to the customer.

Follow your plan of attack and you'll avoid wasted effort, duplication and missed information. And that means more successful repairs in less time.

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.
pmeier@advanstar.com

THE CASE OF THE AUTOMOTIVE CHIA PET

I THOUGHT I HAD SEEN EVERYTHING AS A MOBILE DIAGNOSTIC SPECIALIST, BUT ONE CAR REALLY STANDS OUT

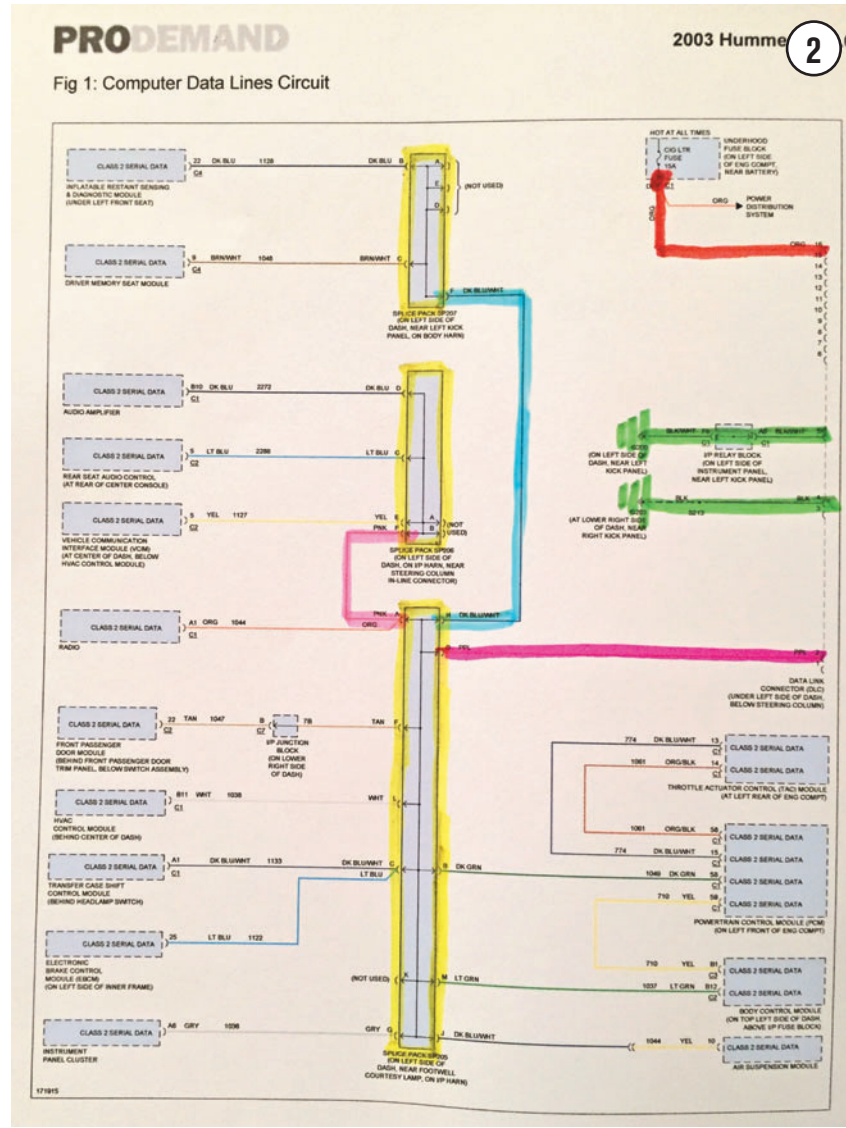
JOHN ANELLO // Contributing Editor

I was called to a shop on a 2003 Hummer H2 with a 6.0L engine with about 120,000 miles on it (**Figure 1**). The complaint was a no-start condition. The owner of the vehicle said he had parked the truck to go into a store and when he came out about an hour later, the truck would start up and then immediately cut out. The shop techs could not communicate with the Engine Control Module (ECM), but they were able to run the truck with carburetor cleaner. The truck had spark and fuel pressure, but was losing fuel pulse. This led the shop to believe that the vehicle was immobilized, preventing the vehicle from being started. The shop knew that this vehicle had the Pass Lock 2 system on board and that the Body Control Module (BCM) played a role in starting the vehicle.

The Pass Lock 2 systems are used on many GM vehicles from 1995-2005 and can be identified by a security light on the dash and by a key with a "PK2" stamped on the metal part of the key where it meets the plastic end. There are some keys that may not have the "PK2" stamped on them and also are used for this system. These keys do not incorporate an internal chip, but function only to turn a lock cylinder that houses a magnet in the center of the key cylinder assembly. When the lock cylinder is rotated in the crank mode, it will travel far enough for the magnet to go past a 3-Wire Hall Effect sensing device located in the lock housing allowing the sensor to pull the 5 Volt Pass Lock signal from the BCM to a certain predetermined level. It is this specific value that is learned within the BCM's memory. If the vehicle battery was to go dead or a new Pass Lock sensor was installed in the vehicle, you would have to perform a 30-minute learn procedure to allow the vehicle to run.

The shop techs were unable to talk to the BCM as well, so they removed part of the left side dash to gain access to the Pass Lock sensor and BCM for further testing. They validated the power and ground feeds to the BCM and Pass-Lock sensor and were not too quick to condemn any unwanted parts. Because both the ECM and BCM were unresponsive, it only made sense that the truck would be in a theft mode. The engine did start and die so that indicated that the ECM was working but was just unable to communicate. The shop at this point decided to call me in to get a second opinion.

PHOTOS: JOHN ANELLO



Enter Auto Tech on Wheels

When I arrived, I validated the shop's findings by trying to communicate with both the ECM and BCM and had the same results with a no communication issue. It would be less than likely that two modules were both bad or that they shared a problem with the exact same power and ground feeds. What they definitely did share was the same data line. Validating communications with just two modules does an injustice in diagnostics. You need to go into every control module that your scan tool supports. This way you actually are validating your scan tool and the entire network so you can dot the I's and cross the T's.

In doing so, I discovered that I could not communicate with any control modules on board. This vehicle had a major network problem. It is not uncommon to have a network that is shorted to ground or power by a bad controller on a network or due to faulty wiring. The hardest part here was to narrow down where the problem was exactly located between the front and rear bumpers. I had to put a game plan of attack together by printing out a network diagram and flowing the wiring schematic to see the players involved (**Figure 2**).

Keep Kias Genuine.
Keep your business growing.

Installing Genuine Kia Parts can help keep your customers satisfied and your Kia service business growing. The only way to assure that you are getting Genuine Kia Parts, backed by the Kia Warranty, is to order them from your local authorized Kia dealer.

Contact your local Kia dealer today for assistance and delivery of the parts you need.

www.kiagenuineparts.com

CALIFORNIA

The Kia Depot
Santa Ana
(888) 859-6573
Fax (714) 560-4124
parts@kiacarparts.net
www.kiacarparts.net

KENTUCKY

The Kia Store on Preston
Louisville
(502) 962-3261
Fax (502) 962-3239
Largest Kia Parts Dealer in KY
Next Day Delivery

MASSACHUSETTS

Wagner Kia of Shrewsbury
Shrewsbury
(888) 859-4827
Fax (508) 581-5789
wagnerkia.com
CollisionLink Dealer

Lev Kia
Framingham
(508) 879-5555
Fax (508) 626-1585
www.levkia.com

NORTH CAROLINA

Gerry Wood Kia
Salisbury
(704) 216-2688
Fax (704) 638-9095
www.gerrywood-kia.com

SOUTH CAROLINA

Best Kia
Easley
(864) 312-4049
Fax (864) 312-4061
Bestkia.com

WASHINGTON

Performance Kia
Everett
(425) 609-5622
Fax (425) 609-5661
parts@performanceKia.com

Genuine Parts

*Contact an Authorized Kia Dealer for details.

The network was a single wire Class 2 Serial Data system that branched out into a parallel circuit. There were about 14 control modules on the network with some modules being optional. I highlighted the grounds in green at the Diagnostic Link Connector (pins No. 4 and No. 5) and the Power Feed in red (pin No. 16). These are standard power and ground feed pin locations on most vehicles with OBDII diagnostic connectors.

I also highlighted the Class 2 Serial data line in purple at pin No. 2 of the DLC connector. This vehicle used three network splices to serve as central connecting terminals for multiple controllers, so I highlighted these in yellow. These splices were incorporated specifically by GM to aid in network diagnostics so that a technician could narrow down a bad control module without tearing the whole vehicle apart to access each control module to pull them off the network one by one. The main 12-pin network splice was conveniently located just above the DLC diagnostic connector taped to a harness conduit (**Figure 3**).

When aftermarket is a bad thing

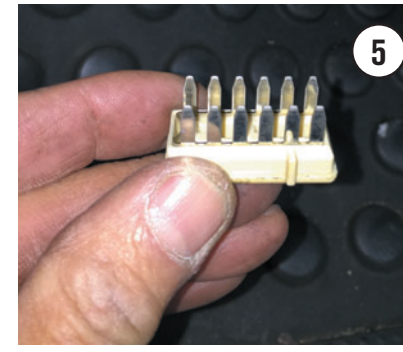
As I was inspecting the connector, my eye came in quick contact with an aftermarket alarm wire tapped into the main purple Class 2 data wire at the diagnostic connector (**Figure 4**). I suddenly had a chill run down my spine thinking, "I found the culprit!"

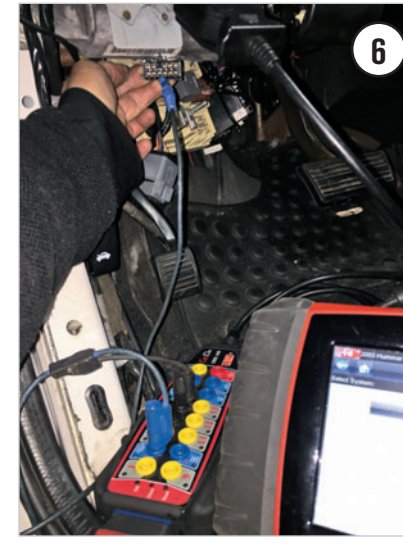
It is not uncommon for an aftermarket alarm to be placed within a network causing a problem in taking down the entire system. Alarm installers will tap into certain networks so that the alarm module they install in the vehicle can go online with the existing controllers and interact with them. There is no need for the bulk of wires needed on earlier alarm systems when everything can be done by network commands. An alarm module today can take a simple command from a user's remote to unlock a door by sending a message out on the network to command a Door Control Module to unlock the doors. This function is only a fraction of what is capable in today's technical advances in aftermarket electronics.

At this point I had no choice but to remove the alarm wire. But to my surprise, the problem was still there. It was well worth a shot, because I have fixed many cars in the field using visual inspections. But this Hummer was going to give me a run for my money. It was all good because I was up for the challenge.

I pulled the 12-pin splice comb (**Figure 5**) from the main splice connector in order to isolate all the onboard controllers from the diagnostic connector Class 2 data feed line located at position "D" of the 12-pin splice connector leading back to the DLC connector pin No. 2. I hooked up my OBDII breakout box to the DLC connector. This is a very handy tool to have especially if you don't desire to lay twisted under a dash. The OBDII breakout box gives you quick access to all 16 diagnostic connector pins and incorporates LEDs for each port to show ground, power and data transmission activity. It also incorporates a male OBDII port so you can hook up your scan tool while testing the ALDL ports.

I used a jumper wire from the No. 2 DLC pin and connected it to each of the twelve individual splice connector pins one at a time to validate each controller for communication (**Figure 6**). I was able to talk to all the controllers that were built for this vehicle except for the Air Bag and Driver Memory Seat. These modules shared a common blue/white





wire on pin "H" of the main splice connector. This same wire ran to a second 6-pin splice connector that was located in the left kick panel. It was here that the Air Bag Control Module data line and the Driver Memory Seat Module data line tied into the blue/white wire.

I removed the splice comb from the 6-pin splice connector at the left kick panel to completely isolate both the Air Bag and Driver Seat Memory control modules from the network (**Figure 7**). I cycled the key to reset the vehicle network and attempted to start the vehicle. To my surprise, the Hummer started right up immediately. I was on the right track and now it was time to move in for the kill.

Honing in on the problem

I next used a jumper wire to jump out the brown/white data line coming from the Driver Seat Control module to the blue/white wire feeding back to the main splice connector pin "H." I again attempted to start the Hummer and it started without a problem. Then I jumped out the blue data wire feeding back to the Air Bag Control Module and jumped it to the blue/white wire leading back to the main splice connector pin "H." I attempted to start the Hummer once again and it would not start. Okay, so now I found the culprit. The problem was in the Air Bag Control Module or wiring.

Just out of curiosity, I used my Power Probe to see if this wire was shorted to

ground and I was very surprised to see 13 volts on the wire (**Figure 8**). How can this be? Did the air bag module have a bad ground causing feedback voltage on the data line or was it simply a bad internal Air Bag Control Module board causing the same result? It was time to take a closer look.

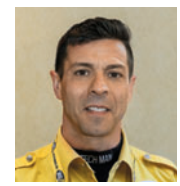
I carefully pulled back the carpet under the driver seat so that I could validate the Air Bag Control Module wiring. I was suddenly shocked at what I saw! The module looked like an "Automotive Chia Pet" and it was caked with some nasty white milky powder (**Figure 9**). I wasn't about to touch the mess for fear of the unknown substance. It seemed like moisture had built up under the carpet and created a corrosive breakdown of the aluminum housing of the Air Bag Module. This in turn worked its way into the harness connector causing cross voltage shorting into the data line.

I immediately disconnected the battery as a safety precaution to prevent an unintentional air bag deployment. I also instructed the shop technician to handle the "Chia Pet" with latex gloves. I did not want him to get the corrosive powder in his skin. I even gave him the option of using a hazmat outfit before he attempted to extract this Chia Pet from the vehicle.

What a humdinger of a diagnostic adventure this was for me. You diagnose cars for more than 25 years and you come across something that's so unimaginable to believe. This is the kind of stuff that keeps me in the business. It's the daily challenges and the rewards we reap that make it all worthwhile. I probably could have used a scope or meter and placed it on the data line to check for a short to ground or power and validated the data line for a known good communication pattern.

This would also involve knowing high and low signal thresholds and possibly frequency stats, but I decided to take the low road to keep it basic. I know that a lot of techs may not be a network expert or may not have GM experience. What I do know is that the average tech is able to follow a diagram and flow it mentally so he or she can build a game plan of attack without getting too technical.

My basic goal was to keep it simple and just break down the system piece by piece until I found that needle in the haystack. There are many networks that are much more complex but it seems to me that GM simplified this system by using network splices to aid in isolating a circuit fault in the system. Sometimes these splices are hidden and taped in inaccessible areas of the vehicle, but having good information systems can help you pinpoint their locations in the vehicle. In the end it's all about knowing how to utilize your equipment, information systems and building a game plan of attack that makes you a winner.



JOHN ANELLO owns Auto Tech on Wheels in northern New Jersey, which is a mobile diagnostic service for 1,700 shops, providing technical assistance and remote programming. He is also a nationally known trainer.
atowscopeit@aol.com

Motor Age SearchAutoParts.com

PRESENT

autopro NETWORK

Step into a Virtual Training Lab Designed Specifically for Automotive Professionals Like YOU!

WE'VE GOT TERABYTES OF FREE RESOURCES TO IMPROVE YOUR SKILL AND GROW YOUR BUSINESS:

- HOW-TO VIDEOS
- MANAGEMENT AND TRAINING OPTIONS & RESOURCES
- INFO ON THE LATEST PARTS AND EQUIPMENT ... **AND MORE!**

PETE MEIER
Director of Training / Technical Editor

"The autopro NETWORK connects you with experts, colleagues and industry professionals in a user-friendly, online platform. Step your game up by exploring information and resources for technicians, shop owners, manufacturers, distributors and more!"

Join today at https:// WorkShop.SearchAutoParts.com

WD-40 Specialist impresses in the shop

Historic Hayward, Wis., home of Ernie's Auto Body, attracts year-round tourists who take advantage of the region's spectacular scenic beauty and its opportunities for cross-country skiing, snowmobiling, golfing and bicycling.

Serving the vehicle repair needs of both the guests and neighboring residents as efficiently and expertly as possible is the prime goal of John R. Magowan, the shop's owner. Quality repairs, high CSI scores and low cycle times are key elements of his success.

"At Ernie's Auto Body, we are continually searching for the best product to help us deal with removing rusty bolts," John says. "After trying several products, we were given the opportunity to try WD-40 Specialist Rust Release Penetrant Spray and have found it to be a far superior product, helping to increase our level of efficient and quality repairs."

"Living in northern Wisconsin subjects vehicles to the most brutal of winters," John reports. "The salt on the roads can cause vehicles to deteriorate and rust even in their early years."

These factors, of course, can lead to the toughest of challenges when it comes to facilitating the repair disassembly process. "So using WD-40 Specialist Rust Release Penetrant Spray is a must," Macgowan says.

Ernie's Auto Body 15995 Nursery Rd | Hayward, WI 54843

John and Karen Hoover, the owners of Jake's Auto Body & Towing, have fully embraced industry-leading "lean" production strategies while maintaining a stellar 9.9 Customer Service Index (CSI) rating at their "small but mighty" repair facility in High Falls, NY. "I've been using WD-40 [Multi-Use Product] for over 35 years and it never lets me down. Our shop runs lean — one choice product on every tech cart for the task at hand," John says.

"From the farm to the body shop, rusty bolts don't stand a chance," John points out, expressing high praise for the WD-40® Specialist® Rust Release Penetrant Spray.

John goes on to point out that "lean production is simple as long as you stay with it." He suggests that you monitor the operational measurements associated with production and look at all your numbers to "understand your expenses and what it costs to open the door." Ongoing education is present throughout the entire operation, which includes utilizing the most effcient materials – including WD-40® Specialist® Rust Release Penetrant Spray.

"Cycle time is mission-critical in our business. The WD-40 Specialist Rust Release Penetrant Spray works instantly.

We can't afford to wait for results, and with this product we don't have to," he says.

Jake's Auto Body & Towing 2302 Lucas Turnpike | High Falls, NY 12440

"Work smart, not hard," descirbes the shop floor philosophy at Quality Auto Paint & Body, a high-volume collision repair facility in Roanoke, Va. that consistently pursuescontinuous operational improvements.

"With a name like Quality, our customers expect their vehicles to be repaired right and fast," says General Manager Richard W. Henegar Jr., who is universally known as "Junior."

"WD-40 Specialist Rust Release Penetrant Spray helps our business meet those expectations. It makes the toughest bolts and fasteners easy to remove, and the repairs are completed smoothly where other products have failed."

"In an industry that is constantly changing in technology and procedures, it is great to have something that evolves with us to make the job easier," Henegar says. "Our shop always uses WD-40 Specialist Rust Release Penetrant Spray," he adds.

"Let's be honest, working on cars can be seemingly impossible at times when nuts, bolts and parts can't be removed to complete the repairs," he explains. "WD-40 Specialist Rust Release Penetrant Spray helps to make the impossible jobs seem possible. With so many uses, it is one of the most versatile tools a tech can have."

Quality Auto Paint & Body 1529 Seibel Drive | Roanoke, VA 24012

POSITIONS AVAILABLE

PRODUCTS

FAN ASSEMBLIES

VDO Fan Assemblies are ready to install right out of the box. No assembly required. They're OE-quality, vehicle specific assemblies built and tested to OE specifications. Exclusive "Dual Bearing" design provides quieter, efficient motor operation. The 100 percent pure plastic resin compounds ensure superior durability and thermal stability. Below OE dealer pricing offers economical choice for shops.

WWW.VDO.COM/USA

ELECTRONIC FUEL PRESSURE REGULATORS

FUELAB 529XX Series Electronic Fuel Pressure Regulators work directly with FUELAB Prodigy fuel pumps to control pump speed, thereby, reducing heat build-up and vapor lock conditions related to street and strip operation. Just like standard EFI regulators, the 529 Series regulators relieve pressure (back to the fuel tank) once the set pressure is achieved.

WWW.FUELAB.COM/PRODUCTS

ENGINE, TRANSMISSION MOUNTS

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

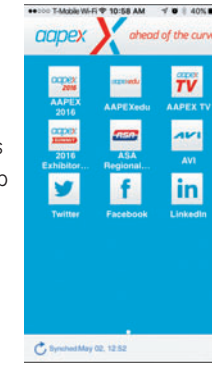
WWW.NAPAONLINE.COM

BRAKE PADS

Carquest Wearever® Gold Brake Pads, available exclusively at Advance Professional and Carquest, are formulated to meet or exceed OE specifications for consistent, quiet and clean braking. Engineered for exceptional, ultra-quiet stopping power, longer life and cleaner wheels, Carquest Wearever Gold provides the level of quality and safety you and your customers depend on. For more information on Carquest Wearever brake products, contact your local Advance delivery location.

WWW.ADVANCEAUTOPARTS.COM

AAPEX 365 APP



With the new AAPEX 365 App, you no longer have to download the app year after year. Instead, it will update automatically with new content as it becomes available. To download it now, visit the App Store and Google Play. AAPEX will be held Tuesday, Nov. 1 through Thursday, Nov. 3, at the Sands Expo in Las Vegas, with AAPEXedu sessions starting on Monday, Oct. 31.

WWW.AAPEXSHOW.COM

BRAKE PARTS LUBRICANT

Permatex Silicone Ceramic Extreme Brake Parts Lubricant prevents disc brake squeal and chatter. Protecting caliper pins, sleeves, bushings, and pistons against seizing and galling. The 100 percent silicone, non-petroleum based formula will not melt. High-temp, ceramic-solids deliver excellent performance on all sliding surfaces. Works from -50°F to 3,000°F. Will not wash out. Lasts throughout life of pad. Compatible with all components.

WWW.PERMATEX.COM

ELECTRICAL PIN CLEANERS

Innovative Products of America®'s No. 8043 Micro Male Electrical Pin Cleaners are specially engineered with an innovative, contoured design and durable diamond coating to safely clean Deutsch, Cannon, Bullet and other round terminals ranging in sizes from .030- to .040-inch, .060- to .070-inch and .090- to .100- inch – the same sizes found in most makes of cars, trucks, construction, agriculture, industrial and military equipment.

WWW.IPATOOLS.COM

AUTOMOTIVE FILTERS

MANN-FILTER provides premium oil, air, cabin air and fuel filters for the automotive aftermarket. MANN-FILTER products are known for high quality performance and reliability, as well as product coverage of more than 96 percent of European makes and models on the road in North America. By supplying products to meet the most demanding manufacturers' requirements, MANN-FILTER has set the industry standard.

WWW.MANN-HUMMEL.COM

AD INDEX

AD INDEX

ADVERTISER	PAGE #
AAPEX	35
ACDELCO	3,5
ADENNA	52
ADVANCE AUTO PARTS	7
ARAMARK UNIFORM SERVICES	47
ARNOTT INC.	68
AUTOMECHANIKA FRANKFURT	20
AUTOMOTIVE MGMT. INSTITUTE	73
AUTOMOTIVE TRAINING INSTITUTE	16
BENDPAK INC.	27, 28, 53, 54
BLUEDEVIL PRODUCTS	49
CARTER FUEL SYSTEMS	15
EXXON MOBIL	CV2

ADVERTISER	PAGE #
FEDERAL-MOGUL MOTORPARTS – GARAGE GURU/REWARDS	70
FEDERAL-MOGUL MOTORPARTS – MOOG	25, 59
FEDERAL-MOGUL MOTORPARTS – WAGNER BRAKES	43, 67
FORD MOTOR MEDIA – PARTS WHOLESALING	8, 9, 63
FORWARD LIFT	39
FOX VALLEY TECHNICAL COLLEGE	74
GATES CORP.	51
INDUCTION INNOVATIONS	55
KIA MOTORS AMERICA	31, 71
LAUNCH TECH USA INC.	57
MERCEDES-BENZ USA	23
MITCHELL 1	21
NAPA – BILLING	COV TIP, 19

ADVERTISER	PAGE #
NISSAN MOTOR CORP. USA	CV3
O'REILLY AUTO PARTS	11
PICO TECHNOLOGY	37
PUROLATOR	33
RANSHU	40, 41
RITCHIE ENGINEERING	24
SCHAEFFLER GROUP USA INC.	16A-D, 26
SHELL OIL – PENNZOIL	12, 13
TENNECO INC - MONROE SCHOCKS & STRUTS	65
TYC GENERA	45, 61
WD-40 CO.	76
WORLDPAC	CV4

PRODUCT INDEX

AAPEX 78	INNOVATIVE PRODUCTS OF AMERICA 78	PERMATEX 78
ADVANCE AUTO PARTS 78	MANN-FILTER 78	TRICO 79
BENDPAK 79	NAPA AUTO PARTS 78	VDO 78
FUELAB 78	OIL EATER 79	WORLDPAC 79

WIPER BLADE LINE

The TRICO Exact Fit® blade line offers three new rear part numbers that fit 1.8 million registered vehicles. The 10-B blade replaces OE integral blades on Infiniti, Mitsubishi, Nissan and Suzuki vehicles; the 10-E blade fits snap claw wiper arms on Chevrolet, Dodge, GMC and Saturns; and the 15-I blade is designed to fit on Audi, Porsche and Volkswagen models.

WWW.TRICOPRODUCTS.COM

LOW-RISE LIFT

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

WWW.BENDPAK.COM

TEXTAR HIGH CARBON BRAKE DISCS

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

WWW.WORLDPAC.COM

FLOOR CLEANER

Oil Eater has introduced a specially formulated powdered floor cleaner in a 38-pound bulk case that keeps waste to a minimum by requiring only one scoop per mop bucket to maintain proper dilution and control overuse. The ultra concentrated product features a combination of non-petroleum solvents and surfactants to eliminate grease, oil and dirt from soiled floors and other areas in maintenance areas.

WWW.OILEATER.COM

COME ON IN — THE WATER IS FINE!

ISN'T IT TIME YOU JUMPED INTO THE REPROGRAMMING POOL?

PETE MEIER // Director of Training

A technician's job is becoming more like that of an IT specialist than that of a greasy wrench head every day — not saying there is anything wrong with the latter! Many of the complaints and concerns your customers are bringing to you, though, increasingly are related to something a computer is doing. And the repair requires some form of interaction with that computer and sometimes with other computers that rely on the same sources of information.

The first onboard automotive computers were very basic, and code retrieval often was just a matter of jumping certain pins in a wiring connector and watching a light flash out its version of a Morse Code of sorts, identifying the code that was recorded. There was no reprogramming, though on many models the memory chip had to be swapped from an old module to a replacement one.

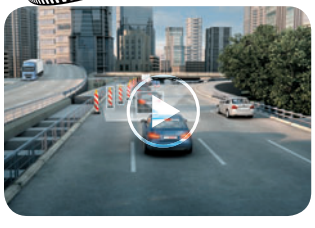
Today, the computing power of individual modules on a car rivals that of the laptop you use in the shop or at home. Instead of just one module, now there are dozens of modules on the car, making up multiple networks that control everything from engine management to how cool the cabin stays.

TODAY'S TECHNICIAN has more in common with an IT specialist than he or she does with wrench turners of old.

Replacing failed modules often requires some form of initialization procedure before the car will accept the transplant, and many customer concerns are related to faults in the software of the controlling module. Additionally, other components on the car have to be learned by the controlling computer(s) and the list of these components is always growing. Today, on many models, even a new battery has to be introduced to the ECM.

The need to be involved in reprogramming and to understand what tooling and precautions are needed to be successful in meeting these challenges is old news, yet many shops still ship off these money-making opportunities to their local dealer rather than take the plunge themselves. In this edition of The Trainer, we'll show you what it takes to enter this arena and add a very profitable source of revenue to your shop, with a little help from our friends at Drew Technologies.

VIDEOS

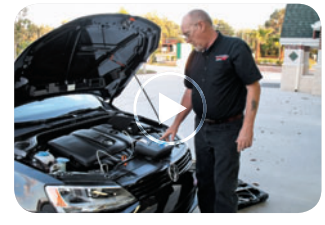


Defining the "connected" car for your shop

MOTORAGE.COM/jun16trainer

Don't cause a cooling system problem!

MOTORAGE.COM/may16trainer



How to handle a hot customer

MOTORAGE.COM/apr16trainer

How to check volumetric efficiency

MOTORAGE.COM/mar16trainer

NISSAN

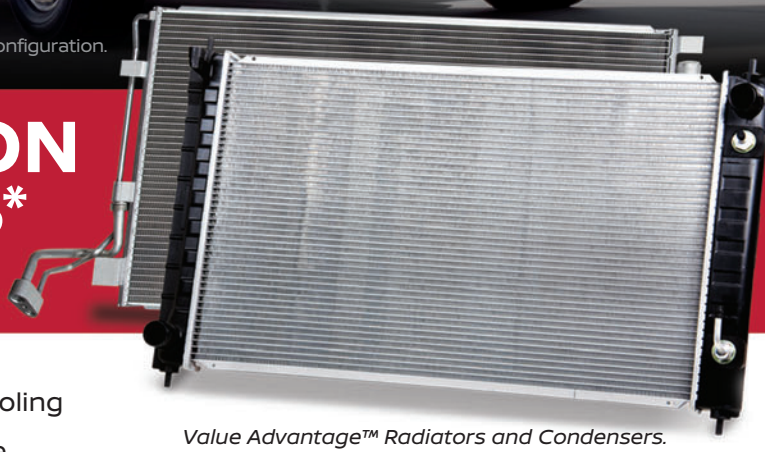
Innovation that excites

THE HEAT IS ON

SAVE BIG ON NISSAN COOLING COMPONENTS

2016 Titan® Platinum Reserve model shown. Towing capacities vary by configuration. See Nissan Towing Guide and Owner's Manual.

35% OFF MSRP ON POPULAR PARTS* EVERY DAY



Value Advantage™ Radiators and Condensers. Nissan-validated performance at a very competitive price.

Summer can put a lot of strain on an engine's cooling system. Be sure your customers are ready for the hot summer ahead. They deserve products that meet Nissan OE standards for fit, form and function.

MORE HELP IS HERE.

When you are unsure how to fix it, call the no-fee Nissan Installer Repair Hotline powered by Identifix: 1.855.828.4018**.

nissantechnews.com

parts.NissanUSA.com

*35% off MSRP for eligible popular parts only. MSRP excludes all applicable taxes. Participating dealer sets actual price. Exclusions apply. Subject to part availability. Value Advantage™ remanufactured engines and transmissions are not included in eligible part categories and are not eligible for discount. **Identifix Repair Hotline hours are Monday-Friday, 7am-7pm CST.


SO MUCH.
SO SIMPLE.
Complete Solutions for Independent Service Professionals
SACHS
ZF Parts
DELPHI
HELLA
VDO
PENTOSIN
akebono
BRAKE EXPERTS
MANN FILTER
ACDelco
MAHLE ORIGINAL
DENSO
STABILUS
LEMFÖRDER
TRW
BOSCH
bosal
Continental CONTITECH
Gates
TEXTAR
KYB
World Class Shocks & Struts
HELLA PAGID
BRAKE SYSTEMS
SCHAEFFLER
AUTOMOTIVE AFTERMARKET
LuK
INA
FAG
RUVILLE
rein AUTOMOTIVE
AISIN
BEHR HELLA SERVICE
WORLDPAC TES
EXEDY
WTI
WORLDPAC Training Institute
CARDONE
NPN
REDLINE
WBR
World Brake Resources
BILSTEIN
DORMAN
NEW SINCE 1918
WORLD SOURCEONE
ISG
brembo
VICTOR REINZ
NGK
SPARK PLUGS
Zimmermann
Valeo
ENEOS
MITSUBISHI
Niiral
autologic
BANDO
MAVAL
ADVICS
prestolite
mountain
LASO
GLYCO
GEBA
GMB
IDEMITSU
FEQ AXLES
febi
bilstein
MOPAR
LIQUI MOLY
NISSIN
SPECTRA PREMIUM
FTE
ONE-CLICK PRODUCT ORDERING
NTK
OXYGEN SENSORS
PILENGA
Brake Disc Division
metrix
VAICO
BERU
RED LINE
SB SANGSIN BRAKE
CSF
The Cooling Experts
VEMO
CORTECO
GOETZE
Nissens
PRENCO
Arnott
Motorcraft
The Right Part at the Right Time™
WORLDPAC
Wholesale Distributor of Original Equipment Automotive Parts
WIN! Microsoft Surface Pro 3
worldpac.com/simple5