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July 2015
Talk Shop Anytime
AUTOPRO WORKSHOP
Vol. 134, No. 7

COMMUNITY

GM 'BAS' ENGINE START/STOP INACTIVE

Identify which pressure switch assembly design level belongs in the transmission

TECHNOLOGY

NO CODE DIAGNOSTICS

Just because a problem doesn't store a code doesn't mean the problem can't be found.

OPERATIONS

HELP YOUR CUSTOMERS SAY YES

A purchase decision is based on the value they perceive

NOT YOUR FATHER'S CHARGING SYSTEM

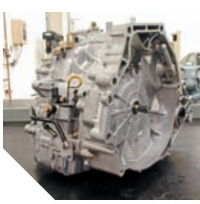
TIPS AND TECHNIQUES FOR SUCCESSFUL TROUBLESHOOTING OF CHARGING SYSTEM CONCERNS

ENTER THE MOTOR AGE TOP SHOPS CONTEST TODAY MOTORAGE.COM/2015TOPSHOPS

TECHNOLOGY

CLEAN AND LEAN

We take a close-up look at the new Dodge Ram 1500 EcoDiesel light-duty truck



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TACKLING CVTS

Training is needed to diagnose and repair these transmissions of choice for hybrid vehicles

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July 2015 Vol.134, No. 7

Motor Age

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TECHNOLOGY

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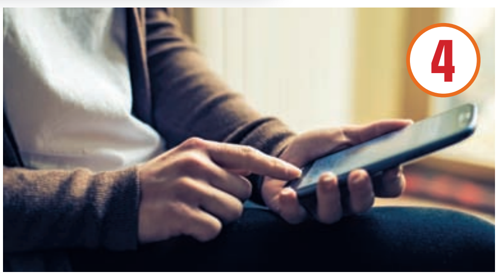

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ONLINE COVERAGE

THERE'S MORE ONLINE:

ENTER THE MOTOR AGE TOP SHOPS CONTEST TODAY

The Motor Age Top Shops Contest is taking submissions, and the pared down digital-only makes it easier than ever to enter. The deadline is July 31!

»» MOTORAGE.COM/2015TOPSHOPS

EPA SEEKS STRICTER OZONE STANDARD

A proposed change could change the standard from 75 parts per billion to an aggressive standard of 60 ppb.

»» MOTORAGE.COM/OZONE

CARS BRINGS ON MITCHELL 1 TRAINER FOR SESSION

CARS announced the involvement of Tim McDonnell, Mitchell 1 National Training Manager, in a "Shop Management Unleashed" session on July 22.

»» MOTORAGE.COM/MCDONNELL

TIMKEN LAUNCHES NEW TRAINING VIDEOS

The Timken Company has released three new training videos for technicians.

»» MOTORAGE.COM/TIMKENTRAIN

ASA'S MOLLA TO KEYNOTE MACS 2016 TRAINING EVENT

Tony Molla, vice president of the Automotive Service Association will be the keynote at the MACS 2016 Training Event and Trade Show, Feb. 11 in Orlando, Fla.

»» MOTORAGE.COM/MOLLAMACS

FEDERATED SWEEPSTAKES TO GIFT A GMC SIERRA

Open to any fully enrolled Federated Car Care Center member, the "Need A Lift?" sweepstakes is open until Aug. 15.

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ENTER INDUSTRY NEWS

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SOCIAL MEDIA

Brands get more positive feedback on social media

Social media users would rather post positive feedback to brands and companies than a complaint, according to the latest Customer Service Benchmark results from Voice of the Customer specialist eDigitalResearch.

The benchmark results reveal that, since the last wave back in March 2014, consumers are predominantly using social media to give positive feedback. Of the 2,000 consumers surveyed who have used social media to contact a brand in the past year, 6 percent have used social media to send positive feedback about a company compared to 2 percent who said they have sent a complaint.

Users turning to social media as a customer service touch point within the past year has grown to 11 percent. The study also found that live chat rated much higher than other digital touch points with a 73 percent satisfaction score. Live chat offers customers the ability to chat to a brand representative in real-time without long delays, automated systems or "hold" music. One third of those surveyed now expect to be able to contact a brand by live chat.

Derek Eccleston, Global Commercial Officer at eDigitalResearch, said "The latest results suggest that the easier a company makes it for a customer to contact them, the more satisfied they are likely to be."

Photos: Thinkstock

BREAKING NEWS
INDUSTRY INSPIRATION

PODCASTS CHRONICLE SUCCESS STORIES

Remarkable Results; the first ever weekly podcast dedicated to interview today's most successful and inspiring automotive aftermarket entrepreneurs has launched. The podcast has released seventeen episodes since the inaugural debut in March 2015. The "Remarkable Results" podcast (like a radio show) will focus on the professional service provider. The entire distribution channel will be listeners of the weekly segment in search of what drives great operators.

Aftermarket veteran and podcast host, Carm Capriotto, says, "The interviews will engage successful service professional entrepreneurs on what makes up their personal success formula. Listen as guests talk about their

[PODCAST] CONTINUES / PAGE 7

Discussion is on-going in MotorAge.com forums


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[PODCAST]
CONTINUED FROM PAGE 4

pathway to remarkable results and get inspired by their wisdom, challenges, flashes of brilliance and passion for what they love to do.

Many guests have won local, national and industry recognition and are implementing cutting edge ideas to make a difference within their businesses and in their community. There is also a sister podcast called "On-Point" that will focus on a single subject that will include industry and company representatives to discuss critical, important and timely information that will benefit the podcast subscriber base.

Remarkable Results was chosen as the name of the podcast because there are so many service pro's that have outstanding businesses and have results that exceed normal business standards; be it in marketing, tech training, financial/business, social media, and/or team building among others.

Our industry recognizes the extreme value and worth of the service professional and with vehicle technology on the rise and DIY waning the entrepreneurial service professional is the pinnacle of the industry and worthy of this focus, according to show organizers.

Capriotto is building a community of listeners that are dedicated automotive aftermarket professionals who want to learn from each other and share their remarkable results. The podcast can be streamed on iTunes, Stitcher Radio and on www.remarkableresults.biz website.

The first 17 episodes feature these professional service entrepreneurs: Dave Striegel from Elizabeth Auto Care, Jose Bueso, Lee Forman and Dwayne Meyers from Dynamic Automotive and Clint Dudley from Shade Tree Auto, Gene Morrill from Certified Automotive, Diane Larson from Larson's Service, Dough Whiteman from George's Shell, Joe Marconi from Osceola Garage, Amy Mattinat from Autocraftsmen, Matthew Roayaee from Auto Check, Judy Walter from Zimmerman's Automotive and Dave Serio from Vehicle Service Plus.

SCHAEFFLER STEPS UP WITH TRAINING

Torrance, Calif. – Knowing new automotive technology is out in the market, and actually getting a chance to see, touch and learn about something new are entirely different things. Just ask Paul Barnhart of Connie & Dick's Service Center in Claremont, Calif.

"I'm glad that I'm here," said Barnhart, at a June training event hosted by Schaeffler Auto Group. "The dual mass flywheel (DMF) and that new style clutch set up, I didn't know why they had gone to that. Having the clear explanation, I understand now why they went that way."

Barnhart was one of close to 100 participants in the two-day training program. Schaeffler brought in trainers from Ohio and Mexico to highlight new technology from Luk, INA, FAG and Ruville. The Southern California event was the first of two training programs for Schaeffler, which hosted a similar event in Toronto two weeks later.

John McKenna, Schaeffler Manager, Engineering & Product Development, said the double clutch that captivated Barnhart is now standard on most Ford Fiesta and Focus models since 2012. "That transmission in there, could theoretically replace an automatic transmission. That's big if it were to go that route," said McKenna.

Fast-moving technology is the very reason the company started events like this, and is planning to do more in the future. "Cars will be rolling into their shops and they're going to say, 'I've never seen one of these.' They have to learn about it," he said.

Schaeffler's Fernando Maya talks clutch technology with attendees during training in So. Cal.

Photo: Michael Willins

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QUESTION OF THE MONTH

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A. Technician A
B. Technician B
C. Both A and B
D. Neither A nor B

Take the test, and then go to MotorAge.com/jul15 to register for the free prize drawing from our partner, Federated Auto Parts!

FROM THE BLOG SPHERE

GM 'BAS' engine start/stop inactive

Identify which pressure switch assembly design level belongs in the transmission

BY **WAYNE COLONNA** | MOTOR AGE CONTRIBUTOR

A 2009 BAS (Belted Alternator Starter) equipped vehicle may have a complaint of the engine stop/start system being inactive and the Malfunction Indicator Lamp (MIL) is illuminated. Diagnostic Trouble Codes P1808 (Transmission Fluid Pressure Position Switch Stuck OFF) or P1809 (Transmission Fluid Pressure Position Switch Stuck ON) may set.

The Transmission Fluid Pressure Switch Assembly (TFP) for BAS equipped vehicles has an additional switch input to the Engine Control Module (ECM) which allows the ECM to know when proper line pressure is being maintained by the main pump or the auxiliary pump. This is called the pressure switch "A" switch signal (figure 1).

There is a first design level and a second design level, the first design level has a Normally OPEN switch, the second design level has a Normally CLOSED switch. The first design level switch was prone to collecting sludge in the switch contact area, which would result in preventing the switch from closing. The sec-

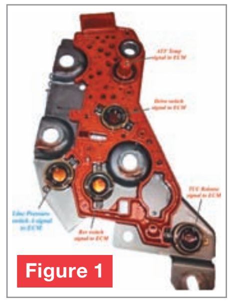
Figure 1

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

Brian Albright
Auto recalls are up but many warranty repairs not completed

The number of vehicles recalled in the U.S. reached a record high last year, but even as important safety recalls get more attention in the U.S., drivers often fail to get their vehicles repaired. That means millions of people in the U.S. are driving, buying or selling potentially dangerous vehicles.

Research released earlier this year from Carfax indicates that more than 46 million cars nationwide have at least one safety recall that's never been fixed, and 5 million of those vehicles were bought and sold in 2014. That is an enormous increase over the 2013 figures, when Carfax estimate there were just 3 million cars on the road with an open safety recall.

One in three minivans and one in five SUVs has an unfixed recall, according to the report. California, Texas, Florida, New York and Pennsylvania have the highest number of unfixed recalls. States with the highest ratios of unfixed recalled cars include West Virginia, Michigan, Mississippi, Wyoming and New Jersey.

"America's cavalier response to manufacturer safety recalls is putting lives at risk," said Larry Gamache, communications director at Carfax. "Every morning millions of people drive to work, school and other places in a potential ticking time bomb. Fires, crashes and serious injury are just a few consequences of letting recalls go unfixed. The minor inconvenience that comes from having a recall fixed pales in comparison to what can happen if you don't."

The National Highway Traffic Safety Administration (NHTSA) requires automakers to quickly notify regulators and owners when a defect is uncovered. But that doesn't mean that owners actually get the repairs made. A 2011 audit by the General Accounting Office (GAO) found that less than 70 percent of vehicles under recall were actually repaired.

The problem is only getting worse as the pace and size of recalls increases. There were 64 million vehicles targeted by recalls in 2014, twice the previous record set in 2004. The recent Takata airbag recall has thrown this problem into sharp relief.

Continue reading at Motorage.com/recalls.

ond design level switch being normally closed would have a longer service life.

When the first design level switch would stick open, DTC P1808 would set. Installing a second design level switch assembly into a first design level vehicle will cause DTC P1809 to be set.

Use the transmission identification tag, located on the transmission case to identify which pressure switch assembly design level belongs in which model transmission. Continue reading at Motorage.com/bas. MA

Motor Age TOP VIDEOS

MOST WATCHED VIDEO

What is "fuel trim"?

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Hybrid conversions can save fleets money!

To improve fuel economy and reduce maintenance costs, many large corporations are converting their conventional vehicles to hybrid drives.

Motorage.com/fleets

Using MotoSHOP to make your shop efficient

MotoSHOP Product Manager Scott Avellino talks with Pete Meier about their newest MotoSHOP technology tool – the Shop Management System.

Motorage.com/motoshop

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Noteworthy

comments from *Motor Age*'s online communities

The best of what you're saying in the *Motor Age* group on LinkedIn

Lance Boldt, Co-Founder/VP of AutoNetTV wrote:
What do you find to be the most effective way of changing service customers' feelings from fear to confidence in you and your business?

Richard Nelson, Technology Project Manager and Team Builder:
This is why I continually stress relationship, relationship, relationship! Social media is awesome for communication but extremely dangerous and dicey with regard to managed perception.

Michael Rodriguez, IT Coordinator and Technical Support:
I could not agree more with your comments, Richard. Taking the time to get to know your customer is paramount and you must know your own limitations so you can confidently walk with them on this journey. In time this feeling of fear will be subdued, maybe not entirely, however; if it should rear its ugly head, you have built a solid foundation on trust and your customer will know this and feel it.

Jorge Antico, Founder and CEO, eAutoClub.com:
I don't usually jump in on discussions, but this one is close to my heart. You're touching on a vital aspect of our business that is often misunderstood. In the interest of full disclosure, I have been working on this specific problem for the last 15 years. No amount of marketing will ever deliver the "awesome automotive service experience."

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

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ABRN.COM

The changing face of the jobber industry
The paint jobber industry is undergoing significant change. Increasing customer concentration is putting pricing pressure on the entire refinish materials supply chain.
ABRN.com/jobber

Repair vs. replace carbon fiber
Knowing when and how to repair newer materials, such as carbon fiber, and whether the repairs are structural or cosmetic, will allow you to make the best recommendations.
ABRN.com/carbon

You are not the only one
Surveys give shops an opportunity to better understand the billing and payment policies of other shops. *ABRN.com/surveys*

AFTERMARKETBUSINESS.COM

O'Reilly Automotive authorizes additional $500 million in shares
Board of directors approves resolution to increase the authorization amount under its share repurchase program.
AftermarketBusiness.com/repurchase

Uni-Select completes sale of US parts distribution activities
Uni-Select completed the sale of all assets of Uni-Select USA and Beck/Arnley Worldparts to affiliates of Icahn Enterprises L.P.
AftermarketBusiness.com/uniselectsale

Automechanika to come to UK
Messe Frankfur announced the launch of Automechanika Birmingham, June 7-9, 2016.
AftermarketBusiness.com/birmingham

2015 INDUSTRY CALENDAR

31

July 21-25
NACE | CARS 2015
Detroit, Mich.

November 2-5
AAPEX 2015
Las Vegas, Nev.

November 3-6
SEMA 2015
Las Vegas, Nev.

November 4
NASTF General Meeting
Las Vegas, Nev.

read it on MotorAge.com

ROTARY LIFT VIDEO FOCUSES ON CUSTOMER SUPPORT
Video shows what sets company apart from others
/rotaryvideo

CREW CHIEF TODD GORDON EARNS PROBLEM SOLVER HONORS
He delivered best second-half improvement
/gordon

FEDERAL-MOGUL RECEIVES NCMA AWARD FOR EXCELLENCE
Recognized for integration of FP Diesel product
/fmaward

MANAGEMENT

INVEST IN WELLNESS

CREATING AND IMPLEMENTING AN EMPLOYEE WELLNESS PLAN WILL HAVE A POSITIVE IMPACT ON YOUR SALES, PRODUCTION AND PROFITABILITY

BY **BRIAN CANNING** | CONTRIBUTING EDITOR

ON THE one hand, having a business plan that sets performance goals for such items as sales, production and profitability is critical to our success but too often our greatest resource — our staff members — are an afterthought and little or no thought is given to their well being or health. Every year the automotive repair industry loses millions of dollars in sales, productivity and profits to a lack of attention to employee wellness, though study after study shows that investment here provides a huge opportunity for a strong return. Investing in the wellness of our technicians, service advisors and service managers is definitely worth the effort, not only for them but for our shop and for the automotive repair industry as well.

Have you ever had a technician who smoked or abused drugs or alcohol? Whether or not you want to know about or acknowledge the negative impact smoking, drug or alcohol abuse can have on your staff and therefore your shop, all three are common behaviors having a major impact on the workplace across all industries in the U.S. These behaviors are also, without a doubt, in one way or another impacting our sales, profits and productivity. That minor cold that turns into bronchitis and a weeklong absence is very typical of the challenge smoking brings to our work place. It is very difficult for that technician to be productive sitting at home on his couch hacking his lungs out.

The impact of alcohol on our service operation is just as bad, if not worse. By promoting employee wellness, and in this, smoking cessation along with drug and alcohol programs, we could contribute significantly to the health of our staff members and our viability as a business.

It would be easy to say that wellness is not our concern as shop owners or as service managers. But just as our service advisors and technicians need to contribute to the viability and sur-

Photos: Thinkstock

vival of the shop to assure their own wages and continued employment, we as shop owners and service managers need to contribute to the efforts and well being of our staff members to assure our own success and survival.

Along with providing quality shop equipment and a good working environment, we need to invest in the health of our staff members and develop a wellness plan that will enhance their efforts, encourage improved behaviors and in this, assure their consistent and best effort.

Like everything else that we do, employee wellness programs cost money, but unlike a lot of the things we spend money on in the automotive repair world, wellness programs have the potential to provide a very strong return on investment (ROI). This is most clearly visible in reduction in both shop keepers' and healthcare insurance premiums, as well as reduced absenteeism and improved productivity. Study after study has shown that wellness programs can reduce healthcare costs and costs associated with absenteeism from 25 percent to 30 percent within 3.5 years of inception, all of this without the additional benefits of improved morale and retention. This ROI comes from lower health insurance premiums, reduced worker compensation claims, reduced absenteeism and increased productivity. Believe it or not, employees tend to feel good that their employers are making the effort and taking an interest in their wellness, which takes the very positive effects of quitting smoking or weight loss and magnifies that impact by giving our staff things to feel good about and reasons to stick around and work smarter and more productively. What's not to like about that?

Wellness plans use a variety of methods to encourage employees to become healthier including health appraisals, counseling and weight-loss programs. Some provide financial incentives for participation and many companies create an environment that promotes healthy behavior, with smoke-free zones, on-site fitness facilities and free gym memberships for participating employees. Remember, studies have shown again and again that these wellness programs will generate a tangible return for us and for the business, so be creative and thoughtful in whatever directions you move and make your effort toward improved employee wellness relevant to you, your shop and to your staff. If you have no smokers on staff, having a smoking cessation program will probably not be that impressive; however if you have a couple of guys who are overweight or struggle with the bottle, it might be a great thing to have a weight-loss program, free gym memberships or drug and alcohol counseling included in your plan.

Another very important step is our full commitment and participation in whatever we do. If our staff members see us, as shop owners and service managers, losing weight or quitting smoking, our plan has a much better chance of having an impact and delivering that ROI we talked about. Talking wellness is one thing, but walking that walk is another.

No two wellness plans are alike. We need to make ours unique to our shop and our staff, with goals and expectations that suit us. We need to find our own way of spelling success and find ways to make the success of our staff members within the wellness plan part of our success as a shop. Their success, improved health and availability to work are as big a win for them as it is a win for our shop.

Incentives are important in changing behavior and are very useful in helping us measure commitment and success. A very important step is getting your staff interested in participating. Your actions and commitment here are crucial to making employee wellness something our employees will care about. If you care, I can promise you they will.

A great place to start in developing a wellness plan is with your healthcare provider. If they are unable to come up with a plan that works for you, find somebody who can. A Google search will yield any number of providers. The right plan is definitely out there.

Successful wellness programs incorporate some or all of the following elements:

- A company sponsor (that's you!)
- A comprehensive plan design
- Commitment and leadership from the top down
- Assessments of employee health status, identifying risks or concerns
- Individual counseling on assessment results, especially for high-risk employees
- Risk-management strategies
- Incentives that are relevant to our staff members
- Proposed changes (A published plan)
- Efforts to maximize participation (Make it "Our Plan" not "My Plan")
- A continuing commitment and leadership toward employee wellness

More than that canned marketing plan you just had to have and way more than that gas analyzer you bought last year that nobody uses, creating and implementing an employee wellness plan will have a very positive impact on your sales, production and profitability; but don't do it for that. Do it because your greatest resource, your service advisors and technicians, deserve it and will benefit from your care and concern. If you take care of them, the sales, production and profitability will take care of itself.

Think of what you could do if three and a half years from today you were paying 25 percent or 30 percent less for health insurance, your staff members were missing far fewer days of work each year and as a result of this, you were generating 10 or 20 more billable hours per week. I am guessing maybe you could find something to do with that money and could easily live with the improved operation and reduced stress.

Employee wellness is not about them. It's about us, all of us. It's about being a good shop or a great one. Which do you want to be? MA

BRIAN CANNING
CONTRIBUTOR

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

Email Brian at brimarc@hotmail.com


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HELP YOUR CUSTOMER SAY YES

A PURCHASE DECISION IS BASED ON THE VALUE THEY PERCEIVE

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

WE ALL want to help our customers see the value of investing in their car. I overheard ATI coach Mike Bennett teaching a client exactly how and when to sell value. I have also included a link to the ATI Service Advisor Checklist to help you and your staff present estimates better. Mike began: "Man, it's just that time of the year; it's tax time; it's the weather; it's the holidays. We just can't get anyone to say, 'Yes.'" As a coach, I hear one of these "justifications" a couple dozen times a week. But justification? Maybe a better word would be excuse. Let's make one thing clear. When we are talking about selling, it's more about customers buying. The key is to present the very real needs of the customer so they can make the informed decision to maintain their vehicle.

I understand that there are times of the year when a customer's willingness to invest in their vehicle may seem to go down. But perhaps it is more true that their need to feel and understand value has gone up. To understand our customers we need to understand that a purchase decision is not based on just price. It is based more on the value they perceive in what you are presenting. There are times when it may seem their perceived willingness goes down. However, it's more accurate that, because of whatever is going on in life their need to feel value — their value threshold — has gone up.

Our presentations do not change a whole lot from day to day or season to season. We present an estimate the way we present an estimate. What changes is that there are times when a customer's decision-making threshold, or the value they have to perceive to make the approval, goes up.

Talk to the customer's value level

Assume your standard presentation has a value level of 7 on a scale of 1-10. If a customer is getting ready for vacation or their child is about to take the car off to college, their "need for value" threshold is, say, a 6. So, your presentation at a level 7 will certainly be enough to satisfy their value threshold, and you will likely make the sale.

Now, imagine it's February. There are no travel plans anytime soon. The Christmas credit card bill has arrived and the youngest was just at the dentist who is talking braces. This customer's value threshold just jumped from a 6 to a 9. So if you're making your standard sales pitch at a value level 7, chances are you are not going to get the sale today!

So, the opportunity is to take a critical look at our sales presentations and figure out what we can do to make every presentation a 10! Are we communicating the value of our service? Have we established the vehicle value to make the value of investment we are asking them to make seem appropriate and sensible?

When working with service advisors, I stress a couple things when reviewing the elements of the value presentation. 1) Great sales persons are not born. The skill is developed

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"WHEN YOU EXPLAIN AN ESTIMATE TO THE CUSTOMER, SHOULD YOU SAY THIS IS YOUR COST OR PRICE? I LIKE TO USE: YOUR TOTAL INVESTMENT IN YOUR CAR TODAY IS..."

CHRIS "CHUBBY" FREDERICK [ATI CEO]

and honed. Practice and preparation makes perfect. 2) Believe in what you are selling. If you don't believe it, neither will the customer. The very best salespeople passionately believe in their product. Below is a list of what I see as the important elements of a sales presentation.

Summary of the estimate presentation

- **Don't just dial the phone.** Be prepared with the key points to cover. Have your descriptive analogies ready and make sure you understand what you're talking about.
- **Take a breath.** Be prepared to communicate with control, energy and passion. Bring emotion and a dynamic voice to the conversation.
- **Lower the walls.** When they answer the phone and realize it's you, they are instantly apprehensive. Their initial thought is likely, "How bad is it? What's this going to cost me? And, is the vehicle even worth it?" Your opening statement should be about building value in the vehicle. Help them start from a point of feeling good about the vehicle rather than launching into what you found and all the negatives related to what is broken or needed. "We've had a chance to evaluate the concerns you mentioned, as well as give the vehicle a thorough inspection. Overall the vehicle is in really good condition, and it is clear you've done a good job of maintaining it."

Follow a four-point presentation model for each item, system or recommendation. This is simple and should not be drawn out or deeply technical.

1. What is it, and what does it do? Give a simple explanation of what component or system you're referring to, how it works and why it is important.
2. What goes wrong? Give an explanation of the factors that can cause the condition and what happens when it goes bad.
3. What are you going to do to fix it? You're the professional. Explain what you're recommending and why.
4. What is the value? What is the customer going to get from the repair? Why should they want to approve the repairs and what is the win for them?

"An oil pump's job is to circulate engine oil through an engine just as a human heart would circulate blood throughout the body. When the oil pump wears out, just like a weak heart, it (the pump) can't circulate enough oil to keep metal-on-metal parts well lubricated and eventually those components will wear out. What we are going to recommend is to replace the oil pump and clean the screen that feeds the oil to the pump. Doing this will not only fix the tapping noise, but it will also return the lubrication system to as good as new, so the system will have the same capacity and function as it did the day the engine was new, and that means the engine should last for a long, long time and give you good and reliable service." This should not take more than a minute or two.

- This is not a monologue. Make sure the conversation is a two-way conversation. Ask questions that they can acknowledge and respond to with a yes. "Mrs. Jones, have you been noticing that the steering wheel has been shaking for a while when you hit the brakes?" YES. "OK, I assume that condition has been getting progressively more noticeable then?" YES. (Remember to praise them. Let them know that they've done a good thing by bringing the vehicle in and having the situation addressed.) "Well, Mrs. Jones, it is a good thing you brought the vehicle in for us to inspect. The condition is certainly not going to improve, and it is getting to a point where it could affect the reliability of the brakes in a panic situation." Getting a customer to say yes three to five times in a conversation increases the likelihood of a positive response to the close question.
- Wrap the presentation up and ask for the close. Review the plus points of the vehicle and reiterate the value you've already built into the recommendations. "And as we have discussed, your Chevy is in really good shape. You've done a great job keeping up with the maintenance. We are going to get these couple of items addressed and handled so the car should be back delivering the solid reliability you'd expect. The price for everything I have reviewed including sales tax is $XXX. We can get this done for you today by five o'clock. Is there any reason why we can't get started on this for you?" Some people are wired to say NO instinctively. Phrasing the close in this way allows them to say YES by saying NO.
- Once you have asked for the sale, shut up! If you have done your job using the techniques above, the only logical response the customer should be able to give is: "Yes, let's get it done." The golden rule of sales is: "He who speaks last, loses." You've made your pitch and presented every benefit for why it should be done. Once you've given them the price and asked for the approval, be quiet. Any additional conversation on your part just gives them time to talk themselves out of the approval.

Since selling is not like riding a bicycle, it always helps to have a checklist in front of you before you call the customer. You can receive our ATI Service Writer Checklist to help you and your staff present better estimates — try it free for a limited time by going to www.ationlinetraining.com/2015-07 MA

CHRIS "CHUBBY" FREDERICK
CONTRIBUTOR

Chris "Chubby" Frederick is the CEO and founder of the Automotive Training Institute. ATI's 108 associates train and coach more than 1,250 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 ATI Coach Brian Hunnicut.

E-mail Chubby at cfrederick@autotraining.net


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THE DAILY GRIND

REVIEW KPIS EVERY DAY WITH YOUR TEAM TO ENSURE CONTINUED PROGRESS

BY **BOB GREENWOOD** | CONTRIBUTING EDITOR

MANY shop owners are now seeking out courses that mathematically prove a great deal of net income is available in each business from their current business coming through the door. We know that the average five- to six-bay shop is missing $80,000 to $90,000 in net income from their current business. This is proven in every class. They are also learning the processes to achieve the desired results to capture that untapped income.

My concern is simple: are we prepared each day to address things when they fall short? This is a management responsibility and the discipline required to keep driving things forward is a necessity in order to keep the shop on track to achieve the budgeted objectives and guidelines that are set up every year.

These five questions should be verified and acted upon each day at the shop.

Are the KPIs being captured daily?

Daily KPIs must include total maintenance invoices completed today, total labor sold today, total value of deferred work today, number of vehicle inspections completed today, total billed hours and average billed hours per invoice.

Are you discussing the KPIs daily with the team?

It does not make sense to overwhelm the staff with sales dollars from every revenue category. The most important number is the labor number and what becomes of it. Labor dollars and billed hours are the team's life.

Does the team clearly understand daily KPI objectives?

The team must be let into the inner circle of the business and understand the KPIs and processes as to how they are achieved, as well as their importance to the business, their future income and their career.

What are you doing daily when your flat-line number of vehicles is not reached?

Your flat-line number is the maximum number of vehicles you should be booking per day based on your business facts. Too many shop owners don't understand what it does to their business when a shop is overbooked or under-booked. Taking on any work that just walks through the door compared to properly managing your clients'

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vehicle(s) is a road to buying yourself a lousy job. What if you don't reach the flat-line number each day?

Are you reviewing your calendar as to who is supposed to be getting their vehicle serviced based on their service intervals, which are set based on the way they are driving that vehicle? This is called managing the service intervals of every client. That is the way we are suppose to be doing business as our professional responsibility to our clients.

What are you doing daily when the hours billed per invoice falls below the shop objective?

In basic automotive maintenance, the shop should be averaging 2.5 billed hours per invoice. Unfortunately way too many shops are in the 1.2 to 1.6 billed hours. They have never looked at their vehicle inspection process and the managing of the service intervals of that vehicle. They just think they should have more car count and get busier. They are not looking after the business coming through the door in the first place. Why do they want more?

It is important to have a daily management routine. Addressing the above questions each day keeps management focused in the right direction. It is management's responsibility to ensure the team clearly understands the accountability that is required from them by ensuring they understand the math and the processes to achieve the goals, which in turn keeps the team heading in the right direction.

To achieve this understanding, I recommend a daily morning scrum of 10 to 15 minutes maximum before the shop opens to review the previous day's KPIs and the month-to-date trend. The scrum is held in the service bays with everyone standing in a circle and coffee/juice in hand. Management reports to the team. The morning scrum is to be positive, pointing out what we did well the previous day and discuss what we have on our plate today. Get the staff involved in the business, and stop leaving them in the dark. Quality staff are team players, want to contribute to the success of the business and are prepared to be accountable.

When the objectives and guidelines that are set in the budget are achieved consistently, peaks and valleys disappear, the business will be financially successful and the team will achieve above-average industry incomes.

Truly, we know that is the outcome everyone wants from our daily time spent working on our career.

BOB GREENWOOD
CONTRIBUTOR

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

E-mail Bob at greenwood@aaec.ca

SHOP PROFILE

A snapshot of one of the industry's leading shops

ORANGEVALE DIESEL / ORANGEVALE, CALIF.

Keep on truckin'

Reputation, customer service keep business thriving

BY **ROBERT BRAVENDER** | CONTRIBUTING EDITOR

As fuel crises forced up gas prices in the '70s, GM converted some of its standard V-8s to more efficient diesel burners. It was a disaster — head gaskets blew, fuel pumps failed, and within a couple years these misbegotten cars were just another bad memory.

"They did put a ding in the diesel market," recalls Dean Rue. "It gave diesels a stigma with the general public." As the owner of Orangevale Diesel he should know, but fortunately his specialty is the diesel pickup truck market, which has done nothing but grow over the past 25 years since he started his shop near Sacramento, Calif., and to Rue's knowledge, "the longest independently owned [facility] of its kind in Northern California."

California's capital has close to 2.5 million people in its metropolitan area, and Rue pulls from that entire region — and beyond. "I've got customers over in the [San Francisco] Bay area, Vacaville, Napa," he reports. "I've got other customers that come down from Reno. The other day I had a guy come down for transmission service and it turned out the power steering lines were leaking. He came down from Truckee, about a two-hour drive. It was raining and snowing over the summit, but he was here at 8 a.m. It was the first time he'd ever been here; he'd heard good things about us."

Such is Orangevale Diesel's reputation, which Rue recently expanded to social media. "I did that on my own at first," he explains. "Then we contracted out with the phone company. (Clients) might hear about us through word of mouth, and then they'll get on their phone and Google us to get a review or find out a little bit more about us. It's definitely the way things are going."

Reputation gets customers in the door, but Rue says it's also about making people feel comfortable by understanding where they're coming from. "You build trust by giving undivided attention. Let them finish their sentences so they don't think you're a know-it-all. You listen to them, give them some options so that they feel in the loop.

"I've been doing this long enough to where I've seen a couple of generations of families," Rue continues. "Back in 1990 when I first started, I'd get some people who were just retiring, so they buy a diesel truck and a trailer to go RVing. After 10 years that truck gets passed down to the son or grandson while the original owner buys a new truck."

At one time these trucks very utility made them almost disposable — rural artwork glorifies rust buckets

ORANGEVALE DIESEL

Dean & Shelbie Rue
Owners

Orangevale, Calif.
Location

1
Number of locations

25
Years in business

5/4
Total number of employees/techs

5,000 square feet
Shop size - main location

8
Number of bays - main location

$950,000
Annual gross revenue

National Federation of Independent Business
Shop affiliations

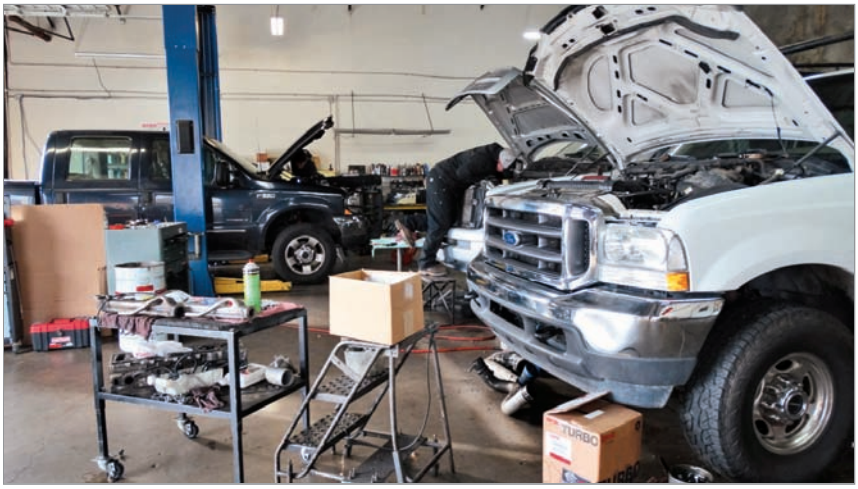
THERE'S STILL TIME! ENTER THE 2015 TOP SHOPS CONTEST @ MOTORAGE.COM/2015TOPSHOPS

Photos: Orangevale Diesel

rotting in fields or next to old barns— but diesel trucks can last a very long time. "Its kind of funny," laughs Rue, "since my employees are younger, when an old school diesel truck like an '82 or '85 comes in, they don't even know where to start."

While GM made up for its former gaffe by introducing the Duramax V-8 in 2002, Rue started off his career working on International-derived Ford diesels. "I was real familiar with those motors, so I decided to open up shop in 1990," he reports. "I work on all makes now: Ford Powerstroke, Dodge Cummins and Chevy Duramax. The other half [of our market] is RVers, retired people who travel a lot. I even used to work on the bigger, bus-based RVs, but I really don't have enough room."

"If they are mechanically inclined and been to school already, I can teach them the rest," – Rue says of finding the right people for his shop.



Since trucks are no longer strictly utilitarian vehicles, even diesel versions are dressed to the nines with options that make them as at home at the opera as on the farm. "I've seen a real big turnaround in the diesel market in technology and application," notes Rue. "It's a little tough to adapt to that, being an independent shop, but basically they're run the same way electronically, so we were able to figure things out."

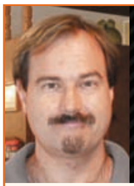
So much of a turnaround that Rue is even considering expanding into German-made diesel cars. "(They) require more specialty tools," he concedes, "but I've got another 1,200 square feet next door that I'd like to use for doing automotive stuff like Mercedes, Audi, VW; I just don't have the people right now."

Finding those people can be difficult, but Rue usually puts the word out to the tool guys, "to see if they know anybody in the diesel or automotive markets," he reports. "If they're mechanically inclined and been to school already, I can teach them the rest." He also uses Regional Occupational Program (ROP) students from the local high school and currently has one he plans to hire after the student graduates. "Its hard work being a mechanic," Rue cautions. "You've got to know fluids, electrical, computers; a whole variety of things."

This may be why Rue prefers the title "mechanic" over "technician" for his shop staff. "(A mechanic) tries to figure out why things break, what actually happened, more of an engineer," he explains, seeing the former as more of an independent thinker, the latter following proscribed steps.

"Our mechanics have their own hand tools and some power tools," says Rue. "Specialty tools like one that can pull out injector cups and run computer diagnostics, I supply. I've got the regular Ford IDS scan tool; I've also got wiTECH for the Dodge. GM works real closely with Snap-On, so we've got that."

The rest of his inventory is retail, since Rue also sells aftermarket parts to some of the dealerships, as well as individuals coming in to buy updated headlights for older trucks where the lenses have gotten glazed, transmission coolers, and a lot of fuel and oil additives. This being the California market, Rue is limited on engine upgrades, but none of this has stopped Dean Rue from doing his part to help take that danged ding out of the diesel market. MA



ROBERT BRAVENDER
CONTRIBUTOR

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

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Tackling CVTs

CLEAR AND VALID TRAINING IS NEEDED TO DIAGNOSE AND REPAIR THESE TRANSMISSIONS OF CHOICE FOR HYBRIDS

BY **WAYNE COLONNA** | POWERTRAIN PRO PUBLISHER

THE acronym for continuously variable transmission is CVT. Amusingly enough there are many other titles that use the CVT acronym. For those who have not had a good experience trying to repair a CVT, you might relate to "Center for Victims of Torture." Perhaps the bad experience provoked the thought of a career change to become a "Certified Veterinary Technician." If one isn't so easily discouraged, "Continuing Vocational Training" may be an option. One thing is for sure, although continuously variable transmissions are the transmission of choice for hybrid vehicles, it doesn't make it a "Current to Voltage Transmitter" or a "Constant Voltage Transformer." OK, so I am being a bit of a "Chemical Vapor Transport" (full of hot air, that is) for this article's opening paragraph pertaining to CVT transmissions. No doubt that "clear valid training" is needed to diagnose and repair these transmissions as many shops are now beginning to want to make that choice.

The M4VA is the first experience I ever had with a CVT used in Honda Civic HX and had an engineering design like no other until most recently. Simply explained, a dual mass flywheel drives the input shaft rather than a torque converter (Figure 1). This input shaft delivers power to the primary pulley via a forward or reverse clutch through a planetary gear set. This was not the unique aspect of the transmission. What makes it unique is the use of a start clutch strategically positioned between the pulley assembly and the differential (Figure 2). This one clutch pack connects or disconnects the pulley ratios to the differential. Quite an ingenious design as it allows the pulleys to stay in rotation should a rapid high to low ratio change be needed with sudden braking maneuvers. Among other things it also is the decouple device when coming to a complete stop, preventing engine stall. What is impressive is that with the excessive release and apply of this clutch, one would think it would fail sooner than when it really does. Good clutch cooling control and clean programming are major factors that keep this start clutch operational as long as it does.

This transmission was an excellent transmission to begin learning CVT diagnostics and repair. Even though it functions differently than others with the use of the start clutch, it provided all the fundamentals. One aspect of this transmission that made it good for learning diagnostics is that it has all the pressure taps you need (Figure 3). All of them are identified with abbreviated embossments in the case next to the tap itself (Figure 4); forward clutch

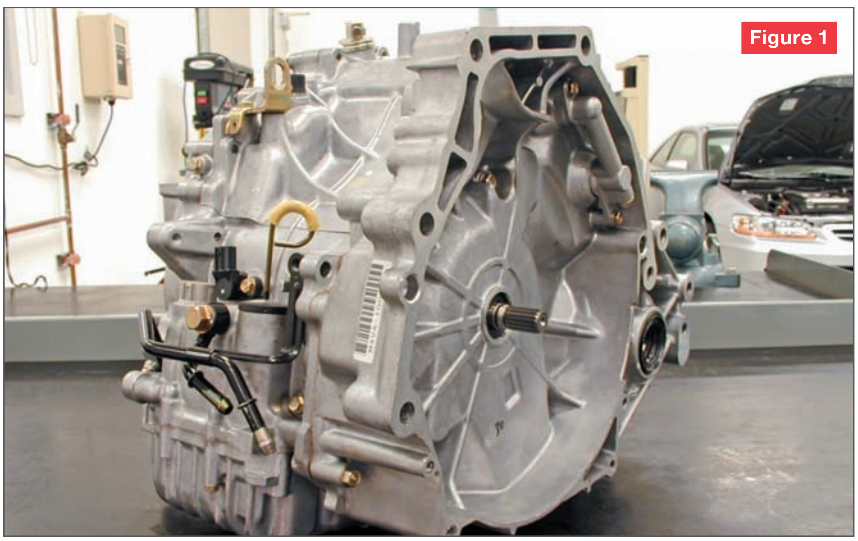

Figure 1

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

Photos: Wayne Colonna


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(FWD), reverse clutch (RVS), start clutch (SC), drive pulley (DR), driven pulley (DN) and lube pressure (LUB).

Checking CVT system pressures are best done using transducers like those from Automotive Test Solutions (Figure 5). CVT pressures can be very high. Some reach 800 psi and greater. Nothing can be more dangerous and unpleasant than to have a pressure line blow out while diagnosing a vehicle on

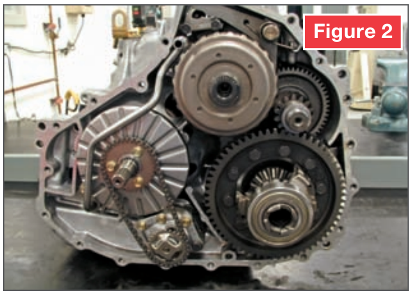
Figure 2

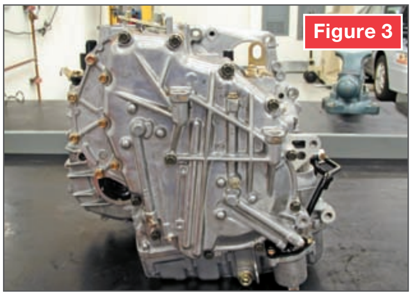
Figure 3

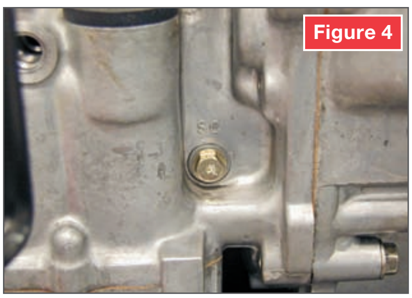
Figure 4


Figure 5

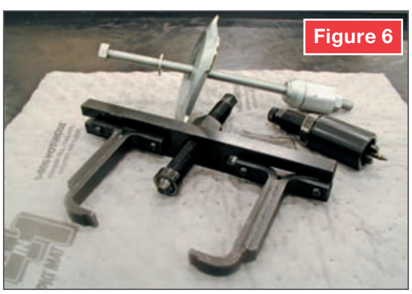
Figure 6

a road test. Not to mention the graph transducers can produce keener data for diagnostics.

Ironically, with each and every pressure tap being available with a Honda CVT, the need to pressure test doesn't come up too often. This is due to its unique operational characteristics. Consider how it operates. With the start clutch releasing at a stop and applying when it needs to accelerate, the forward or reverse clutch remains applied depending on which range was selected. If there was a delay when drive was selected and slipped moving forward, yet reverse operates perfectly, the forward clutch would be suspect. This symptom would also suggest that the start clutch and the pulley system are working correctly. Conversely, if reverse was the problem, yet all was well with forward, the reverse clutch would be suspect. But, should there be a problem with forward and reverse engagements and slipped throughout, this opens up many possibilities beginning with the filter to fluid level, pressure control, start clutch or pulley problems. The condition and level of the fluid would be the first check. It wouldn't take much to drop the pan so it may be the second check to see if it's loaded with metal. If the pan check doesn't reveal serious damage, pressure testing of the start clutch and pulleys could then be considered. If only delayed forward and reverse engagements were the symptoms yet drove reasonably well once in gear, the start clutch would be suspect.

Having a basic understanding of how this system works, a general diagnostic approach can be quickly determined based on the operational malfunction. To pressure check this transmission, Honda begins with safety warnings such as paying attention to the rotating front wheels during the test and to make sure lifts, jacks, and safety stands are placed properly.

Before pressure testing begins, be sure the transmission fluid is filled to the proper level. Then Raise the front of the vehicle, and support it with safety stands. Set the parking brake, and block both rear wheels securely. Allow the front wheels to rotate freely. Connect any adapters needed for the transducer(s) and then connect the transducer(s). Warm up the engine (the radiator fan comes on), then stop and connect a tachometer.

If the TCM has stored a trouble code initiating failsafe, you must use an oil pressure gauge/transducer that measures 711 psi or more when measuring drive pulley pressure and driven pulley pressure.

Pressure specifications:

Forward clutch is checked in the D range at 1,500 rpm: 203-253 psi

Reverse clutch is checked in the R range at 1,500 rpm: 203-253 psi

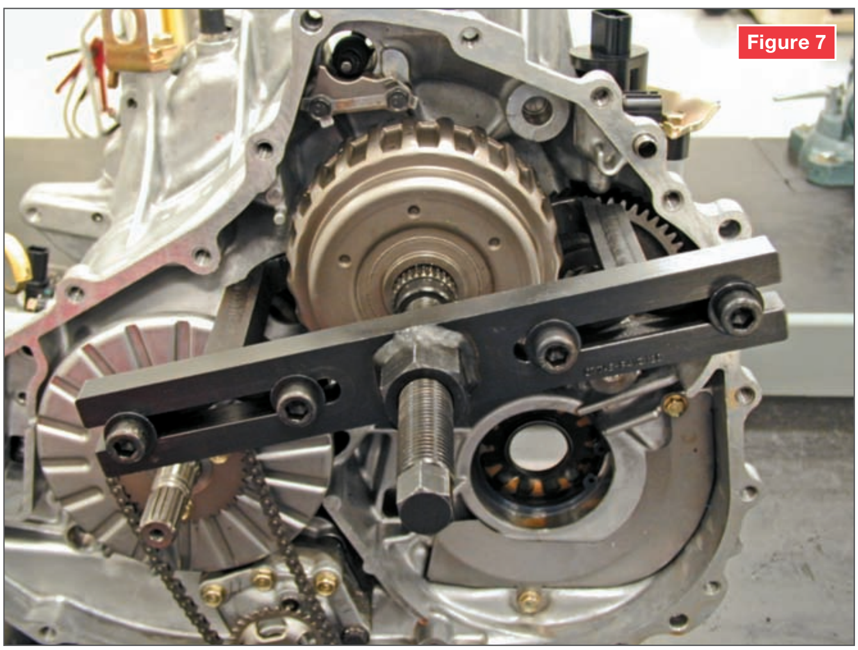
Figure 7

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Drive Pulley is checked in the N range at 1,500 rpm: 28-101psi

Driven Pulley is checked in the N range at 1,500 rpm: 218-334 psi

Start Clutch is checked in the D range at idle: 35-40 psi

Start Clutch is checked in the D range at stall: 120-130 psi

Lubrication is checked in the N range at 3,000 rpm: 30 psi

Time has revealed that when considering this CVT as a whole, the start clutch is by far the most problematic aspect to this transmission, especially the earlier years. Honda has produced several versions of this CVT with great improvements to its longevity. But when it does fail, it is a simple and straightforward repair. The biggest problem is laying your hands on a few special tools that make this process a snap (Figure 6).

These tools are listed in the factory manual with part numbers, but it seems that Honda does not make them available outside of their dealer network. If you can obtain them, they make pulling and installing the start clutch a simple job (Figure 7). The special tools shown in Figure 6 consist of a reverse brake spring compressor (07TAE-P4V0110), a Start Clutch Puller (07TAE-P4V0120) and installer (07TAE-P4V0130).

The puller is designed to reach underneath the park gear, which will pull the secondary drive/park gear out with the start clutch drum as an assembly. If you use a puller to remove the start clutch drum only, you may cause damage to the drum. The secondary drive/park gear will then need to be removed from the Driven Pulley Shaft (Figure 8). The installer is then used to seat the secondary drive/park gear and start clutch drum assembly down onto the Driven Pulley shaft as one assembly. The inner tip of the tool hooks into the inside tip of the Driven Pulley Shaft. The outside part of the tool has a tightening nut which presses the assembly onto the shaft.

One word of caution, the start clutch is held onto the Driven Pulley Shaft with a snap ring. Underneath this snap ring are cotters covered by a cotter retainer. If changing a start clutch assembly for the first time, this cotter retainer can be tight to the drum and spline camouflaging itself as being a part of the drum (Figure 9). Not knowing this, you will have a "continually vicious time" trying to get that start clutch off the shaft. You will destroy the tool and the drum making them and yourself eligible to go visit that "Center for Victims of Torture."

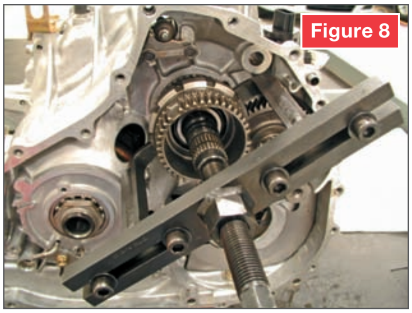
For this M4VA type CVT, the TCM uses four solenoids to control this transmission; an Inhibitor Solenoid, a Pressure High/Pressure Low Solenoid (PH-PL Solenoid), a Shift Control Linear Solenoid and the Start Clutch Solenoid (Figure 10).

One self-inflicted injury that can occur with this M4VA type of CVT is cross connecting the Shift Control Solenoid with the Start Clutch Solenoid. This will disrupt the proper control of the Start Clutch, causing stalling in reverse or drive along with a nasty sounding bang. Figures 10 and 11 both show the incorrect connections of these two solenoids, which is very easy to do. The good news is this Honda transmission has a pan to gain access to these solenoids should you make this type of cross connect error.

Another aspect to this style of CVT is to perform relearn procedures for the Start Clutch. The procedures varied with year and make but are very easy to do. A few of these procedures will be the topic of one of July's 2015 weekly Powertrain Pro newsletters as there is not enough room remaining in this article to add them.

This was glimpse of a CVT that was good to learn from in many respects. After understanding how this "snowmobile" type transmission works and operates in a car, it goes a long way in understanding others. For example, The Audi 01J uses a dual mass flywheel to drive and input shaft like the Honda. The difference here is that rather than using a start clutch to decouple the powerflow at stops, it releases the forward or the reverse clutch. This makes one less clutch assembly to consider. If there is a delayed engagement and slip in forward yet reverse operates well, the forward clutch needs to be looked at. Likewise if reverse has issues but forward movement does not, the reverse clutch needs to be considered.

A couple of drawbacks with this transmission is there are no pressure taps to do any reasonable diagnostics and the computer is inside the transmission. This means there will be plenty of occasions of diagnosing the symptom based on operational understanding.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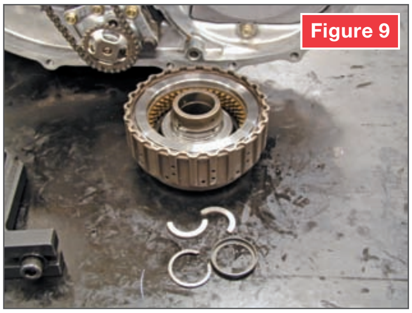
Figure 9

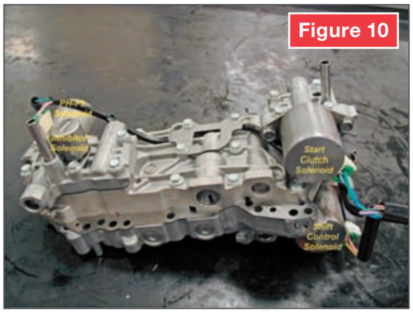

Figure 10

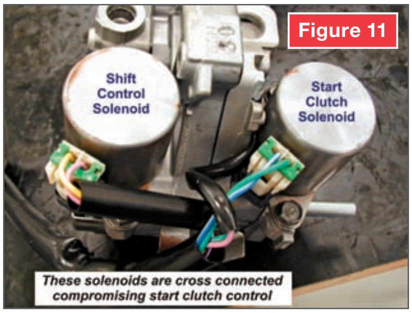

Figure 11

These solenoids are cross connected compromising start clutch control

With this little intro to CVT understanding, the JF011E is a transmission beginning to show up more frequently in shops these days and will be the subject of next month's article. There are several versions of this transmission as it is used in Nissan, Mitsubishi, Dodge and Jeep vehicles. The article will get into its operation, some diagnostics and repair. The more you know and understand, the more "courageous, victorious and triumphant" you will be with your CVT.

CLEAN AND LEAN

The VM Motori 3.0 liter EcoDiesel has been available in the 2013+ Jeep Grand Cherokee, as well as the 2014+ Ram 1500.

A LOOK AT THE NEW DODGE RAM LIGHT-DUTY DIESEL

BY **TONY MARTIN** | CONTRIBUTING EDITOR

The light truck sector is one of the most competitive sales segments in the U.S. auto industry. Sporting lofty price tags and higher profit margins, light trucks generally sell like hotcakes when gas is cheap and credit is easy to come by. Conditions now are perfect for increased light truck sales, but the consumer is still faced with a dilemma. What happens if I buy a new truck and fuel prices go back up? The fun factor tapers off when you are making hefty payments on your rig and now it's costing you the remainder of your disposable income to keep the tank filled.

Times have changed mightily. Federal regulations regarding fuel economy have brought the light truck into a new age. This has also led to intense competition between the auto manufacturers to claim the fuel efficiency crown and its associated bragging rights. No stones are being left unturned in this clash of competing technologies: gas versus diesel, aluminum versus steel, etc.

The current fuel economy champion in the light truck sector is the Ram 1500 EcoDiesel. Powered by a 3.0 liter V-6 diesel built in Italy by VM Motori, this truck is putting up impressive fuel economy numbers, as well as meeting tough emissions regulations that put it on par with many passenger cars. It is the only diesel-powered light truck currently in the U.S. market. Numerous technologies have been utilized to achieve clean emissions and high fuel economy; here's an overview of how Ram truck engineers made it happen.

Clean emissions

The North American version of the VM Motori 3.0 liter EcoDiesel was first used in the 2013 Jeep Grand Cherokee. It was MY2014 when it appeared in the Ram 1500 pickup, where it immediately left an impression on the truck-buying public. It is a turbocharged 60-degree V6 with 24 valves and double overhead cams (DOHC). While it produces a modest 240 horsepower, the peak torque output is 420 lb-ft @ 2000 RPM, giving the EcoDiesel V-8 torque with 4-cylinder fuel economy.

Heavy-duty pickups with diesel engines have strict emissions regulations, but these are not as tough as those that apply to half-ton pickups and other vehicles under 8500 lbs. Gross Vehicle Weight Rating (GVWR).

The holy grail of diesel emissions is known as Tier 2 Bin 5 (T2B5), the minimum EPA emissions rating required for a passenger vehicle to be sold in all 50 states. A car or light truck with a lesser rating does not qualify for sale in California or any of the 14 states that have adopted California emissions regulations (also known as "Green States" or "CARB States"). This rating is critical to vehicle sales, because the Green States are major car-buying markets

Photo: FCA US LLC

and represent a high percentage of new car registrations in the U.S.

Diesel engines struggle with two regulated emission gases: particulate matter (PM) and oxides of nitrogen (NOx). While engine tuning has a direct impact on the production of these gases, whatever is done in the combustion chamber to minimize one will typically result in an increase in the other. For instance, PM levels tend to decrease when combustion temperatures rise, but the hotter flame causes an associated increase in NOx. The reverse is also true; cooling the flame will reduce NOx output, but PM then rises. This is a two-edged sword with one caveat: a hotter flame increases engine power output and overall efficiency.

With these dynamics in mind, VM Motori designed the 3.0 liter EcoDiesel to use a hotter combustion flame and then deal with the increased NOx after the fact. This requires the use of urea Selective Catalytic Reduction (SCR) as an exhaust aftertreatment system to reduce NOx to acceptable levels, but brings with it the following advantages:

1. Increased engine power output and fuel economy
2. PM production is lowered, relieving the load on diesel particulate filters and limiting associated regeneration issues.
3. NO2, a component of NOx, is a powerful oxidizer and helps regenerate diesel particulate filters.

An operational challenge with urea SCR is that the driver is responsible for replenishing the Diesel Exhaust Fluid (DEF), also known as AdBlue in Europe. The Ram 1500 is unique in that it utilizes a DEF gauge on the instrument panel to manage the system's DEF level. Most diesel pickups do not have a gauge, but instead rely on chimes and warnings to indicate when the DEF is low. The 8-gallon DEF tank is insulated, and the lines are heated to improve system performance in cold weather. The exhaust system is also designed to maintain optimal NOx conversion temperatures without requiring additional energy from the engine and causing an associated decrease in fuel efficiency.

Cooled high-pressure EGR is the first line of defense in the EcoDiesel's NOx reduction strategy. The basic idea is to inject cooled inert gases into the engine's fresh air charge, which act as

The 3.0 liter EcoDiesel is a turbocharged DOHC V-6. Its high-pressure common rail injection system can develop pressures up to 29,000 psi (2000 bar).

Photo: FCA US LLC

a heat sink to reduce combustion temperatures. When used in moderation, EGR prevents NOx from being formed during the combustion process. It can also warm a diesel engine more quickly, thus cutting down on white smoke during a cold start. Numerous ECM-controlled actuators are used to control the EcoDiesel's EGR system, including a swirl valve, airflow control valve, cooler bypass and the EGR valve itself.

The turbocharger plays a major role in the operation of the EGR system. EcoDiesel's variable geometry turbocharger (VGT) is water-cooled and incorporates a nozzle controlled by a rotary electric actuator (REA) to manage boost and exhaust backpressure. If the nozzle is closed, exhaust backpressure rises and causes an increase in EGR flow. Partial closing of the airflow control valve also enables EGR flow by effectively lowering the intake air pressure. The greater the pressure difference, the higher the flow of EGR gases.

EcoDiesel uses a Diesel Oxidation Catalyst (DOC) and Diesel Particulate Filter (DPF) that are close-coupled to the engine exhaust manifold. This helps warm these components quickly and keep them hot during normal vehicle operation, which is critical to fuel economy performance. A hot DPF will regenerate itself more easily without intervention on the part of the engine controls, saving fuel that would have been used to initiate an active regeneration. The performance of the DPF is also monitored by a PM sensor that is mounted downstream on the SCR catalyst. Monitoring of

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DPF and other major emission control system performance is required under OBD II regulations.

High-pressure common rail (HPCR) has been the dominant diesel injection technology for many years, but it has evolved. The Ram 1500 EcoDiesel uses the latest generation of Bosch HPCR (FCA calls it MultiJet II), which can generate injection pressures up to 29,000 psi (2000 bar). More importantly, the system is capable of breaking each injection event into eight separate pulses and thus maintain exceptional control of the combustion process. This is all accomplished using a solenoid actuator, instead of the more expensive piezocrystal stack that is often utilized for high-performance HPCR injectors. Enhanced control over the injection process makes it easier to increase performance and fuel economy, while simultaneously reducing emissions.

Fuel economy

A clean burning engine is a great starting point when building a light truck for fuel efficiency. However, it takes a holistic approach to make serious gains on the fuel economy front, including many changes that seem almost insignificant by themselves. Add up enough of these improvements, though, and it can turn into a major accomplishment. The key to success is to not take anything for granted and look at every vehicle system as a work in progress.

According to Ram Truck engineers, a 5,000-lb. reduction in vehicle weight equates to a 2 percent increase in fuel economy. Weight reduction is a no-brainer approach to increasing fuel economy, and it starts with the engine itself. The engine block is made of compacted graphite iron (CGI), which is engineered to disperse graphite more evenly and thus be stronger and more durable than conventional cast iron. These properties enable engineers to use less CGI to build a block of equivalent strength. CGI also helps limit the noise, vibration and harshness (NVH) issues that plague conventional diesels. As a further weight reduction measure,

The Ram 1500 EcoDiesel uses urea SCR to meet 50-state emission standards. The diesel exhaust fluid (DEF) filler is located behind the fuel door on the driver's side of the truck.

The Ram 1500 EcoDiesel's DEF tank holds 8 gallons, and the level is indicated on a gauge on the instrument panel.

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other EcoDiesel engine components are made from aluminum, including the cylinder heads and the oil pan.

Pulse width modulation (PWM) technology was used extensively when designing the Ram 1500 EcoDiesel. In this context, PWM is a real technical term as well as being used to describe a design philosophy. The basic idea is look carefully at the vehicle electrical system and determine where energy is consumed with no benefit being realized. The system is then redesigned to use the minimum amount of energy required to get the job done. Examples of this include the forward cooling fan and the fuel delivery system, which not only use less energy but also live longer. Collectively, PWM improvements on the Ram 1500 EcoDiesel resulted in a 0.4 percent increase in fuel economy.

Taking a page directly from the hybrid-electric vehicle book, the Ram 1500 EcoDiesel uses electric power steering (EPS) to increase vehicle fuel economy. EPS does away with the power steering pump and its belt drive, which waste energy most of the time because they are only put to work at low vehicle speeds. The only time that EPS uses energy is when power steering is actually required, which results in fuel savings of up to 1 percent.

Another hybrid-pioneered technology used in the EcoDiesel is the start-stop system, which shuts the engine off when idling under certain conditions and then automatically restarts it when the driver depresses the throttle. By limiting excessive idling, the start-stop system generates another incremental improvement in fuel efficiency.

Aerodynamics make a major contribution to the fuel economy performance of the Ram 1500 EcoDiesel. Pickup trucks have traditionally been designed as rolling bricks, with little consideration given to how their shape impacted fuel consumption. Numerous tricks have been employed to reduce the drag coefficient of the Ram 1500 EcoDiesel, including ECM-controlled Active Grille Shutters (AGS), which block air from passing through the radiator when it isn't needed for

There are a select few motor oils that meet the specification required for the VM Motori 3.0 liter EcoDiesel.

The Garrett turbocharger used on the EcoDiesel has a rotary electric actuator (REA) to control the variable nozzle.

Photos: Tony Martin

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engine cooling. The shutters improve fuel economy but have a side benefit of helping maintain engine temperature in extreme cold weather.

The High Fuel Efficiency (HFE) model of the Ram 1500 EcoDiesel pushes the aerodynamic envelope one step further, with the addition of underbody panels and an air suspension system. The underbody panels are another hybrid car trick that serves to cut down on wind turbulence, which is further reduced when the air suspension automatically lowers the truck body at highway speeds. The air suspension is a closed system, with a nitrogen reservoir and a pump to adjust the air springs.

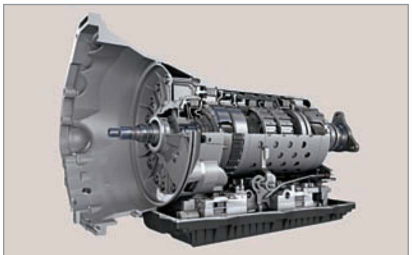

Photo: FCA US LLC

The Torqueflite 8-speed automatic transmission is used in both the Jeep Grand Cherokee and the Ram 1500 versions of the EcoDiesel.

Ram Truck engineers also looked carefully at energy losses that take place in the Ram 1500 EcoDiesel's powertrain. When the truck is first started, the engine coolant warms up rapidly but the other fluids take time to get up to temperature. Cold fluids cause more drag in the powertrain, as well as negative effects on vehicle drivability.

To address this issue, they devised a thermal management system that utilizes a heat exchanger with dedicated pathways for coolant, engine oil and transmission fluid. Engine coolant transfers its heat to the other fluids, which serves to warm them up more rapidly and improves shift quality and overall efficiency. The reverse is also true as excessive heat developed by the EcoDiesel's 8-speed transmission can be dissipated to the cooling system, improving the transmission's durability and performance. The thermal management system's impact on fuel economy is definitely worth the trouble, with a 1.7 percent gain in fuel economy realized.

Wrapping it up

No technological stones are left unturned in the quest for the light truck fuel efficiency crown. While the low-hanging fruit has already been harvested, incremental fuel economy improvements are transforming the pickup's traditional image. The diesel engine is also proving its resilience as it steps up to meet emission control challenges. It should be fun to see where the road takes us next!

TONY MARTIN
CONTRIBUTING EDITOR

Tony Martin is a mobile equipment maintenance trainer with Kinross Gold Corporation. He is a qualified Heavy Duty Equipment Mechanic and post-secondary level educator. He writes about automotive electronics, diesel technology, and alternative energy.

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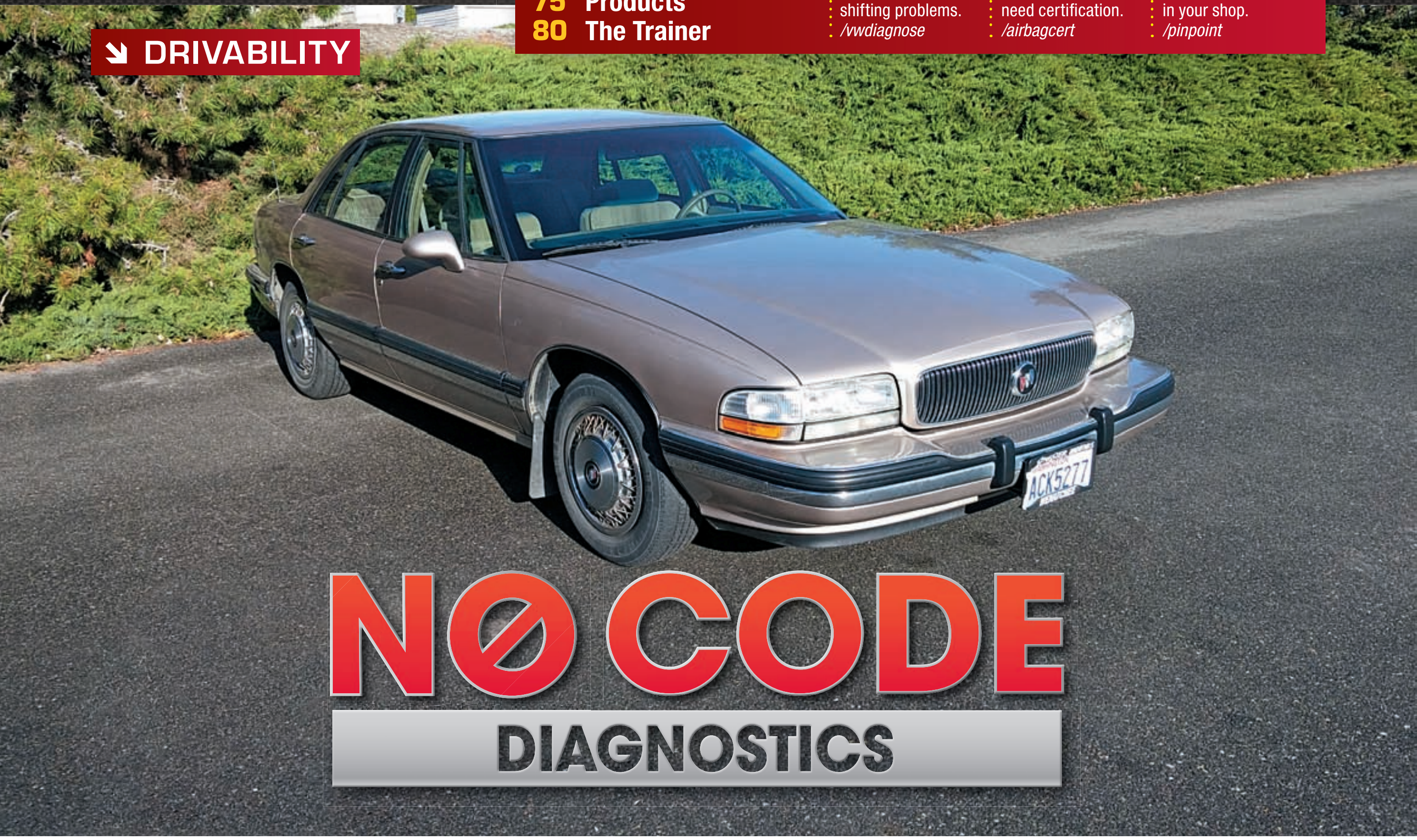


NO CODE DIAGNOSTICS

WHAT TO DO WHEN THE ECM ISN'T HELPING

BY **ALBIN MOORE** | CONTRIBUTING EDITOR

From time to time a vehicle will come to our bays with drivability concerns, and there is no check engine light and no diagnostic trouble codes (DTCs) stored in memory. An even worse situation is when the vehicle has no check engine light and the complaint is something that only happens intermittently. What do you do when something like this is sitting in your bay? Just because the problem didn't store a code doesn't mean the problem can't be found.

When we think of drivability problems, we tend to think of an engine that doesn't run properly, but drivability problems also can be an engine stall, a transmission that doesn't shift properly or even a poor power complaint. My question to you is, Where do we start when these kinds of concerns show up in the shop?

Many in the business will tell you a good interview with the person who drives the vehicle is always the starting place, and I totally agree. On the other hand, there are times when this interview will get some of the information we need, but there is a chance that the most important information will be lost in translation between the vehicle driver and the person doing the interview. Technicians do not always do a great job of handling these interviews since we tend to think and talk car, and most vehicle owners and drivers do not speak our language. I find that asking the correct questions — who, when, why, where and to what extent — will draw out the needed information. Keep it simple and speak in terms your customer can understand.

For the technicians accustomed only to OBD II, we have had the luxury of DTCs to gain a direction. For those of us who've been turning wrenches longer than OBD II has been around, we can remember when we didn't have this luxury and had to actually think our way through each diagnostic process. I embrace the self-diagnostic capabilities of the electronic modules on the vehicles we see in our shops today, but sad to say, there are times when a fault that can cause a drivability problem will not code. When this happens, what do you do? Problems like this can and will test the grit of technicians. Sad to say, many times a vehicle with a no-code drivability problem will get backed up to the parts store and loaded up. If that doesn't make the problem go away, the vehicle will get passed from shop to shop until 1.) the owner runs out of patience or money; 2.) trades the

Photos: Albin Moore

vehicle in for another, or 3.) takes the vehicle to a shop that has a great drivability technician.

Before we can start on a diagnostic journey, we need a direction. Many times, this direction is obtained from our interview, other times the direction comes from a test drive. No matter where it comes from, we must have a direction before we start using up our valuable diagnostic time.

Gaining direction

When I think of no-code drivability problems, I try to break them down into two different categories: mechanical problems or electronic problems. Mechanical problems could be something like an intermittently sticking valve or a camshaft timing problem. Electronic problems could be things like a misreporting mass airflow (MAF) sensor or an intermittent electrical problem with an engine control module (ECM). Problems like these still require gaining a direction before the diagnostic process starts.

To get a diagnostic direction, I always start with a scan tool to check for any stored DTC. If no information is stored, then it's time to move on to other things. Since I live and die by fuel trim information, I always take a look at engine data to see if there are any clues here. It is amazing how many driveability problems can be found with this data. Of course, to get fuel trim data, the vehicle needs to be taken out on the road for a test drive.

If the direction is not found with a scan tool, then it's time to pull out a Digital Storage Oscilloscope (DSO) and start testing. But wait — poking around with a DSO can take you on a scope safari. The art of diagnostics is to get the problem to come to you. In the case of an engine drivability concern, using your DSO to run a relative compression test might be a great way to get this direction, or even a starting point to get this elusive problem to come to you.

In every diagnostic process I use three easy steps.

1. Verify the customer's concern
2. Learn how the system works
3. Apply the learned knowledge to the problem (do the testing)

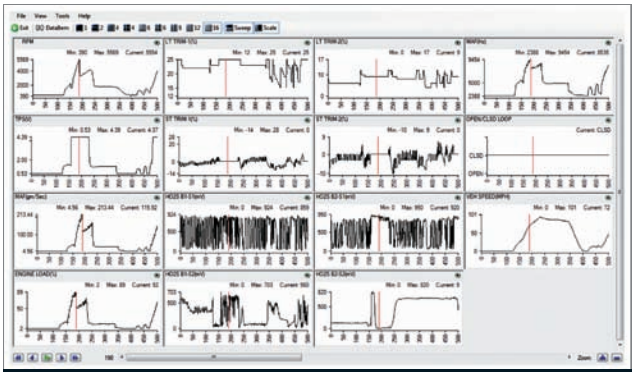
Before you start any testing procedure, always ask yourself, "What do I expect to find with this test?" And "Why am I doing this test?" Don't start testing things in hopes of finding something, and don't blindly follow the troubleshooting flow charts every manufacturer has. Always use a testing plan and follow a direction with your testing.

An example

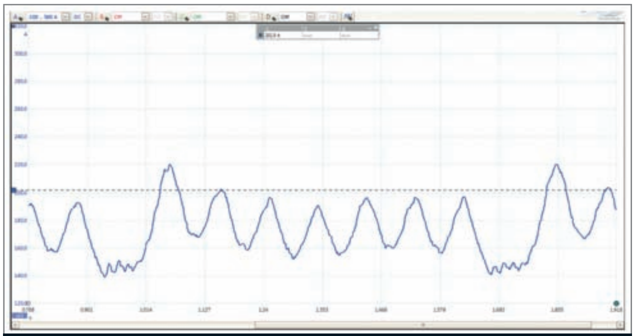
The vehicle is a 1995 Buick LeSabre equipped with a 3.8 liter V6 engine with 135,000 miles on the odometer. The vehicle owner concern is an intermittent engine stall. When the engine stalls, it can be restarted immediately. In the last year or so, several attempts have been made at fixing this stalling problem. A set of plugs and wires, three new ignition coils and a new Ignition Control Module were all installed with no fix for the problem.

I started by checking to see if any DTCs were stored. None were found, so the vehicle was taken on a short test drive. After driving the vehicle a short distance, the stall was experienced. This test drive only took two miles before the engine stalled as it fell to an idle while turning around for the return trip to the shop. While pulling the vehicle into the shop, the engine stalled two more times with all engine stalls happening with the engine at idle. These stalls felt like someone was turning the key off and smelled of something electrical, rather than mechanical or fuel related. Time to read up on the ignition system's operation.

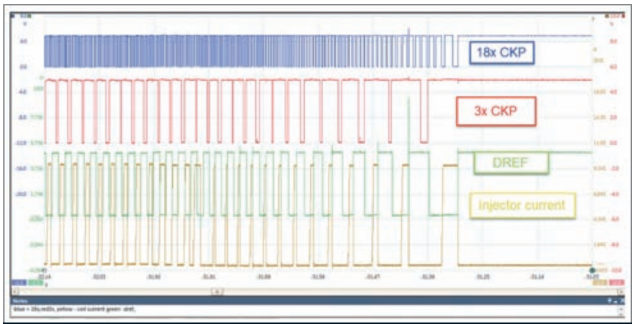
Using my service information system, the theory of operation for the 18X and 3X Crankshaft Position (CKP) sensors reads:



Many times, scan data can be used to find a direction on drivability problems. This scan data is an example of using fuel trim data to find drivability issues.



DSO capture of a relative compression test. I would use something like this if the engine had a misfire. The relative compression test done with a DSO is a very fast and accurate way to find a cylinder or cylinders with low compression.



A DSO is great for testing an action/reaction of a component. In this case, the scope is capturing the action of the 3x and 18x CKP sensors, and is also capturing the reaction of the DREF and the ignition coil current. When the engine stalls, all 4 signals remain correct. The problem is not found here.

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3X reference PCM (Powertrain Control Module) input
From the ignition control module, the PCM uses this signal to calculate engine RPM and crankshaft position. The PCM compares pulses on this circuit to any that are on the Reference Low circuit, ignoring any pulses that appear on both. The PCM also uses the pulses on this circuit to initiate injector pulses.

18X reference PCM input — The 18X reference signal is used to accurately control spark timing at low RPM and allow IC operation during crank. Below 1200 RPM, the PCM is monitoring the 18X reference signal and using it as the reference for ignition timing advance. When engine speed exceeds 1200 RPM, the PCM begins using the 3X reference signal to control spark timing

Since the engine runs strong at cruise and acceleration, I have ruled out a fuel supply problem as the cause of the stall. One more thing to think about — since the stall happens at idle, as if the ignition key were turned off, I want to know if the stall is caused by a lack of spark or a lack of fuel. Knowing the theory of operation for the dual CKP sensors, it seems as if there is a problem with the 18X CKP sensor since the engine stalls when it comes back to idle.

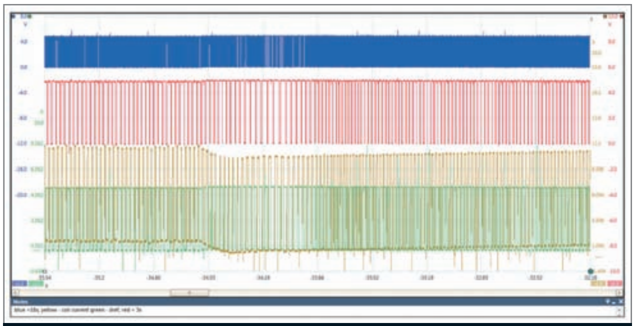
This ignition system uses a Distributorless Ignition System (DIS) that is controlled by an Ignition Control Module (ICM) with three ignition coils piggybacked on top of the module. The ICM is controlled by a dual CKP sensor (3x and 18x) and a Camshaft Position (CMP) sensor. The 3x signal has three interrupters spaced 1, 20 and 30° apart. The 18X signal has 18 identical interrupters spaced equally around the 360° of the reluctor. The changing relationship between the 3x and 18x CKP signals allows the ICM to quickly identify the correct ignition coil to fire within the first 120° of crankshaft rotation and allows for quicker starting. If the 3x signal is lost while the engine is running, the engine will continue to run, and the fuel injection will continue to run in a sequential mode. Loss of the 3x signal will prevent the engine from starting.

Most engine management systems need some sort of ignition feedback signal sent to the PCM to operate the fuel injectors. In the case of this GM system, the service information refers to this signal as the "fuel control" signal. In the days of the GM distributor systems, this signal was referred to as the distributor reference (DREF) signal. Without the DREF, the PCM will not pulse the fuel injectors.

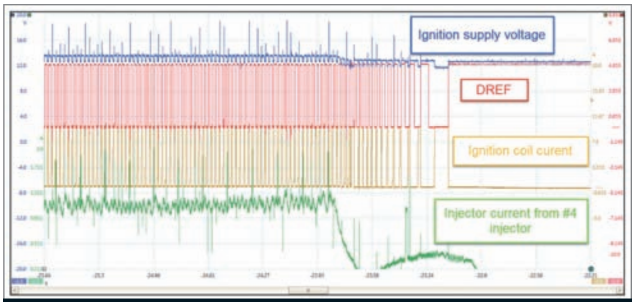
When using a DSO to analyze a problem like this, we need to hook to the signals that support both the ignition system, and fuel injector operation. My logic behind the test is that the two CKP signals are needed to operate the ignition coils. The DREF signal is needed by the PCM to pulse the fuel injectors, so the scope was set to watch both CKP sensors, ignition coil current and the DREF signal.

The engine was idled until it stalled and these waveforms were captured. No problems were found with the ignition, but there is some good information gathered. The ignition system is not the cause of the stall and neither is the ICM, since the coils are being fired. But wait, as the engine dies, the ignition coil current trace changes. Is this possibly the cause of the stall?

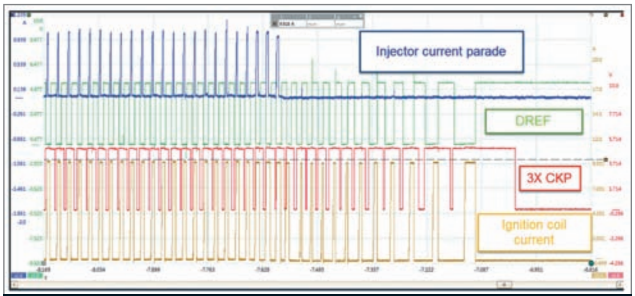
One more try with the same data — after idling for about five minutes, the engine faltered for a second or two, then went back to idling smooth. The data was captured on the DSO.



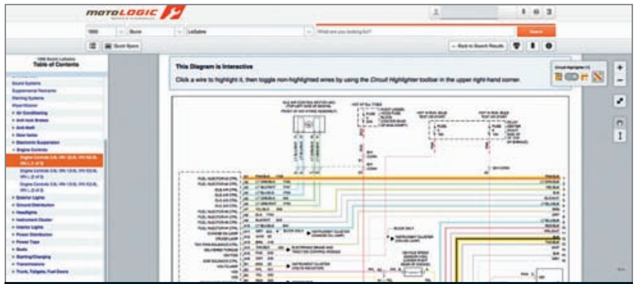
DSO capture of the 18X CKP (blue channel), 3X CKP (red channel), DREF-fuel control signal between the ICM & PCM (green channel) and Ignition coil current (yellow channel). The engine hicupped during this capture. The scope data shows the engine speed slowed down, and the ignition primary current dropped a little, but none of the signal traces went away. There was no problem found with this trace. Time to move on.



The scope leads have been moved around. Ignition control module supply voltage (blue channel), DREF-fuel control signal (red channel), fuel injector #6 current (green channel) and primary ignition current (yellow channel). The green trace shows something that looks like the fuel injectors' quit pulsing. I want to see the current from all six fuel injectors. Since the fuel injectors are pulsed only once every 720 degrees of engine rotation, too many things can happen between injector pulses to be accurate in this analysis.



The scope leads were again moved. This time the blue channel is a current probe hooked to all six fuel injector control wires at the PCM. Green channel is the DREF signal from the ICM to the PCM. Red channel is the 3X CKP and yellow is primary ignition current. When the engine stalled, the PCM quit pulsing the fuel injectors. The labscope waveforms show the PCM has all the needed inputs; 18X, 3X and DREF to fire the injectors. Time to pull the trigger on a new PCM.



Knowing where to connect your scope starts with the circuit diagrams. In the case of the Buick, the PCM is inside the car and away from possible interference from other underhood electronics. We'll connect to the circuits we need there.

Photo: MotoLOGIC

With this new data, all it has done is raise more questions.

Is the problem possibly a poor power supply to the ignition module?

DSO tip: When scoping electrical components and using current to analyze a problem, it is also important to use voltage along with the current. The next scope capture was taken with a voltage lead and a current probe hooked to the power supply to the ICM. This will prove if the voltage to the ICM is the problem. I also hooked another current probe around the #4 fuel injector to see if the cause of the stall is the fuel injectors being shut off.

The fuel injector is not a good place to get this information. The engine turns two revolutions between each fuel injector pulse, and too many things can happen in two engine revolutions. There is also a lot of electrical noise under the hood, and a current probe set at a low current is capable of picking up that noise. The PCM is mounted under the glove box and is easily accessed with the removal of one small panel. The wiring is even hanging down where all six fuel injector control wires can be grabbed with the current probe. This puts the current probe inside the vehicle where the air is clear of electrical noise. This also allows monitoring the current from all six fuel injectors.

With this information on the scope screen, it is now easy to see exactly what is happening. The ignition system is working well, the ICM is sending the DREF signal back to the PCM so the fuel injectors can be pulsed at the correct time, but the PCM has stopped pulsing the injectors. In this case, the PCM needs to be replaced. The PCM was tap tested and twisted, but no problems were found with cracked solder joints or cracked circuit boards.

This problem was on an old archaic Buick, but these diagnostic principles can be applied to most any type of ignition/fuel system built today. Understand how the system works, get a diagnostic direction, then do the proper testing. MA

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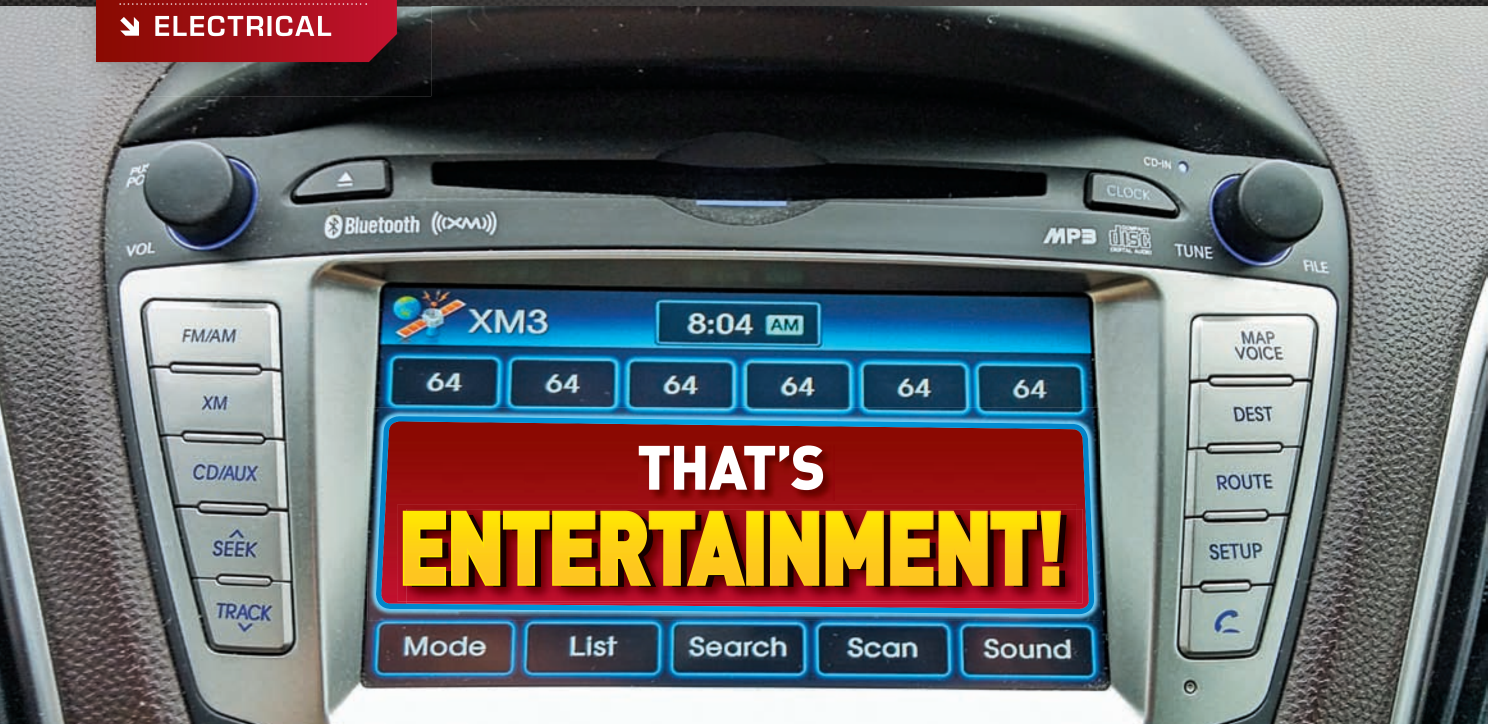
Albin Moore spent 21 years in logging before opening in 1992 a shop that specializes in drivability problem analysis. He is an ASE CMAT L1 technician with 40 years of analyzing and fixing mechanical and electrical issues.

Email Albin at bwrench@yahoo.com



THAT'S ENTERTAINMENT!

Much more than the AM radios my dad's car came with. Today's infotainment systems provide all the conveniences driver's demand – entertainment, navigation and safety to name a few.

WE SHOULD TRY TO REMEMBER THAT OUR HOMES ARE NOT OUR VEHICLES AND VICE VERSA.

BY **JAIME LAZARUS** | CONTRIBUTING EDITOR

Radio entertainment was, at one time, available only from large, stationary units that occupied a great deal of space in one's living room. That luxury was enjoyed sparingly at first, and usually by the whole family at the same time. I imagine the same arguments about distracted driving dangers took place when cars were first fitted with radios, just as they are taking place now (for even more reasons)!

While browsing through a huge retail store recently, the realization occurred to me how fast expensive items lose their value. Microwave ovens used to cost a few thousand dollars when they first hit the market. Some cost less than $50 these days.

Everyone has at one time or another purchased something only to realize in a short period of time that the same item isn't worth anywhere near the price we paid for it! In other words, we couldn't sell what we bought for a "reasonable" price shortly after we paid a "premium" price. Its become typical for a new item to command a high purchase price when first brought to market, then in a short time we see that same item's selling price rapidly decrease. Does the difference mean it was expensive if it now sells for much less than we paid? Does that mean what we bought has less value now?

I bring these questions to the table because at the same time I was shopping, I started wondering if the depreciation of value could also apply to some aspects of automotive repair. It didn't take me long to apply that concept personally. Without too much effort I can think of a few instances where I just had to have something for my car, and eventually the newness wore off (decreasing in value, to me anyway). In that short time its actual value also decreased!

Music to my ears

Here's an example: While in the process of purchasing my first new car, I was offered a variety of audio systems with which the vehicle could be equipped. Some were factory-installed, some were not, but I chose the finest available (read: most expensive). I got the one with the most bells and whistles. In other words, it had the most features and capabilities of any of my choices and therefore, I figured those commanded a high price. It was just expected. It had what was called something like theater surround sound, a customizable equalizer, the most wattage per zone, a huge amount of memory to store pre-set preferences and what was most important to me at the time — a six-disk CD changer! I paid a premium price for this new (at the time) luxury.

You see, music has always been important in my life. In addition to being an automotive technician, I was also an amateur musician, so having a premium sound system was important! At the time this purchase took place, I was spending a lot of time in my car traveling through areas without any radio stations (well, none I cared to listen to). So having choices of listening pleasure that were previously unavailable had great value to me.

When it came time for that car to be

Photos: Jaime Lazarus

traded in, I purchased a vehicle from the same manufacturer. The sales representative assured me I could transfer that CD changer from the old car to the new so that I could save some money on the sound system, but he was wrong. The unit connected electrically and would physically fit where a changer was intended, but it simply would not work. I found it worked just fine in the model year before the current year, but not in the vehicle I purchased. Eventually I recognized my best option was to purchase the upgraded radio with the built-in CD changer for my new car and to offset that extra cost by selling the CD changer that I'd already spent the time removing from the old car and futilely fitting to the new car.

Here is where reality hit me in the face. That premium quality CD changer, although capable of fitting many brands of automobiles and of being mounted in a variety of positions and locations didn't have anywhere near the value of what it initially cost to purchase. I tried various outlets in an effort to relieve myself of the burden of owning a CD changer that I couldn't use, only to learn no one else wanted that burden either. Alas, I was left accepting the fact I got a lot of entertainment from that investment, and it really didn't owe me a thing. In fact, I believe I got my money's worth of enjoyment from that investment over the years many times over. Besides, would I return my new car, the one that the changer would not work in, just for that reason? Not hardly!

Bringing your living room to your car

Fast forward to modern vehicles and we now have what are known as vehicle infotainment systems. That conjunction is derived from joining the words information and entertainment. These systems are quite sophisticated and are the medium used to bring into the vehicle not only audio, but many forms of entertainment, and a wealth of information, which not too long ago, used to be available only from a stationary personal computer.

Yes, they offer a variety of ways to enjoy our sounds; AM, FM, XM, CD, DVD, USB, iPad, iPhone, Android, internet based (Pandora, etc.) and the list goes on! Today's infotainment systems also provide us maps and navigation and may even suggest to us how we should drive. Well, they redirect us when we aren't on the path we pre-programmed. We've all heard, "Recalculating," through the vehicle's speakers. I can use my infotainment system to keep rear-seat occupants distracted by playing movies that they can see on screens made for non-drivers.

I can even pair my smart phone's capabilities via the vehicle's Bluetooth so calls can be made and answered through the vehicle's microphone and heard through the vehicle's speakers. This is called hands-free operation (and lately, voice-to-text capabilities allow for that to be done hands free, too). Doing these otherwise may be illegal, and I can attest to how distracting even the hands-free methods are, but so far, they haven't been outlawed anywhere, to my knowledge.

Infotainment systems can even give us news about up-to-the-minute events happening anywhere in the world. They are integrated with other systems throughout the vehicle like lane management, anti-collision, parking assistance, active suspension, and so on.

More than entertainment

Heck, with some systems I can see what the rear-facing backup camera might be able to show me. Its lens is usually located strategically to display what I can't see in my rear-view mirror or when I'm turning to see if there is any danger while backing up. I've seen certain systems place imaginary lines on the display that imply where your vehicle will end up if you backed up with your steering wheel turned the way it is presently, and those lines "move" if you turn your wheel in any direction! I know a few drivers who could benefit from such help, but probably would continue to back up the way they do now even if they had this luxury! I could write many more pages about the various infotainment systems and capabilities available today but I have a fear; I'm afraid that of which I wrote about today may already be obsolete by tomorrow!

I can say with a certain amount of confidence that the reliability of modern infotainment systems far exceeds the reliability of just about any other system on today's cars. Once outside of the dealership environment and out of warranty, it seems there are little to no failures. I mean, how often do your customers ask about repairing their infotainment systems? The only times I've been asked are when a child had partially deposited a peanut butter and jelly sandwich in a DVD tray, and once when some overflow from a console's change tray had entered the radio face. What about updating those systems? Have you had to do much of that? Not hardly.

I suppose it's possible another reason for the lack of complaints may just be the newness has worn off and now the wiz-bang options are ho-hum, obsolete or maybe they are just not used anymore. Much like the fabulous capabilities VCRs had, but no one used. We simply put in the tape and hit PLAY. All the options of preprogramming months ahead of time, on various channels and at various times lost their luster after the first or second power outage!

Reliable, yes they are. In case you are seeing more problems with infotainment systems than the shops that I deal with, you would probably wonder if you could obtain some tools to help you determine where those problems might lie. There is good news! The mandatory-for-the-dealer tools are available to the aftermarket. In addition, there are other universal tools used to test almost any manufacturer's system. Not too surprisingly, they look remarkably similar to the dealer tools.

All of these tools have a multitude of capabilities – not necessarily directly proportional to their costs – but enough to help almost anyone determine whether the infotainment system has a problem or if it may be something else.

Some can test the remote audio input and the system's outputs, the USB connections to the head, the Bluetooth interface, the display and some even call home to see if there's a problem with the antenna or vehicle network or the communication module (if external).

But before you start shopping for your next tool-junkie fix, consider what your customer base might require of you and whether or not you're willing to gamble on close to immediate obsolescence. I say that because of how fast technology advances. Some of the newer infotainment systems have self-tests requiring no tools to diag-

The driver is in control, able to add additional media sources or even upload directly to the system.

nose them. You can even reset some in case the software gets corrupted. That restores the software to the original operating mode, much like restore does to a Windows-based computer.

Consider the network

The most common complaints I've heard about infotainment systems I've resolved by fixing other vehicle problems. It's been my experience that network-related problems, those affecting other systems as well, are the cause of faulty infotainment systems. Once I fixed the vehicle network communication problems, then the infotainment systems work properly again. I get some humor when I find the owners have ignored (or just put up with) other vehicle systems that have been faulty, typically for quite some time, then worry about the vehicle only after they're unable to be entertained while driving. I usually hear, "That hasn't worked for some time," when discussing the other items I find inoperative along with their infotainment system that share the same network.

So, I suggest if you want to address your customer's problems related to their infotainment systems that you brush up on your networking diagnostics. There are numerous classes and seminars focusing on network analysis techniques available from a wide variety of providers. I recommend taking networking classes regularly because so much changes with them and so rapidly that we need to keep up.

As always, it also helps to have accurate information about the vehicle's network(s) and wiring diagrams to help guide you. You might spend countless hours looking for a problem and not be able to bill for your time without a good wiring diagram. That's just not professional. Don't forget to search for any Service Manual Updates (SMUs) to ensure you are working with the latest revision of the service manual!

It seems today's infotainment systems can provide nearly every comfort of home for us to enjoy in our vehicles. My question is why? Why would anyone want to have all those comforts when they are so much more comforting at one's at home? Why would we want to pay what it costs to have these systems in our cars – a cost that's usually exponentially higher than the comparable home entertainment systems? Why aren't we more focused on the task at hand – driving – instead of being distracted with one of these infotainment gizmos? Why does it seem each manufacturer tries to outdo the others by incorporating more and more bells and whistles when they, and we, are well aware that if they build it, it will break eventually? When they do break it may cost so much to repair that the system may have completely lost its value.

I realize those questions were asked rhetorically. I know it's not our job to tell our customers not to drive distracted. Do you realize though, those folks are right beside you when you're going down the highway? That's just a reminder. MA

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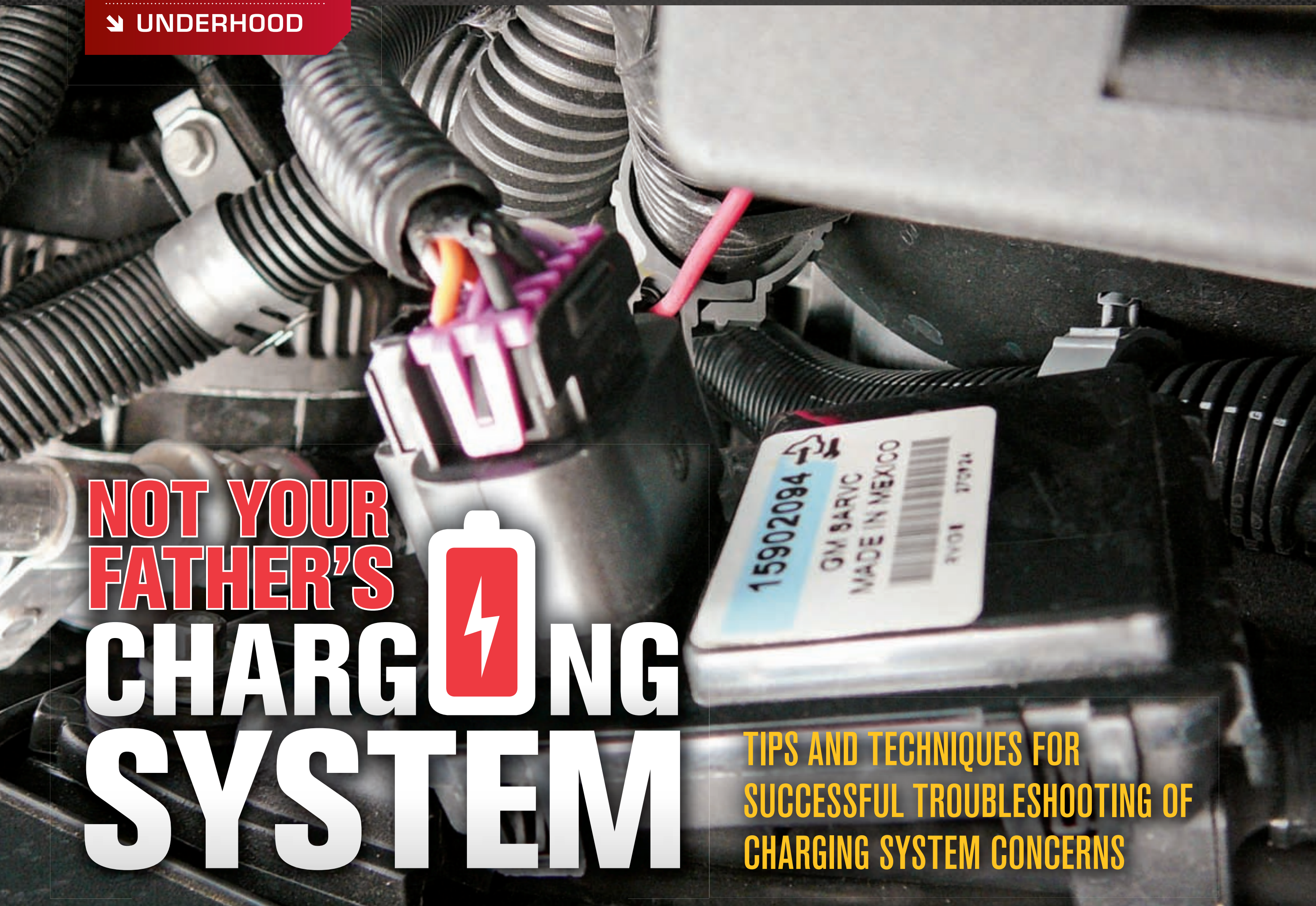

NOT YOUR FATHER'S CHARGING SYSTEM

TIPS AND TECHNIQUES FOR SUCCESSFUL TROUBLESHOOTING OF CHARGING SYSTEM CONCERNS

No longer used in favor of a simpler Hall current sensor without logic and CAN communications, the SARVC module is the controller for the alternator's regulator and current sensor. Working with the BCM for load monitoring and diagnostics and with the PCM to report in alternator load, the sensor does a lot for a small package.

BY **DAVE HOBBS** | CONTRIBUTING EDITOR

When it comes to any modern automotive system, you can accurately say some things never change. You can also say with equal accuracy some things are changing faster than most of us are able to keep up with! If you've found yourself struggling to keep up with the changes in 12-volt charging systems on late model vehicles, this article will update you on what has changed and remind you of some things that never change!

Keeping up with electrical changes in charging systems has been a challenge to me dating clear back to my days in the 1970s learning how to use a Sun VAT 28 (Volt-Amp-Tester) at Hobbs Auto Electric in Kokomo, Ind. But we can't know where we are going until we make a note of where we've been, here's a short history of charging systems so we can move to the present before blasting off into the future.

Generators to alternators

In the early 1960s, my father was an outside sales rep for a parts store in Kokomo. An interest in two-way radios and an electrician father-in-law gave dad a boost in learning electrical fundamentals. This inspired him to learn more about a new automotive component called the alternator. Chrysler had just invented the new charging machine, which featured a revolving field (stator) in lieu of the old generator's fixed field winding (field coils). The fixed windings that became excited when exposed to the rotor's changing magnetic flux featured three separate coils. Since the "excited" coils didn't change polarity back and forth to keep their output in a Direct Current (DC) state, as in the case of the conventional DC generator, this new charging machine produced Alternating Current (AC). Because a vehicle's electrical system has no use for AC, diodes were installed to rectify the AC current back into DC current. In those days, some of the heavy-duty charging system applications placed diode rectifiers outside the alternator. Most light-duty truck and automotive applications, however, placed the diodes internal to the alternator.

During this period, electrical innovations increased as space travel and computers moved into the technology scene. Dad was a good parts salesman

Photo: Dave Hobbs

but became frustrated with trying to instruct his mechanic customers how to properly use test equipment and not return "No Trouble Found" alternators and voltage regulators to the store. His frustration led him to call it quits with the parts business and start his own repair shop. That auto electric business would be the center of my family's life for the next 40 years!

It's always been about voltage regulation

Another advance in automotive electronics that would affect the charging system was the Engine Control Module. Sometimes referred to as F.R.E.D. (Frustrating Ridiculous Electronic Device) the ECM became mandatory on all the OBD I iron in the early 80s. By the mid 80s, Chrysler was back in the spotlight with another charging system innovation: the ECM controlled charging system. Their 1985 four-cylinder equipped cars began featuring Electronic Fuel Injection (EFI) using an ECM split into two parts — a Logic Module for calculations and a Power Module to do the actual outputs.

For more than a decade, most other manufacturers continued on the path General Motors had taken since 1972 with a two-pin autonomous solid-state voltage regulator built into the alternator. Ford and others would eventually move their voltage regulators into the alternator. The two-pin GM voltage regulators only needed a voltage signal from the cluster to come to life and begin charging. The lower the voltage sensed internal to the alternator, the more field current the regulator would provide the two brushes and the more current the alternator would produce.

In the early 80s, GM began an experiment called the "X" car many of us remember as Chevy Citations and Buick Skylarks. These FWD transverse mounted four-cylinder engines were quite underpowered and prone to stalling and even strange tail pipe vibration as the two-pin GM "Delcotron" alternators were immediately turned on to a full-field condition in order to take care of a sudden increase of 12-volt accessory demand. Not quite ready to trust "F.R.E.D." to handle voltage regulation, the GM/Delco Remy CS series alternators were born to gently ramp up the field current when a sudden current increase was demanded. As the alternator sensed internal voltage at the output post or external voltage at the new four-pin regulator's new "S" terminal (tied to a strategic spot in the wiring harness), the smarter voltage regulator would ramp up the PWM of a duty cycle running at 400 Hz.

There was also a regulator terminal marked "P" (for Phase) that in applications of non-electronic diesels (GM 6.2 liter V8) became the tachometer input from one leg of the stator. A third voltage regulator terminal was in many cases the only terminal with a wire going to it (besides the heavy gauge output circuit) and was originally marked "L" for Lamp. A fourth terminal ("I" for Ignition) to those CS series machines was an option on some vehicles to supplement the cluster's connection to the "L" terminal when the ignition was turned on.

OBD II & Smart Charge — Does F.R.E.D. really charge the battery?

1996 took a big turn when OBD II gave us all a new challenge. About that time, Ford began following Chrysler's technology of having the alternator controlled by the PCM. Not all late model Ford alternators are PCM controlled. Terminals for the voltage regulator in a Ford that is not controlled by the PCM are marked "I" (for indicator), which is hot with the ignition key in the RUN position. Voltage is applied through the warning indicator circuit to the voltage regulator. This turns on the voltage regulator, allowing current to flow from the battery sense "A" terminal circuit to the generator field coil. Another regulator terminal is marked "S" (for stator) and supplies rectifier charge information. The last terminal is marked "A" (for absolute) and is a dedicated battery voltage sense line measuring system B+ voltage.

Ford's later PCM-controlled charging systems use alternator connector circuits descriptively marked "GEN COM" and "GEN MON" for Generator Commanded PWM (PCM Output) and Generator Monitor carrying the generator load info and error condition to the PCM (PCM input). If you use a DVOM with a frequency counter or a DSO, you'll find Ford's GEN COM to be around 132 Hz with a variable duty cycle that changes with the PCM's command for the charge rate. A third terminal may be used (A for Absolute) and is the dedicated voltage sense line. The PCM uses input info from the TPS, ECT, IAT and VSS sensors to set the charging rate.

On later OBD II GM vehicles, we saw the same CS series alternator we used in the late 80s, but now the PCM was connected to the terminals marked "L" (for Lamp) and "F" for field for about the first decade of OBD II. In the case of most OBD II GM alternators using four-wire regulator connections, unless the vehicle is equipped with RVC (Regulated Voltage Control), the PCM is not in control of the charging rate. More on RVC systems later.

The PCM's circuit marked "L" titled "Generator Turn On Signal" in many schematics only triggers the regulator to turn on. The reason the PCM now controls this signal is so that it can inhibit the charging output of the alternator until the engine is fully running. Once it is, the alternator gets its current limited turn-on voltage from the PCM. The PCM does not control this circuit to vary the charging rate as in the case of OBD

II and later Fords. The second circuit connected between the GM PCM and the four-terminal CS series alternator's voltage regulator is marked "F" for field and titled "Generator Field Duty Cycle Signal."

GM RVC Smart Charge

One very basic fact with charging systems is that the alternator needs to tailor the charge rate to the vehicle's current demand and battery temperature. Colder batteries need charging voltages closer to 15 volts to take a charge while warmer batteries need lower voltages closer to 13 volts to not overheat. Chrysler's tradition has been to use a battery temp sensor in the battery tray on some models, while other OEMs have relied on either the voltage regulator's built-in thermistor or the PCM's ECT/IAT or even OAT (HVAC's ambient air temp) along with some thermal modeling software values to tailor the charge rate in order to keep a battery healthy.

For years, various OEMs including GM have also been utilizing "Load Shedding" to turn off/limit power to heavy current accessories (rear defoggers and heated seats, for example) whenever the 12-volt battery begins to show signs of getting too low during times of heavy demand and low RPMs.

Having the BCM to simply "keep an eye on voltage" is only good to an extent. Since in the mid 2000s, GM's smartest charging system dubbed "RVC" (Regulated Voltage Control) uses either a four-wire or newer two-wire Bosch alternator regulator connector and a current sensor. The current sensor looks a lot like an inductive amp clamp's jaws permanently installed around the battery cable. Typically mounted close to the battery, these sensors show up in two versions: stand-alone (SARVC) and non-stand-alone (RVC) models. The stand alone has its own logic functions. Acting in concert with the PCM and BCM via the CAN bus, this current sensor with multiple wires actually controls the field wires connected to the voltage regulator in the alternator. These are used on mid to late 2000 GM LD trucks and SUVs. Since the BCM is involved in some of the charging system "thinking," it also logs DTCs from the SARVC module. This means you must look at BCM codes along with the usual PCM DTCs when diagnosing charging system problems on these models.

Non-stand-alone RVC models use a three-wire sensor, which is basically a current-sensing Hall sensor. The sensor will typically stay powered up courtesy of the BCM several minutes after the key is turned off to watch for battery drains.

The real magic of GM's RVC as opposed to other PCM-controlled smart charge systems is the use of the current sensor to supplement the "intel" for charging. If the vehicle knows just exactly what the system and the battery needs to be healthy it can work harder when it needs to (slightly over 15 volts) and take it easy when it can. This taking-it-easy approach to charging voltage control allows for lower outputs from the alternator, which means the alternator is easier to turn. That spells a fuel economy gain. Besides increasing MPG, the smart charge systems can float back to just over the 12.6-volt mark to maintain battery state of charge, thus increasing the battery's life.

Back to basics – When the alternator won't charge

The best alternator and fancy computer controls can't get past a faulty battery so a thorough battery state of health test with a modern capacitance-type battery tester (think Midtronics) followed with a good old back up carbon pile load test (whenever in doubt) are always first orders of business. Next would be checking for excessive voltage drops between the battery post and alternator output terminal while the engine is running with a heavy load. Double checking for poor grounds, of course, is the proverbial fatherly advice that must always be remembered in the real world of electrical problems. Finally there is the test for diode leakage from the alternator's rectifier bridge.

Way beyond basics – Hybrid 12-volt charging systems

HEVs and EVs are not a disappearing fad as some have presumed. Since every one of them have a 12-volt battery for 90 percent of the vehicle's electrical functions regardless of how many volts their high-voltage batteries have, it is important to not overlook the profound differences in these charging systems. First off, all HEVs use a DC-DC solid-state converter to keep up with the vehicle's 12-volt electrical demand and 12-volt battery charging. Using the higher level voltage (anywhere from 42 volts to 360 volts depending on the model of HEV you are working on) the charging voltage for the 12-volt system is derived from this higher voltage source via a step down transformer. Even on GM Belt Alternator Starter (BAS) systems that had only 42 volts of high-voltage power (blue cables) in mid 2000 models and now 130 volts (orange cables) in 2013 and 2014, the device that looks an awful lot like an alternator is really a high-voltage three-phase AC motor/generator. Basic testing is identical to conventional mechanical alternators: monitor charging voltage at the 12-volt battery both unloaded and loaded (accessory turn on or with a carbon pile) and look for DTCs related to the DC-DC converter, much like you would an alternator setting a DTC. Keep in mind DC-DC converters are solid state – they only need a good high-voltage battery pack as their muscle for charging, not engine RPMs. On many HEVs the gas engine doesn't even have to be running for the DC-DC converter to put out 14.5 volts. Since there is not a conventional diode bridge for rectifying AC, HEV DC-DC converters make the perfect DC voltage for all conditions without any ripple voltage.

Even though those alternators dad taught me to rebuild still have diodes today, some experts are saying within the next few years diodes in conventional mechanical alternators on non-hybrids will be replaced with solid-state transistor controls like Insulated Gate Bi-Polar Transistors (IGBTs) now used in HEV/EV inverters. From Delcotrons to DC-DC converters – my father (who's now 86) and I both agree: some things never change — and some things are always changing!

DAVE HOBBS
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BITS AND PIECES FROM THE TST BAYS

NEVER A DULL MOMENT!

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

The TST/ATTS training center is also a full-time shop located north of New York City. Keeping my hands dirty keeps me current on the problems my students (and my faithful readers) are facing. Here's a few we had recently.

A faulty Ford

We had a 2003 Ford Expedition 4.6L V8 with 110,552 miles come in with Diagnostic Trouble Codes (DTCs) P0135, P0141, P0151, P0161 and P0443. The vehicle had already been to the Ford dealer, and they told the owner that the O_2 sensors and PCM (Powertrain Control Module) had to be replaced. Since the owner was not happy with the dealer diagnosis (or the quoted price), they came to me. I confirmed the DTCs and checked for Technical Service Bulletins (TSBs) and found one that related to our DTCs. We called a local parts store looking for a replacement for the PCM, but no one had a listing but the dealer.

The cost of this PCM was more than $800, so we wanted to make sure it would solve the problem before we replaced it. We checked all the O_2 sensors' heaters for battery power and ground to make sure the heaters actually worked. What we found was that the sensors had power but no ground — that is supplied by the PCM. We used a PowerProbe to supply a ground to test the sensors and found that they were capable of drawing the correct amount of current along with heating up properly. The problem of a failed PCM was now confirmed since we proved that the components (O_2s) could function properly if they were provided with power and ground.

Because of the vehicle's age, the owner asked us to find the most reasonable way of repairing it. The new unit was so expensive and there were no aftermarket units available, but I remembered a company called Ourecms. Years back I used the company and recommended them to my students because they would ship you a unit to try for $75.

I thought since I have the Ford IDS I could get a used PCM and program it to confirm our diagnosis. A Google search pulled up www.autoecms.com — it was the same location where I had purchased PCMs years ago. I read through their site and found this, "Misdiagnosis no problem, if an electronic unit was ordered but a misdiagnosis was discovered, after the unit was installed, yes you may return our unit for a refund less a $75 test/restock fee and all shipping charges."

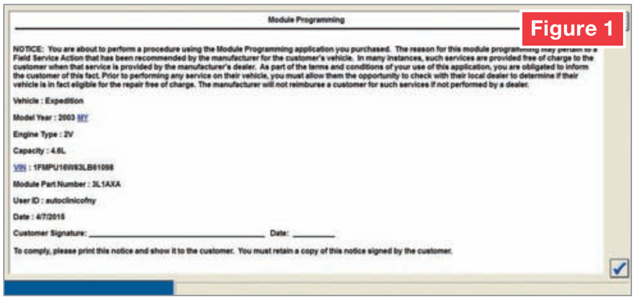

Figure 1

We ordered the PCM, installed it in the vehicle and reprogramed (Figure 1) the unit so the vehicle would have all the correct information and start. When you are programing a new or used Ford PCM you have to deal with their antitheft system PATS (Passive Anti-Theft Systems) and program the keys as well. Make sure to have at least two OE keys available or the procedure cannot be completed properly, and the vehicle will not start. You should also have all the key fobs for the vehicle and know if there is remote start available on the fobs. If that is the case, you will have to program the fobs as well. Another important step when you program a vehicle is to utilize a battery maintainer and make sure you type in the vehicle VIN number and other important information.

After the programing was completed, the engine started up and ran great. I took the vehicle for a test drive to make sure that Mode $06 would display passing test results. After two of us drove the vehicle all the monitors except EVAP (evaporative emissions) were "Ready." After the vehicle sat overnight, we test drove it again and completed all the monitors, confirming our repair.

An unhappy Honda

Our next vehicle is a 2009 Honda Pilot with 135,739 miles and DTCs P0420 and P0430. This vehicle had not been maintained properly and the owner (of course) did not want to spend any money. After a diagnosis, we found it needed a tune up, thermostat, coolant flush and new catalytic converters. The Mode $06 data (Figure 2) displayed failures on the catalyst and misfires on cylinders, along with an Air Fuel sensor that was borderline. To get this vehicle back in good running condition, it needed the oil changed, a complete

Photos: "G" Jerry Truglia

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AUTO ENGINUITY

480-827-TOOL (8665) www.autoenginuity.com tune up, a fuel system cleaning and new converters.

Take a look at some of the test results on this vehicle starting with fuel trim. The Escan STFT and LTFT (Figure 3) graphs for both banks were way over the normal limits. Bank 1 at idle was commanding +26 and Bank 2 was adding +16 and both had rich commands all the way through the range with the exception of rpms over 3500.

The engine also had a thermostat problem that most likely contributed to the P0420 and P0430. Looking at the thermostat test (Figure 4), I noticed that the cooling system was not warming up in the proper time frame. This condition would have made this engine run richer while still producing heat inside the vehicle and not raise a flag. This is a common overlooked problem since there is no complaint of a lack of heat. Make sure that the engine temperature is rising about one degree a minute while warming up.

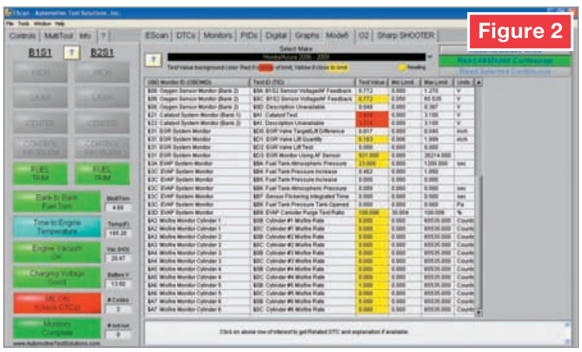


Figure 2


Figure 3

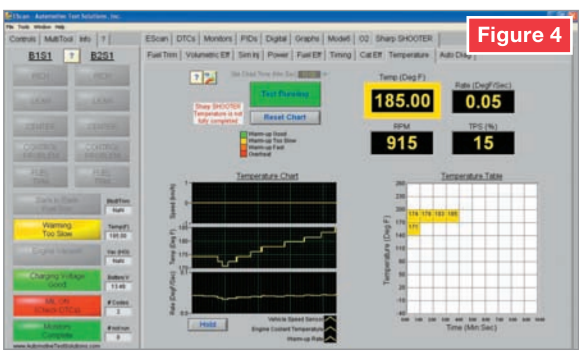


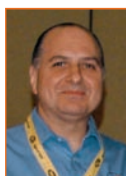
Figure 4

Our next test was to check Volumetric Efficiency (VE) on this 3.5L engine by using the VE tab. As the throttle was depressed during this test, I noticed the yellow line (actual results) versus the red line (calculated amount) did not look right. One problem with the test results not being as accurate was due to the elevation reading about 460 feet lower than the correct elevation of 660 feet that we are at. The setting of the wrong elevation could cause the wrong calculation of the red line, causing it to be lower than normal. Even with the wrong setting, the results of the test had the important information indicating a problem.

The problem with the VE test results was not that the MAF and intake system would not reach the proper height on the test, but rather what the top of the yellow test line indicated. The zig zag at the top of the yellow line indicated that we had a clogged exhaust system. This information made sense, since the vehicle came in with the complaint of low power and the Malfunction Indicator Lamp (MIL) illuminated. Now when you put all the information together — DTCs, Freeze Frame, Mode $06 information, thermostat, misfire information, VE test and an engine that had never been tuned up — we can conclude that the catalytic converters were indeed bad.

Unfortunately, the vehicle owner decided not to fix the vehicle. If he decided to repair this vehicle, we would have recommended a complete tune up, fuel system cleaning and after the cleaning we would perform a back pressure test to see if the converters were clogged. Most of the time we will test the converter to see if it will clean up by viewing Mode $06 data after performing a cleaning. The cleaning is done by disconnecting a coil or wire (ground the spark plug wire) on each bank. With the spark disabled, the converters load up with fuel, then the idle is raised up to 2500 rpms for three minutes. If Mode $06 numbers drop after we complete this procedure, we will recommend a fuel system cleaning that may have to be repeated a few times to try and bring the cats back to life. Remember that if the engine has more than 60,000 miles on it, the carbon build up can be more difficult to clean. We have been very successful using this test and clean procedure and can usually get the system working correctly without replacing the converters. Now in this case, there is a big possibility that these converters would not come back to life since the VE test indicated a possible restriction.

Since training is a diagnostic tool, I thought I would write a brief description of the training that took place this April at Automechanika Chicago. If you missed it, I am sorry. If you attended this event, you will agree that technicians were exposed to all types of training from drivability, transmission, management and more. There were some great instructors such as Bernie Thompson, Wayne Colonna, John Thornton, Scot Manna, Ken Zanders, John Anello, Vin Waterhouse, myself and too many more to list. If you missed it, you really missed out on some of the best training under one roof and all for an unbelievable price — FREE. Keep an eye on the *Motor Age* website and in the magazine for more training events. Thanks to all the sponsors who made the event possible, along with Messe Frankfurt, Advanstar (*Motor Age*), ATSG, ATTS and TST. MA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PUTTING OFF THE INEVITABLE

SOMETIMES PROCRASTINATION IS THE BEST TEACHER

BY **RICHARD MCCUISTIAN** | CONTRIBUTING EDITOR

None of us is a prophet or the son of a prophet, but just about every one of us as a professional mechanic has warned customers of impending vehicular disasters, just to be ignored for one reason or another, only to be vindicated later. For example, there was a pretty blonde who had us do an oil change on her SUV – it was, as I remember, an Asian make with a four cylinder, and while we had it in the service bay, I could hear the timing belt slapping the plastic cover.

"You'd better bring this thing back tomorrow and let us put a timing belt on it," I told her. "If this one jumps time, fixing it will be expensive. It's not a free-spinner." Then I had to explain what "not a free spinner" meant in plain language, which she seemed to understand (not). She had me order a timing belt, which I did (I told her we'd need to check the various pulleys and the water pump, too), but she never showed the next day, the next week, or the next month. About three months later she stopped by my office to tell me her timing belt had failed about six weeks after our conversation and it had cost her $1,500 to get her ride going again.

More recently, another procrastinator I know complained of a coolant leak on his 2005 Power Stroke, and I showed him the crack in the degas bottle that was dumping his coolant. I then called the parts store for him and found that they had one on the shelf for less than $50. I change the degas bottle on vehicles sometimes when I flush the system just to get rid of the rust-stained old one. Well, this guy didn't have the $50 that day, and so he decided to keep adding coolant, planning to change the jug later. The short version of that story is that he destroyed the engine – a 6.0L PowerStroke – and well, that pretty much mothballed the truck, which will probably never be driven again.

Lest I appear too judgmental, I have to recollect one of my own procrastinations. Back in 1981, I was driving a '66 VW Bug, you know, one of those with the little brake fluid reservoir behind the spare tire and the steel line feeding through a stupid rubber grommet in the top of the master cylinder? Well, I had to add brake fluid regularly because it was seeping out around the grommet, and one day, as I pulled into a convenience store parking lot in Port Arthur, Texas, I hit the brake and had no pedal. The fluid was gone. I jerked the park brake and the cable broke, and I jumped the curb and smashed a newspaper machine with the bumper of the bug. The impact ducked the front of the bug in so that the headlights were painting the ground about ten feet in front of the car, and so I chained the bug's bumper supports to the back of my pickup, backed up, and jerked the front back into shape. But in that case, I was a procrastinator in my own right.

Usually the decision to procrastinate is economy related, and we've all known of customers driving

DELAYED REPAIR

2002 HYUNDAI ELANTRA
Vehicle Year/Make/Model

201,043
Mileage

2.0L
Engine

AUTOMATIC TRANSAXLE
Transmission

CAN YOU REPLACE MY ENGINE?
Complaint

Photos: Richard McCuistian

Here's the powertrain swinging on the hoist. This is the smartest way to swap one of these – we've done it both ways and the other way is a pain.

around with grinding brakes, dry-rotted tires, slam-shifting transmissions and dripping water pumps because they simply don't have the money to do any better.

Sage advice

The 2002 Elantra that headlines this article came to us for an oil change, and to its credit, this car had worked very hard to earn its keep and it had gone enough miles to circle the globe eight times. This one was way overdue for a timing belt, and while somebody had replaced some of the hoses, that plastic and aluminum radiator was on borrowed time. Let me digress here long enough to voice my opinion, i.e., high-mileage vehicles that have aged through more than a few summer seasons should have their radiators replaced as a preventative measure, but make sure you choose a reputable brand!

To her credit, the Elantra owner did let us replace the timing belt, because I told her how those engines literally destroy themselves when they jump time. The last one of these little Korean in-lines we saw that jumped time was in a Kia Sephia that snapped the heads off multiple valves and beat the daylights out of one piston, ruining the cylinder head for good measure. Customers don't often take timing belt intervals seriously enough. The lesson I try to teach everybody I know is to pay attention to the recommended timing belt change interval, or else you'll be sorry.

A couple months later, the Elantra owner left me a voicemail asking if we could replace her engine. When I called back and asked her why, she told me the car had developed a radiator leak and had had some overheating episodes. The short version is that this Elantra suffered from the same kind of procrastination that the above-mentioned Power Stroke did. The coolant leak was discovered, water was added a few times, and a radiator was purchased, but the tyranny of the urgent kept the car on the road until it gave all it had, and now the crank was shoving pistons whose rings no longer had temper – the once-lively powerplant had now become a compressionless boat weight. Now she had also purchased a $600 used engine and needed it installed.

In the bay

In the service bay, my guy jerked the engine and transmission out as a unit – which is the smart way to do one of these. A previous student had replaced the engine in a 2005 Kia Sportage, which sports the same mill, and he found out the hard way that reading the shop manual first is better than winging it on one of these. I had told him that, but his procrastination in finding the right way cost him quite a bit of grief. Thus he worked himself into a mess on that one trying to swing the engine away from the transmission and bring it out of there. There wasn't room for that. The Elantra job went a lot smoother because the guy doing this job chose to read the instructions before all else failed (good idea!). My recently developed mantra for newbies is, "before you wrench, read." In this case, that approach paid off.

Sometimes I'll have a team of two do jobs like this, but engine swaps and other such jobs are best done by only one guy, because that eliminates the "he said, she said" element. What that means is when two are working on the same job, one of them either bails off the job before it's done, or they leave things loose, claiming they thought the other guy had tightened it. Personal responsibility goes a long way toward making the job a better one, and if the wrench guy is a one-man show those kinds of mistakes are usually mitigated.

The replacement engine was drop shipped to the shop, and when we got it mounted on a stand, we threw a timing belt and a water pump on it for good measure, and then went to work moving the transaxle from the old engine to the new one. We examined the torque converter seal, which was still soft and pliable, and replaced the half-shaft seals in the transaxle.

Well, while this job was under way, the owner of the Navigator called – you know, the one we put the timing chains and cam phasers in a couple months back? (See the link on the

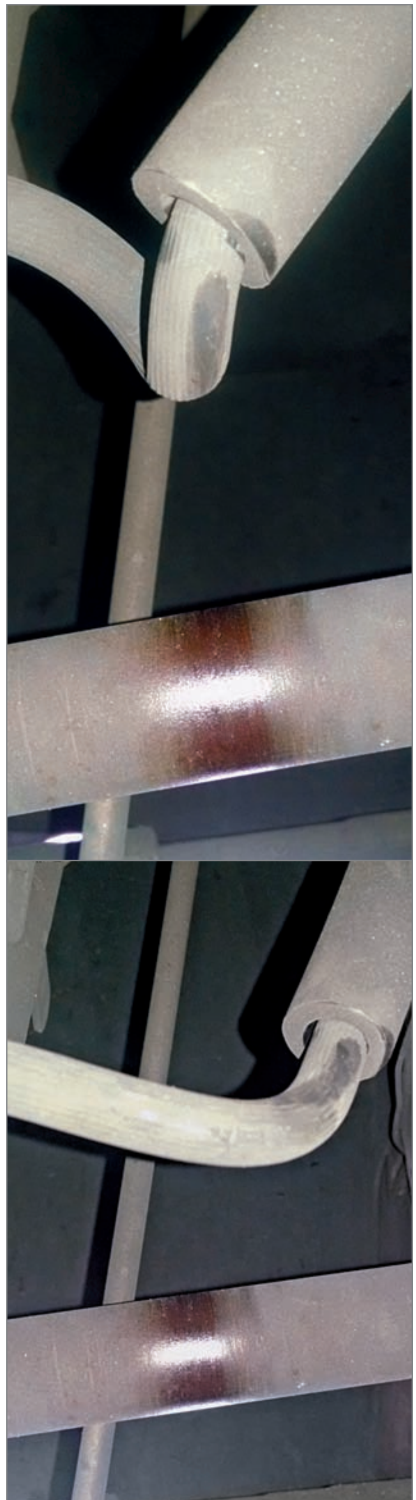
Any salvage yard engine needs a new timing belt and water pump. If the rear main seal is in question or if there's sludge inside, those need addressing as well. New plugs are a no-brainer… it got those too.

top of page 69). On the phone, he claimed the Lincoln was "doing the same thing," and he went on to say that it had run very well for weeks, but then when it was sold, it began running poorly 30 minutes after the purchaser left on it and the vehicle had to be bought back. He was an easy fellow to get along with in spite of that bad experience. I told him to bring it in, and we'd have a look. This was troubling, because we had used aftermarket components, and after the job was done, there were people who warned me that it was a bad idea to use anything aftermarket on a timing chain job like that because of the way the tensioners are made. Well, we've put quite a few aftermarket timing chain kits on with no issues, but had this one bitten us? We'd see when it came in.

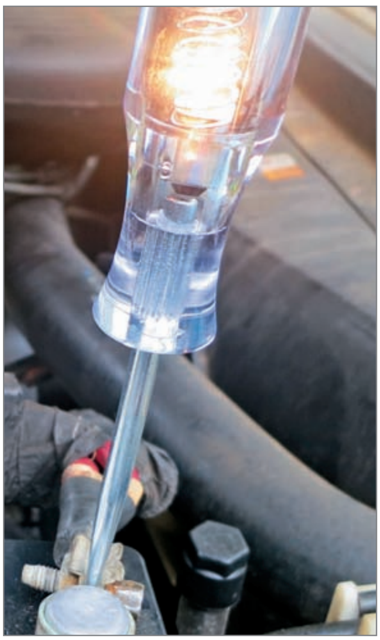
The two false 'same problem' cases

When we did our test drive and code scan on the Navigator, we duplicated his concern, saw a flashing MIL and found cylinder number six tossing a misfire code. This three-valver would need a set of those dandy $15 apiece spark plugs and possibly one coil, so that's what we did. The timing chain tensioners didn't fail after all. And yes, we were dummies for procrastinating in replacing those spark plugs when we did the timing chain job. And believe it or not, the best way we've found to get all those spark plugs out without breaking one is by jerking them out of their holes with an impact wrench. It breaks the carbon bond between the snout of the plug and the head.

For another follow-up, our regular readers might remember the F-150 we discussed in the same article as the Navigator – remember the one with a water-damaged junction box that was keeping things on and killing the battery? Well, the windshield leak had been repaired, but not before he procrastinated a bit, and it rained a time or two during that interim. Since screwball electrical problems started happening again, with various



Here's a tip for DIY brake folks – make sure you don't twist the caliper hose when reinstalling (see top) – this lady had us check her vehicle right before a long trip – had this hose ruptured it would have been an unpleasant surprise.



This was the F-150 adventure – when I checked at the injector, I got the whisper of current you see in the first photo – it didn't match battery voltage or available power at the relay socket. Tapping the relay, I saw it get bright.

different electronics shutting down as he was driving, he bought another junction box from the Ford place, then had a friend help him install that one. Afterward, they determined the alternator was the problem because the battery was slowly dying as the engine ran. The alternator was replaced, but after that work was done, the theft light was flashing and there was nothing showing on the odometer but dashes. Had this chain of events happened at a shop, most customers would have sworn the mechanic was an incompetent boob. That's when they called for the "calf rope."

Before I even made the trip, I asked if there were two keys available for the truck, and the customer answered that there was only one key, so I made him come up with a second one just in case I had to erase and re-burn the keys.

When I stopped by the guy's house to see about the truck, I saw the theft light flashing, and while my scan tool would talk to the Hybrid Electric Cluster (HEC), the PCM wasn't communicative at all.

In these situations, I like to disconnect an injector or the IAC and see if EEC power is present on the red wire, because the EEC power relay also feeds the PCM. In this case, with the key on, I saw a very dim glow at injector number one instead of the nice bright light I got at the battery – voltage was being dropped somewhere between the battery and the business end of that circuit and since this wasn't my first rodeo, I had an idea where to look first. I gently propped

This is how the ABS sensor looks when a customer has been procrastinating, driving with scrubbing brakes. It's an interesting visual, but this one got rotors and pads and a good sensor cleaning.

When these 3 valve spark plugs fail, they do it in a big way. What was so amazing is how good the vehicle ran after we did the timing chain – the harsh skipping started a few hundred miles later, and was on several cylinders.

This was the 2.0L Hyundai going back in. This little mill ran like a dream until one of the transmission cooler lines popped off because of a loose clamp. Of course, nobody reading these words has ever had anything like that happen, right? Heck we test drove the car for a long way and it didn't happen to us. It was embarrassing to get that call not 10 minutes after the customer left with the car, but I sent a couple of my folks to take care of it, and we had her come back so we could steam the greasy mess away before releasing the vehicle for good.

my test light up in such a way that it would remain in contact with the EEC power wire at the injector, then tapped gently on the EEC Power Relay to see the test light get very bright, I heard tones, and the Theft light stopped its infernal blinking. When I switched the key off and back on, however, the problem returned, making it impossible to use the quick way of programming the new key. I moved the fuel pump relay to the EEC power relay's socket, and at that point I was able to start the engine and program the new key by simply cycling the first one.

Here's one of the ultimate procrastinations. This guy drove his '94 Suburban skipping for a long time before he had us do exploratory surgery – it had blown a gasket between two cylinders, and this was the result. This old bomb would need an engine.

On the road again

The Elantra engine job went like a song. The new radiator was installed, along with all new fluids, filters and belts, and the test drive went well except for the fact that the left front wheel started making a bit of noise. It turned out that the otherwise fastidious guy who replaced the engine had procrastinated in regard to applying the torque wrench to that wheel and it drove out of the shop with the lug nuts barely snug. We caught it, though, and tied up that loose end before setting the air pressure in all the tires and applying a windshield sticker with her next oil change mileage. Then we had to retrieve the car after it left because of a loose transmission line clamp. Oh well, the point is that no matter who's doing the learning, procrastination is the best teacher. MA

RICHARD MCCUISTIAN
CONTRIBUTING EDITOR

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

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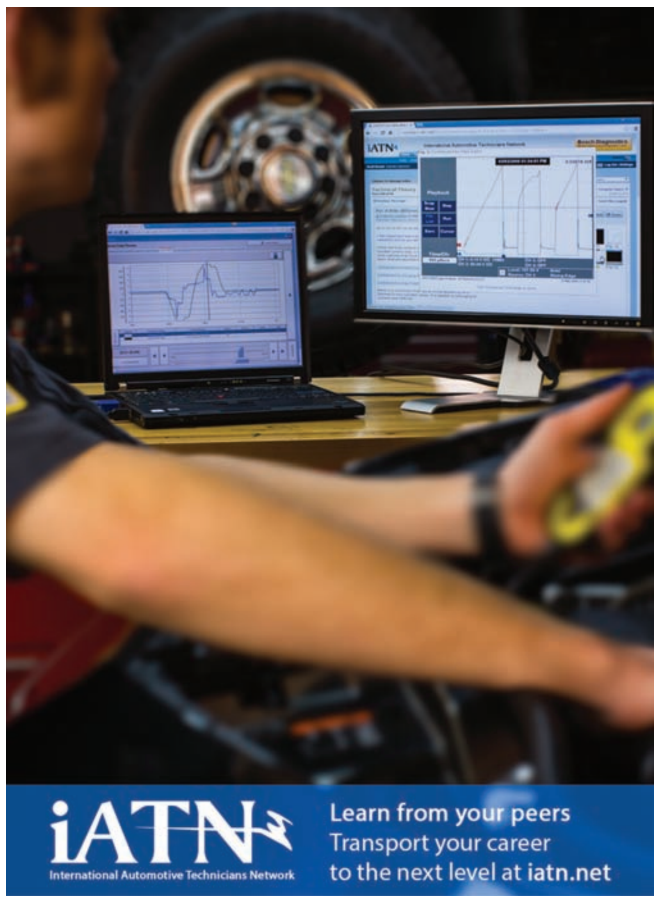

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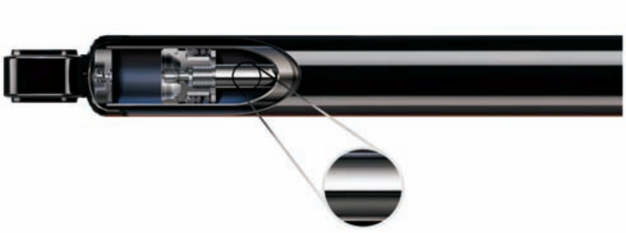
Quality and Durability — Built into Every One

Pressure Tube - D.O.M.

- Gabriel's metal forged D.O.M. (Drawn Over Mandrel) process removes the weld seam and imperfections from the surface
- This smoother finish surface reduces friction and leads to a longer product life
- Gabriel's surface smoothness measures at 3.0*, which indicates a smoother tube surface. Competitors' measure as high as 36.0*



Chromed and Super-Finished Piston Rod

- The rod surface is chromed and super-finished to prevent corrosion
- The super-finished chrome carries the proper amount of lube to the seal, providing a consistent wear surface and longer product life
- Competitors' rods show corrosion, Gabriel's remain clean**

Durable Piston Valve Assembly

- Gabriel's piston valve assembly design is extremely durable
- Gabriel's O-Ring piston seal adjusts as it wears to maintain a tight seal between the piston and pressure tube. This minimizes leak paths for a longer product life
- Many competitors' valves don't use an O-Ring and don't adjust for wear over time

Dirt Wiper Oil Seal

- Gabriel's integrated dirt wiper raises above the oil seal to help keep road debris, dirt and grit from getting inside the seal and the shock
- Many competitors' products don't contain a dirt wiper

* In Gabriel tests

** Both rods went through the same industry standard 96-hr ASTM-B117 salt spray test

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When it comes to quality and reliability, Gabriel has always been ahead of the pack. And to make sure we stay there, we go to great lengths to ensure our new shock and strut designs are specifically fine-tuned to meet the needs of today's vehicles and their drivers.

At Gabriel, our products are backed by more than 100 years of innovation, engineering expertise and continuous improvement in ride control products. So we understand the critical importance of careful design and thorough testing. It's why we engineer, test, and validate our new light vehicle shock and strut designs for proper fit, ride and durability – to ensure you get the same easy installation, high quality and long-lasting performance with every new Gabriel product.

You Have Questions. We Have Answers.

THE ANSWERMAN

They say there's more than one answer for any given question. Rest assured, we've got all of them. The Gabriel Answerman is your go-to technical resource center for general questions about shocks and struts, as well as specific technical and installation questions about any of our Gabriel products.

Need help with a tricky install or have technical questions about a Gabriel product? When you call our Answerman Tech Line, the person you speak with is one of the same technicians that fits, ride-tests and validates every new Gabriel design. So, no matter what your question, expert answers based on first-hand experience are never more than a phone call away.

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Tracerline

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Walker Products

NEW BENDPAK LOW-RISE LIFT PICKS UP WHERE OTHERS LEAVE OFF

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

BendPak

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Hunter Engineering

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K-Tool International (KTI) introduces a 4-Drawer Locking Service Cart, bringing you and your tools the mobility you crave and the flexibility you need. The service cart comes with 4 drawers with a locking top set up with gas shocks to raise and support the top. Each drawer is designed with ball bearing slides for easy, smooth opening. Its 18-gauge steel construction provides a rated load capacity of 500 lbs.

K-Tool International

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WORLD BRAKE RESOURCES (WBR) is a complete braking solution for Asian, domestic and European vehicles. Products include WBR brake rotors with Run True™ Technology, WBR Dual-Technology brake pads, WBR Premium and Premium OptiSelect calipers, WBR Quiet-Clip Technology hardware kits and WBR brake shoes. All WBR products offer professional quality with proven performance and are available exclusively at WORLDPAC. Visit www.worldpac.com.

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Gumout® Multi-System Tune-Up contains polyether-amine (PEA), a nitrogen-based detergent found in any truly effective fuel system cleaner. PEA is stronger than most other cleaning agents and can withstand the high temperatures found in the combustion chamber. PEA helps Gumout complete fuel cleaners remove carbon deposits from across the entire fuel system, while also preventing future carbon buildup. Learn more at Gumout.com.

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Easy-Run Engine Test Stands

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Dorman Products, Inc. has launched its new Stainless Steel Brake Hydraulic Line offering. The program is designed to provide a superior aftermarket choice in brake line replacement while saving technicians time with pre-formed application-specific replacement solutions. Dorman's Stainless Steel Brake Hydraulic Line category will launch with coverage for today's most popular full-size GM and Chevy trucks; in a variety of trim levels and year ranges.

Dorman Products

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IN THE GROOVE

VISUAL INSPECTION ALONE IS NOT ENOUGH WHEN INSPECTING SERPENTINE BELTS

BY **PETE MEIER**
Technical Editor

Auto designers would love nothing more than to remove every accessory drive you see on the front of the engine. Each one pulls power away from the rear wheels and reduces fuel economy to some extent. But until they do, it is important that we, as professional technicians, stay on top of the proper inspection, service and repair of these systems.

In the old days – the really old days – the accessory drives included the alternator, water pump, power steering pump and perhaps the optional air conditioning compressor or the emissions-required secondary air pump. And they were all driven by V-shaped belts running on tapered pulleys. Adjustment consisted of manual tension assemblies that were often nothing more than a sliding assembly that was locked down by two bolts — one at the pivot and the other at the slide.

Nearly every car you service today, though, uses one or possibly two serpentine belts to drive the accessories. Early serpentine belts were made of neoprene with one basic construction design. Heat and time caused the neoprene belts to crack, fray and eventually break as their fibers weakened with age. Today, a material called EPDM (ethylene propylene diene monomer) is the base material for the belts. This material allows belts to live for 100,000 miles or more, but the drawback is that the signs of wear we were used to are not as prevalent. It is not unusual for an EPDM belt to be worn past its useful life yet show no or little visual signs of damage.

And the drives themselves are becoming more complex. Automatic tensioners and active decoupling on drive assemblies are just two that come to mind. And have you run into an accessory drive that had no tensioner? That's the "stretchy" belt and that design takes special service precautions all its own.

So join us in this edition of The Trainer as we turn to the experts for the latest advice on the proper care and servicing of today's accessory drive systems. MA

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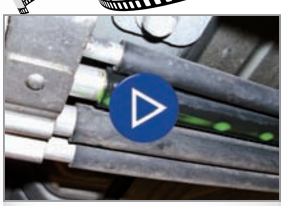

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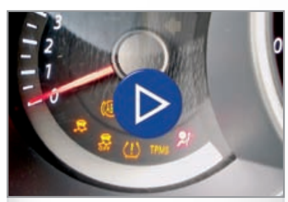

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