

# Motor Age

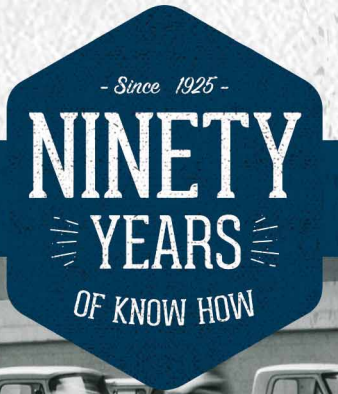
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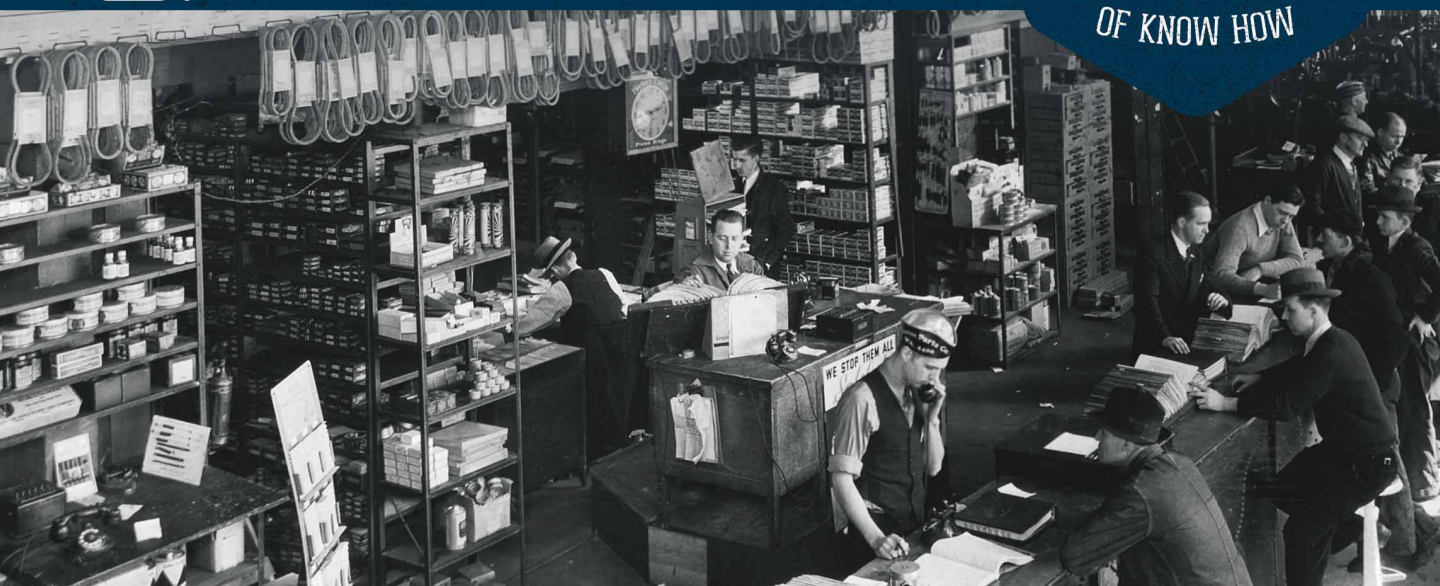
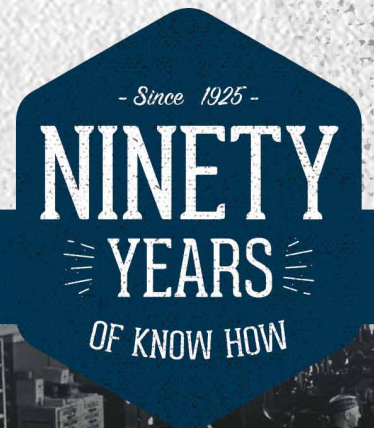
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MARK YOUR CALENDAR!  
2018 NACE AUTOMECHANIKA  
AUG. 8-10 IN ATLANTA

## TRAINING, NETWORKING IN TODAY'S INDUSTRY

NACE AUTOMECHANIKA KICKS OFF IN CHICAGO AND OFFERS MECHANICAL, COLLISION EDUCATIONAL SEMINARS, AN EXPO, AND A HOST OF CO-LOCATED EVENTS

### LESSONS IN ASIAN DRIVABILITY

28

Another season brings new lessons for dealing with Asian makes

### IMMOBILIZER, NO-START SYSTEMS

48

When a "no start" isn't caused by a bad starting system

## THE TRAINER: TACKLING CATALYTIC CONVERTER DTCS



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### HYBRIDS FOR GAS GUYS

Hybrids — you know they are out there, but have you embraced them in your shop? Join Technical Editor Pete Meier and G. Jerry Truglia with TST and Automotive Technician Training Services for this hybrid-focused webinar. Topics to be covered include hybrid vehicle safety, tools and equipment needed, hybrid component and their functions, preparing for the L3 hybrid certification and more!

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### SERIES: TACKLING GROUND CIRCUITS

This now five-part series — with more to come — by Vincent Fischelli with Veejer Enterprises, walks through what some technicians deem to be mystery about the ground side of the circuit, caused by thinking of positive current flow in circuits, rather than negative current flow.

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**BREAKING NEWS**

TRAINING SOURCE

## NEW VIDEO-BASED TRAINING SITE LAUNCHED

**→ CHICAGO** — The UBM Automotive Group is launching a new video-based training resource — Motor Age Training Connect, powered by AutoMate.

The new, cutting edge video training portal, available at [Connect.MotorAgeTraining.com](http://Connect.MotorAgeTraining.com), is designed to keep industry professionals up to date on the latest vehicle technologies and repair techniques.

Explore over 350 video training modules on dozens of automotive subjects, including engine performance, driveline systems, steering & suspension, electrical, HVAC systems, technical information and tools and equipment, among others. Browse industry news and resources such as tool specs, recalls and DTC information. New content is added monthly.

Upon completion of full training

>> **SITE CONTINUES ON PAGE 6**

CHICAGO TRAINING

# NACE AUTOMECHANIKA 2017 IN CHICAGO KICKS OFF

**KRISTA MCNAMARA //**  
Content Channel Director

**→ CHICAGO** — NACE Automechanika 2017 in Chicago officially launched in July, joining two once-separate events together to bring both the collision and mechanical segments of the industry a trade show and training event with more impact, education and takeaways than either could provide on their own..

The largest U.S. trade show dedicated to high-end technical and management-

related training for automotive and service repair shops evolved into a nearly week-long event featuring an expanded trade show floor and features, a multitude of co-located events and increased attendance and industry participation. The show and training ran July 26-29 at McCormick Place West in downtown Chicago.

In addition to the trade show, education at NACE Automechanika focused on current topics and technologies that will help drive the success of automotive professionals.

**TRENDING**

### PARTNERSHIP UNVEILS MORE POWERFUL, IMPACTFUL EVENT

Automechanika Chicago and NACE came together as one event in 2017, bringing the collision and mechanical segments of the industry together for a more successful program. [MOTORAGE.COM/PARTNER](http://MOTORAGE.COM/PARTNER)

### NACE AUTOMECHANIKA MOVING TO ATLANTA IN 2018

NACE Automechanika is heading south in 2018 — to Atlanta. The event will take place at the Georgia World Congress Center in downtown Atlanta from August 8-10. [MOTORAGE.COM/NAMC18](http://MOTORAGE.COM/NAMC18)

### TAKE YOUR AUTOMECHANIKA EXPERIENCE INTERNATIONAL

One of NACE Automechanika's organizers — Messe Frankfurt — is also involved in Automechanika Frankfurt in Germany. [MOTORAGE.COM/FRANK](http://MOTORAGE.COM/FRANK)

### USING MATH TO MEASURE, IMPROVE AUTO SERVICE RESULTS

Bob Greenwood with the Automotive Aftermarket E-Learning Centre Ltd. taught attendees how to elevate service excellence using productivity mathematics. [MOTORAGE.COM/MATH](http://MOTORAGE.COM/MATH)

### IMPLEMENTING TWO-WAY REVIEW PROCESS FOR ALL

Industry consultant Bill Haas taught NACE Automechanika 2017 attendees about the importance of effective hiring and retention of your best employees. [MOTORAGE.COM/HAAS](http://MOTORAGE.COM/HAAS)



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## APRA BIG R SHOW TO CO-LOCATE IN ATLANTA 2018

CHICAGO — The Automotive Parts Remanufacturers Association (APRA) will be co-locating its International Big R Show with NACE Automechanika in 2018 and subsequent years, according to a Memorandum of Understanding signed by the parties. The first co-located event will occur August 8-10, 2018 in Atlanta, Ga.

Currently, the APRA Big R Show is the leading networking and education event in North America for the independent automotive remanufacturing industry. NACE Automechanika is the largest U.S. trade show dedicated to high-end technical and management-related training for automotive collision and service repair shops.


“APRA is thrilled to be partnering with NACE Automechanika,” stated APRA President Joe Kripli. “Our association’s mission is to create opportunities for members of the association. This combined event will deliver on that as our industry continues to evolve.”

“As we make progress in planning for NACE Automechanika 2018, our main objective continues to be uniting the industry through our commitment to training. We are pleased that beginning with our Atlanta event next year, remanufacturing will be an area of focus going forward,” said Dennis Smith, President and CEO, Messe Frankfurt North America.

The powerful combination of these

two events in 2018 and beyond will create incredible new networking and education opportunities for exhibitors and attendees alike. The co-located Big R Show and NACE Automechanika events will establish the leading and fastest growing trade show for remanufacturing, collision and service repair in North America.

Exhibitors at this year’s International Big R Show to be held in Las Vegas, Nev., Oct. 28-30, 2017 will receive priority position and discounts for the 2018 Big R Show in the co-located event.

The APRA Big R Show will also be co-located with NACE Automechanika for 2019 in Chicago, Ill. and in 2020 at an event location to be determined. 


>> SITE CONTINUED FROM PAGE 4

courses and programs, you will be entered to win monthly prizes, including cash and tools.

Users can access a sample training module, see the quality of the training available and register to receive special offers. The standard access package is \$24.90 per month and allows access to



all AutoMate content. A premium access package will be available — \$29.90 per month — which will include *Motor Age*

original content and video training tools from Technical Editor Pete Meier and other contributors. 

PROCESS POA

## TACKLING AUTOMOTIVE CHALLENGES WITH THE SCIENTIFIC PROCESS


CHICAGO — Handling the technology being thrown at us on almost a daily basis is a challenge. And Eric Ziegler, owner of EZ Diagnostic Solutions, would likely agree with you. During NACE Automechanika 2017 in Chicago, his class, “Essential Diagnostics - The Steps You Need To Take In Tackling Every Drivability and Electrical Concern,” outlined his thoughts on what makes a good diagnostic process – one that can be ap-

plied to any troubleshooting challenge.

Among the many tidbits Ziegler shared was how to develop a logical plan of attack. He was struck by the “Scientific Process” and applies this to isolating the cause of a drivability or electrical concern.

Ziegler demonstrated the process by leading the class through a variety of actual diagnostic challenges he’s faced in the field. He also showed those present

that they need not fear the new technologies the OEMs are creating every day. By applying a process and taking the time to study up on the systems you can successfully isolate the fault and repair the customer’s concerns.

“My career was profoundly influenced by a great instructor. Because of this, I always have looked at training as a way of helping others and paying it forward,” Ziegler said. 

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## REPROGRAMMING

# DOS, DON'TS OF REPROGRAMMING WITH A J2534-COMPLIANT DEVICE

PETE MEIER // Technical Editor

CHICAGO — Anywhere from 40 percent to 70 percent of drivability concerns are resolved by reprogramming the Engine Control Module's software.

Besides the repetitive warning from me about checking the service information for any related Technical Service Bulletins, there isn't much more you can do about solving this unless you are equipped to perform a "reflash" on the offending module. For most ancillary systems, that means owning the factory equivalent scan tool or paying someone who does. But for many of the OEMs, taking care of those drivability issues can be performed with a compatible J2534 "PassThru" device – a device that connects your computer to the vehicle's Diagnostic Link Connector. Then, by going to the OEM's service website and downloading the appropriate software (at a fee, of course), you can perform the reflash rather than farm it out to someone else.

But performing a reprogramming on any given manufacturer's ECM is not without its pitfalls. If you aren't familiar with the challenges, you may find yourself well in the middle of a reprogramming attempt, only to be stopped in a most unpleasant manner – including the demise of the module you were trying to reprogram.

Not to worry, though, especially if you sat in on G. Jerry Truglia's class, "Reprogramming with J2534" during NACE Automechanika 2017 in Chicago. Truglia is an experienced technician, shop owner, trainer and consultant with nearly 40 years practical experience under his belt. And it showed, as Truglia led his attendees through the maze of dos and don'ts of reprogramming with a



**G. JERRY TRUGLIA** presents Reprogramming with J2534 to industry attendees at NACE Automechanika 2017 in Chicago last month.

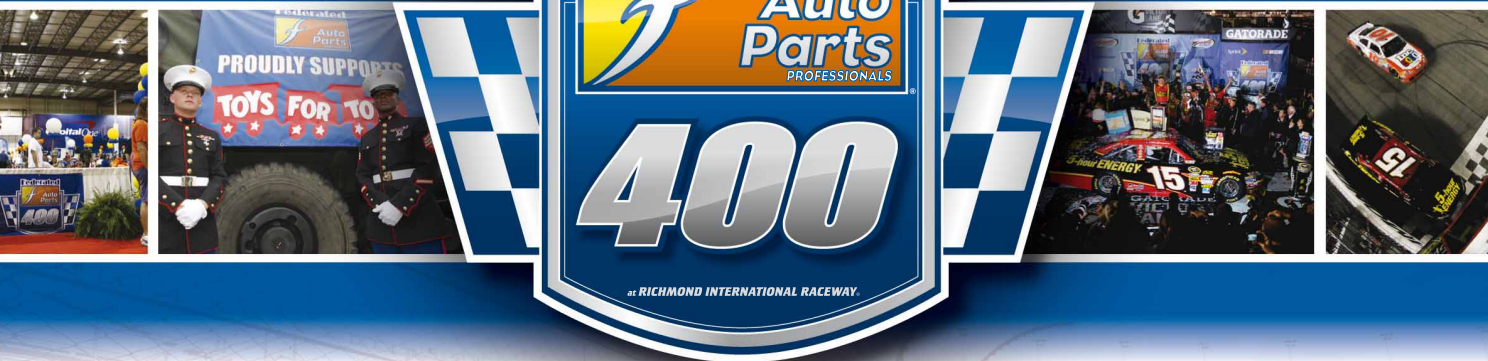
J2534-compliant PassThru device.

Truglia let the attendees know that there is money to be made performing vehicle reprogramming and offered practical tips on how to access the information they absolutely needed to know before they started buying the needed equipment. He cautioned his audience to first check the equipment requirements on the OEM service site, showing them where they could not only find the needed information but where to find the related links. He pointed out that some OEMs were not compatible with the latest Windows operating systems and how to perform a work around. Truglia also shared from his own experience serving multiple car lines that some OEM software is not compatible with others, and should be hosted on different laptops, making it clear that if a shop wanted to start offering this service, it might be best to do so one manufacturer at a time and shared his thoughts on where to start.

The presentation covered specifics needed on a wide range of OEMs, and also included some hard won personal observations. One less known bit of information he shared was how important it is to use the correct battery maintainer on the car during the programming process, pointing out that not only was it critical to maintain the proper system voltage to the module but it was also critical to avoid any AC "ripple" that may float on top of the DC voltage the maintainer was putting out. "Never use a regular battery charger," Truglia cautioned, showing the AC voltage most chargers allowed through and explaining how that alone could spell the death of the module they were trying to update.

Truglia added that reprogramming was not as hard as many make it out to be – but you do have to know what you're doing before you make that first attempt. Those who left the room after Truglia's session now certainly fall into that category. *TM*

# The "Race For The Chase" Is On..... Federated Will Be There



Federated Auto Parts is honored to once again sponsor NASCAR's "Last Race Before the Chase."

This year's Federated Auto Parts 400 Sprint Cup race is being held September 9 at the Richmond International Raceway and will be seen nationally on NBC Sports Network.

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# Three marketing musts that you can't just hire out

No solution can do it all for you; you have to do some things yourself.

**E**very shop owner I know is constantly called by people trying to sell them the latest and greatest in marketing solutions. As in life, not all things are created equal. I'm not saying that some of the marketing companies aren't great. They are. We use a lot of them and recommend them to our members.

The real problem is that none of them can do it ALL for you. There are things that YOU HAVE TO DO YOURSELF. These things take work, dedication and persistence. You cannot, as owners of the business, just sign away or pay away some responsibilities. If you want to get the most from your shop and your marketing dollars, then there are three things that YOU must do. Let's listen to Head Coach George Zeeks explain the three.

## Customer Frequency Reports

For a shop, this is must-have information. While there are some companies out there that can generate this report for you, there is a way that you can gather some of the basic information

yourself. It is nowhere as complete as a computer-generated product, but it can get you started in the right direction. Either way, you must look long and hard at the results. If you have a company giving you the information, spend the time to go through it and make changes based on the information.

If you don't have a company generating the report for you, here are some things to look for. First, pull up the week from this time last year. Look at all the customers who came in and pull them up in your Point of Sale System. Then look at each customer and see how many times they have come in since last year. Write down each customer, and next to it have columns for 0, 1, 2 and 3+ visits. If this is done weekly, you will begin to see what is really going on in your shop. Any customer who has not been back in 12 months you may have already lost. Think of every person who has ever come into your shop. If you still had every one of them, would you even have time to read this article?

Now it is time to follow up. You might want to give the customer a call. The only

one who can tell you why they didn't come back is the one that didn't come back. Call them, send a text, send an email or a postcard — but do something. You can recover a lot of these customers and that is much cheaper than trying to generate new ones. Have a plan and then follow it through. Do the work.

## A phone log

The second key thing you must do — and no one can do this one for you — is to have a Phone Log. If you are spending any time, money or energy on marketing, then you must follow up and see what is causing people to call your

**YOU CANNOT, AS OWNERS OF THE BUSINESS, JUST SIGN AWAY OR PAY AWAY SOME RESPONSIBILITIES.**

shop. You have to track how people are finding your number. You have to know what is driving them to call you.

The phone log will let you know how many cars a day your front staff is handling. Is it causing a problem with getting the job done? Is it generating cars in the door? The phone is your lifeline and it needs to be treated with respect. A phone log, kept on every call, will track what is or is not coming in your door. It takes only seconds to write down a potential customer's name, year, make and model, phone number, how they found you and make the appointment. Not only will this help you follow up on the no-shows, it lets you know how people

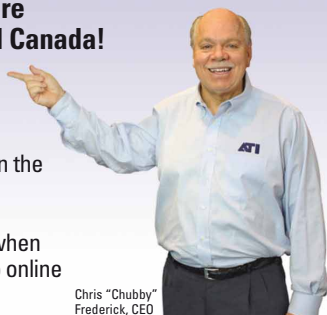
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Chris "Chubby" Frederick, CEO

found you. Then we can look at the different marketing that we are doing and see what is working. Is one marketing source providing more people than another? Do we have something that is creating phone calls but not people giving us the keys?

Or suppose you are getting a lot of calls but very few are showing up. Perhaps we need work on our phone skills? Selling starts at the phone, not when the customer walks in. Either way, this is information that you have to know.

### Marketing Source Report

Finally, you must have a Marketing Source Report. Every customer who walks through the door must be asked how they found out about you. Every possible marketing source must be included. Did they find you from a friend? Are they a repeat customer? Was it a mailer, the internet or a sign at a local baseball game? You have to know what is working and what is not. This is the only TRUE WAY to measure the success or failure of your marketing.

More important than that is you must know how many are coming back a second time. The vast majority of shop owners NEVER track the SECOND VISIT! It's great if they come in for the first time, but it tells so much more about your business if they come in a second time. Many shops get people to come in once and they never see them again. The worst part is that they don't even know that the customer did not come back. Don't be that person that just doesn't know.



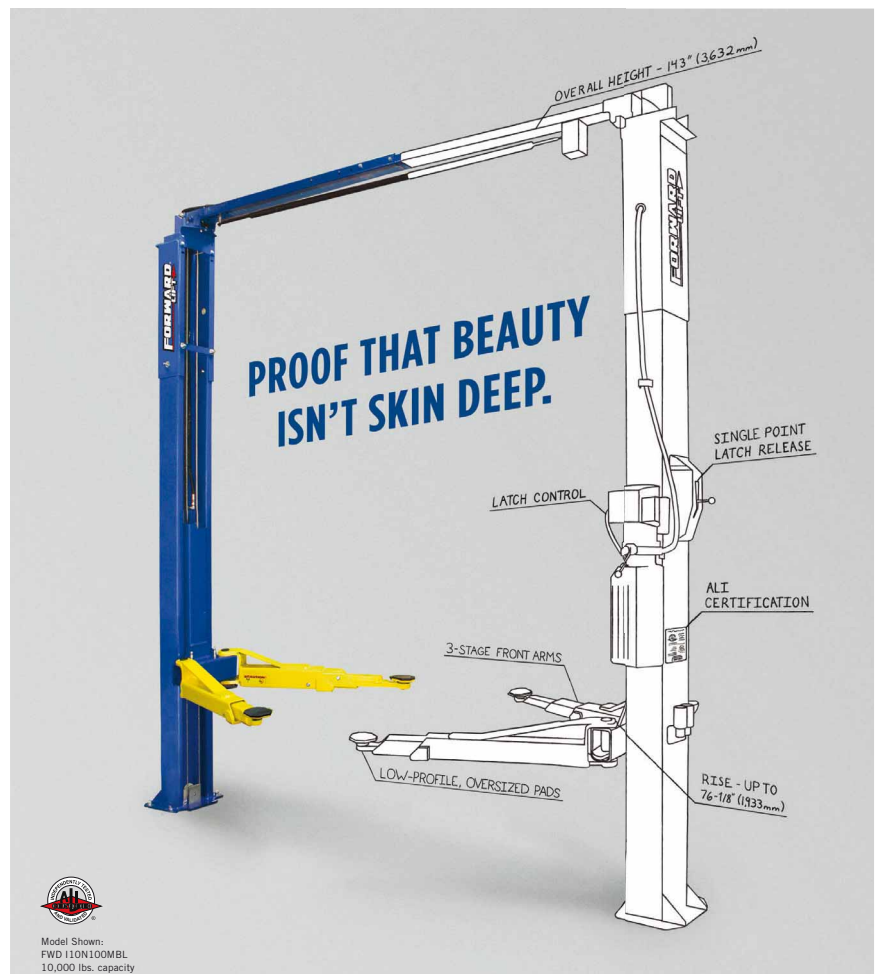
**CHRIS "CHUBBY" FREDERICK** is the CEO and founder of the Automotive Training Institute. ATI's 115 associates train and coach more than 1,400 shop owners every week

across North America to drive profits and dreams home to their families. This month's article was written with the help of Coach George Zeeks. [chubby@autotraining.net](mailto:chubby@autotraining.net)

We see a lot of customers coming in one time and we never see them again. Why? Again, the only person who can tell you why they did not come back is that person who did not come back. You have to find out what happened and if there is anything YOU can do about it! You can't do that unless you have the information. This is easy enough to do

and is found in almost every Point of Sale System. The real key is how do you have yours set up? Does it track the right information?

If you would like a copy of the Marketing Source Report and the Phone Log, you can download a copy at [www.ationlinetraining.com/2017-08](http://www.ationlinetraining.com/2017-08) for a limited time. **TL**



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# Vehicle technology will change labor measurement

Shops must determine how much labor they need in each category for success

**T**he progression of vehicle technology will make a dramatic difference in measuring a typical service shop business. The aftermarket will have to relearn this portion of the business all over again. This labor measurement is one of the changes that will have to be relearned, as the old way of measurement will leave too much money on the table.

As commodity margins decline and vehicle software grows, everyone must understand where their management attention must be directed. A redefined labor measurement will take place within the next one- to three-year period.

The maintenance labor category will be just that — pure maintenance work based on the manufacturers’ recommended service intervals and repairs of worn out or broken parts. Diagnostic labor will be the analyzation of a situation or interpretation of information. Inspection labor will be all completed, paid inspections. Re-flash will be strictly updating the vehicle from the OEM website. Calibration labor will be a category as the lining up of sensors after a repair has taken place will become an additional specialty skill within the shop. Software platforms will have to be understood.

The key information that will need to be understood is “what will the mix of each labor category be within the shop?” This brings back the importance of key efficiency measurements for each category, as specific training will have to be required, along with making sure the shop has the right skill set within the team to ensure professional execution of the services on behalf of the client. The efficiency measurement of each category will also help establish the billed hours per R/O and the required “vehicle count” that will be needed for the shop.

Measuring the “effective” rate will be critical in the labor mix measurement. How much labor should we be getting from each labor category to justify the staffing level?

Another big change coming to the industry will be the set-



**THE KEY INFORMATION THAT WILL NEED TO BE UNDERSTOOD IS WHAT THE MIX OF EACH LABOR CATEGORY WILL BE WITHIN THE SHOP.**

ting of labor rates for each category. Labor rate multiples will change from what they are now based around — the technicians’ hourly wage — to working with the individual shops actual total cost per billed hour. This is a very specific measurement calculation and your accounting data must be accurate or you could end up charging a totally wrong rate for your shop.

Better job quoting skills will have to be embraced because the knowledge for how a job must be done and what kind of labor is involved to complete the job to total client satisfaction must be learned.

As you can see, personnel development and business measurement will become more intertwined than ever before. All of these things combined will affect the net profit of the business.

Vehicle technology is rapidly and dramatically changing the technician competency that will be required to fix and maintain a vehicle properly.

Imagine the additional education that the client with one of these vehicles will need. I suggest you start this education process now, rather than waiting, thinking it is not that important.

I see this as just the beginning of so many changes coming to the aftermarket. What will happen to the shops that don’t have a learning

culture in their business or won’t want to re-learn and move in the direction they must? It is this kind of change that will dramatically separate the shops in a given marketplace.

It is more critical than ever that management is committed to seeking out the business knowledge to keep the business moving forward. Hold on for the ride over the next three years; it will be a great one for the shops that get it. *TL*

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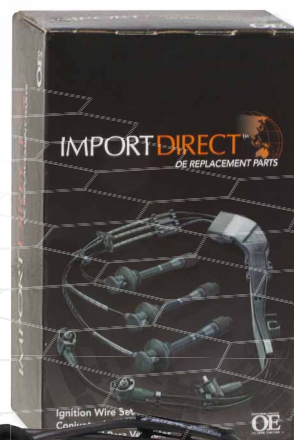
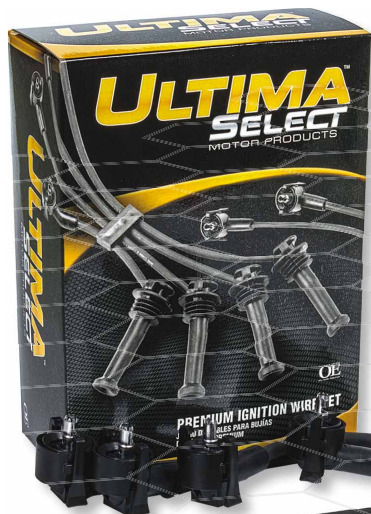
**BOB GREENWOOD, AAM**, is president and CEO of Automotive Aftermarket E-Learning Centre Ltd. (AAEC), which provides business management resources for the automotive aftermarket. Bob has more than 36 years of business management experience and is one of 150 worldwide AMI-approved instructors. [greenwood@aaec.ca](mailto:greenwood@aaec.ca)



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# Welcoming new employees is critical to shop readiness

## ORIENTATION IS NOT THE ONLY ELEMENT OF ONBOARDING

**CHRIS CHESNEY** // Contributing Editor

**H**opefully you're looking to grow your team in order to take better care of your customers and positively impact your bottom line. Onboarding is a new buzz word that many equate to orientation; however, by no means should an orientation be the only element of onboarding. It is critical to your shop's service readiness to have a detailed onboarding process that ensures your new teammates fully understand you, your company, culture, strategic goals, as well as what you expect of them every day.

Recent studies show that two decades ago the average worker held 4-5 jobs in their lifetime; today, the average has grown to 11 jobs. This is reflective of the transient nature of today's workforce and presents a serious challenge to business owners as it relates to the costs of recruiting, hiring, onboarding and developing loyal team members.

Today, the onboarding process should consist of three main efforts. First, prior to the new team member starting, you should take care of any paperwork and associated setup in your backend systems. This includes items like W9s, insurance forms, workman's comp forms, drug test policies, etc. And, if you use a digital point of sale system, ensure the new employee is added before they arrive. Orientation should begin with a shop meeting to introduce the new team member to your team.

Personally introduce your new team member to everyone else. Walk them through the workflow processes, lay out expectations regarding inspections and service standards for jobs like brake service and alignments. This is important: Most people you hire — techs, service advisors and managers — all have their own processes in mind based on past experiences. It is your job to help them fully understand what you expect of them when they get a ticket. Unless you explain these standards, have them documented as reference materials, and have a mentor in the shop demonstrate the standards, your new team member is most likely not going to know the standard. You will also want to explain your process for handling come-backs and establish your expectations for ongoing training. Ensure you have a career path for all teammates and positions. Establish your expectations with respect to attendance in after-hours training sessions or their completion of online training programs. Accomplish all of this the first or second day when your new team member joins.

Finally, schedule time to connect them with mentors in your company who will demonstrate the proper use and care of your equipment and the standards for every service you employ. And, you should pay your team to assist in onboarding new employees to ensure it's not a burden. Show people the right way and how you are going to hold them accountable — whether that is part of an employee handbook

or checklists to guide both the manager and new team member through the onboarding process.

If you hire a newly graduated vocational student, whether it is a student you helped sponsor through school or someone recommended to you, you need to have an equally organized onboarding process for them, too. Consider an apprenticeship program; an organized apprenticeship will allow the new technician to learn to apply the skills they learned in school or learn those skills they didn't in a way that meets the needs of your business. Apprenticeship is essentially a longer term, more detailed onboarding process that I will cover in future articles. With an apprenticeship, you can ensure your new team members ultimately provide customers with the service standards you promise in a timely and productive manner. Investing a year or two in new technicians will pay dividends for your business in the long run.

At the end of the day, when a customer arrives you want to ensure they will receive the service you both expect. These basic steps will help ensure your new team members' success in providing that service, and ultimately build you a more loyal team that will provide you with years of high productivity. **ZZ**



**CHRIS CHESNEY** is the Senior Director of Customer Training for Carquest Technical Institute (CTI) and Advance Professional.  
[chris.chesney@carquest.com](mailto:chris.chesney@carquest.com)



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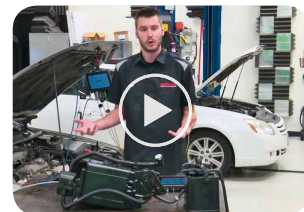


## WATCH + LEARN



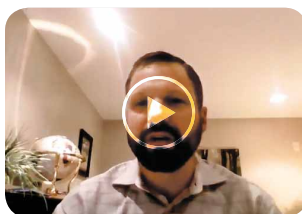
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## TRAINING EVENTS

**SEPTEMBER 6**  
**ATI Repair Shop Mastery**  
Raleigh, North Carolina

**SEPTEMBER 6-8**  
**Auto Care Association Fall Leadership Days**  
*The Palace Hotel*  
San Francisco, California

**SEPTEMBER 14**  
**ASA Midwest Kansas City Chapter Training: The Future of the Automobile**  
*iWerx*  
North Kansas City, Missouri

**SEPTEMBER 22-24**  
**2017 CAN Conference**  
*Westin Chicago Northwest*  
Itasca, Illinois

**OCTOBER 3-4**  
**2017 Auto Care Legislative Summit**  
*Washington Court Hotel*  
Washington, DC

**OCTOBER 31-NOVEMBER 2**  
**AAPEX 2017**  
*Sands Expo*  
Las Vegas, Nevada

**NOVEMBER 2**  
**NASTF Fall 2017 General Meeting**  
*Sands Expo*  
Las Vegas, Nevada

**FEBRUARY 14-17**  
**MACS 2018**  
*Caribe Royale Resort*  
Orlando, Florida



## MECHANICAL MOMENT

SERVICE REPAIR PROBLEMS AND SOLUTIONS  
TO BENEFIT YOUR SHOP TECHNICIANS

### NISSAN VERSA TPMS LIGHT ON – TIRE PRESSURES AT SPECIFICATION

**VEHICLE:** 2008 Nissan-Datsun Versa, L4-1.8L,  
Automatic Transaxle

**MILEAGE:** 101,122

**PROBLEM:** The customer brought the car to the shop because after starting the car, the TPMS light would flash for a minute and then stay on continually. This would happen every drive cycle. The vehicle had stock steel wheels and hubcaps.

**DETAILS:** The tech scanned for codes and found a diagnostic trouble code (DTC), C1709 – Data from transmitter not being received (Front right). He checked the tire pressures and verified that they were all correct and equal (33psi). All tires were inspected for correct size (185/65R15) and signs of abnormal wear. The tires had 6/32" tread depth remaining and no other problems were found during inspection.

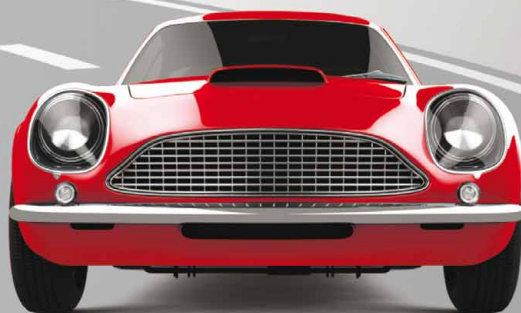
**NOTE:** The spare tire does not have a TPMS sensor. On recommendation from the Tech-Assist consultant, he checked TPMS remaining battery life and found that all four sensors showed under 15 months remaining (new sensors typically report 120-month lifespan).

**NOTE:** Weak TPMS sensor battery life can cause this problem to happen intermittently.


**CONFIRMED REPAIR:** Because there was some battery life remaining, the tech decided to re-initialize the sensors. The light remained off but the car came back a week later with the same DTC. This time, he replaced all four TPMS sensors, registered the sensors and cleared the DTC. After replacing all the TPMS sensors the problem was fixed.

*This tech tip and others come from ALLDATA Tech-Assist, a diagnostic hotline of ASE-Certified Master Technicians. What- ever technicians need — from creating alternative diagnostic strategies to providing step-by-step repair assistance — the Tech-Assist Team can deliver. Learn more at [ALLDATA.com](http://ALLDATA.com).*

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DPSS-16-E

# UNDERSTANDING THE MAGNETO RESISTANCE ELEMENT

## DESIGN, FUNCTION AND TESTING OF MRE SENSORS

**BERNIE THOMPSON //**

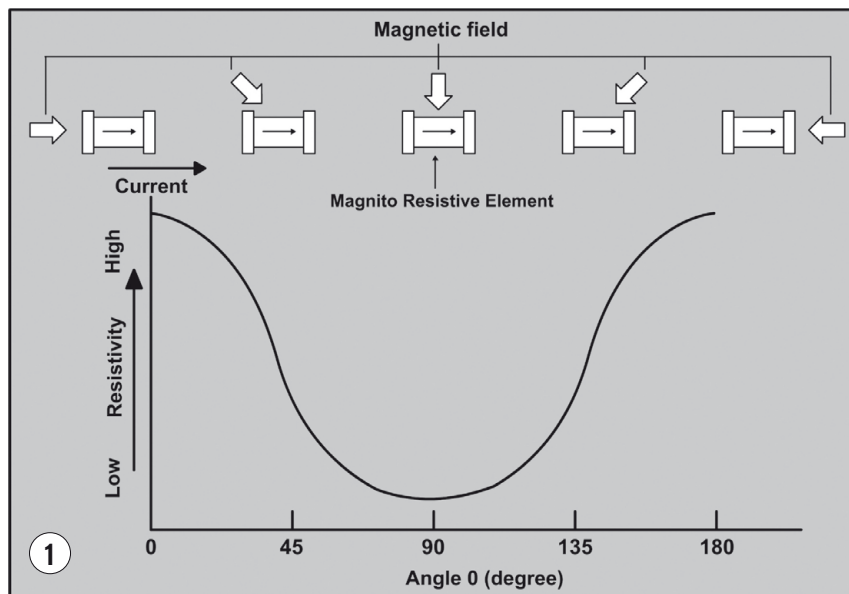
Contributing Editor

**R**ecently a local shop was working on a vehicle with a wheel speed sensor problem. During the diagnosis of the problem, they had removed the wheel speed sensor from the wheel bearing hub. Upon looking through the sensor-mounting hole, they could not see a trigger wheel or tone ring present. So it was determined that this missing trigger wheel was the problem with the wheel speed sensor. However, this is the correct design for this type of sensor. This design does not have a conventional trigger wheel present. Sometimes the electrical world is strange and does not work the way one thinks it should. There are many different ways in which to use electric sensing to measure the physical world. Sensors make measurements of physical quantities and convert these into electrical outputs. These electrical outputs are then used by an electrical circuit or microprocessor. One such sensor that measures the physical world in quite a different way is the Magneto Resistance Element (MRE).

### What is Magneto Resistance?

Magneto-resistance was discovered in 1856 by Lord Kelvin, a prominent

MRE's resistivity change by angle between the current and magnetic field.



mathematical physicist of the time period. However, this principle was not used widely until the 1960s when it was discovered that it could be used for computer memory storage. Magneto-resistance is the ability of a material to change its electrical resistance when exposed to an external magnetic field. When the force of a magnetic field is parallel to the current flow, the resistance of the conductor increases and when the magnetic field moves at a 90-degree angle to current flow, the resistance of the conductor decreases, as seen in Figure 1. This effect is referred

to as the “Anisotropic Magneto-resistance.” Most conductors have some degree of Anisotropic Magneto-resistance, the cause of which is based on the “Lorentz force.” The Lorentz force acts on a moving charge in the presence of a magnetic field. This force causes the charge carriers — electrons that are carrying the current — to move in curved paths, which increases the distance and changes the speed of the carriers across the conductor. This increased distance adds resistance to the current flowing through the conductor. There is also a crowding effect that occurs as a result

# OMNICRAFT: A NEW LOOK, A NEW OPTION

## FORD BECOMES A TRUE ONE-STOP SHOP

**A new parts brand, Omnicraft, presents tremendous opportunities for the aftermarket.**

Welcome to the new world of Omnicraft™ parts.

For the first time in 50 years, Ford Motor Company has unveiled a new brand of parts: Omnicraft. We believe it will not only grow our ability to service current business customers, but any consumer, regardless of the vehicle they drive.

Our launch could not have come at a better time. For a while now, we have looked at the changing landscape of the aftermarket, and we recognize there are tremendous growth opportunities. By 2021, the parts and service market could be worth as much as \$950 billion, and we want to make sure Ford is there to help Dealers and Distributors

share in that growth.

Omnicraft allows us to offer a full portfolio of parts, so our customers can have convenient one-stop shopping at our Ford Dealers and Distributors. Ford and Lincoln Dealerships and Quick Lane locations will now have a single source for the parts needed to repair non-Ford vehicles that come through their service department. Additionally, independent repair shops can now turn to a Ford Dealer or Distributor to get all the parts they need with just one call.

We fully believe that demand for Omnicraft will continue to grow and match that of Motorcraft. It is easy for us to augment our existing infrastructure and leverage our thousands of dealerships and distributors around the world. This provides



**The new Omnicraft lineup includes brake parts, filters, starters and alternators and more.**

us with a unique logistics advantage that rivals or surpasses other aftermarket parts suppliers.

We are pleased you are ready to join us on the Omnicraft parts journey. With Omnicraft and Motorcraft combined, our Dealers will be able to service between 85 and 90 percent of vehicles on the road with premium, replacement parts backed by Ford.

— Dave Johnson, Director, Global Repair Product Planning

# A NEW LOOK AT FORD'S NEW BRAND

Omnicraft brings Ford quality to all major vehicle brands in the first launch of a new line of parts in 50 years.

Omnicraft is the first new parts brand offered by Ford Motor Company in a half-century, and offers the ability to buy quality, trusted replacement parts for all major automotive brands. Non-Ford vehicle owners now are able to purchase premium replacement parts and have their vehicles serviced at Ford and Lincoln dealerships as well as Quick Lane locations.

"Omnicraft is simply the right solution for both our customers and our dealers at the right time," said Frederiek Toney, president, Global Ford Customer Service Division. "We recognized the need to support our dealerships and Quick Lane operations with a line of parts developed for non-Ford makes. Ford also launched Omnicraft to address the growing aftermarket business where auto service centers want to do one-stop shopping for their high-quality parts needs. As we continue the phased roll out of Omnicraft products, we expect to see continued growth in both customer and dealer satisfaction."

Omnicraft launched earlier this year with seven new parts lines. Ford concentrated its efforts on bringing the most commonly requested replacement and maintenance parts to market at competitive price points. Its



phase one launch included brake pads, coated rotors, coated friction ready calipers, starters, alternators, loaded struts and oil filters. A second wave of products will soon follow with engine air filters, cabin air filters, hubs and master cylinders added to the lineup. All currently available lines are featured on [www.OmnicraftAutoParts.com](http://www.OmnicraftAutoParts.com).

"Now, owners of non-Ford vehicles have access to quality parts at competitive prices, backed by Ford," said Jennifer Boyer, Manager, Aftermarket Parts Marketing.

Ford and Lincoln dealers as well as Ford Authorized Distributors are the initial distribution points for the brand.

## Brake Calipers

**1** Omnicraft brake calipers are ready to install out of the box, and pair perfectly with Omnicraft brake pads.

The calipers are tested to withstand a 96-hour salt spray to help ensure corrosion resistance, and are also pressure-tested to reduce comebacks. They are e-coated for long-life so they won't fade with heat or UV exposure, are protected against corrosion and rust, and are superior to powder coating. Omnicraft calipers include coating on bracket bores and parking brake components and have a stylish high-gloss appearance.

## Brake Pads and Coated Rotors

**2** Brake pads and rotors are available for many vehicle makes and are ready to install out of the box. Two types will be featured: ceramic pads formulated for high heat tolerance with little fade and quiet, low dusting braking performance; and semi-metallic pads formulated for high heat absorption to pull heat out of the braking system and provide consistent braking performance with excellent cold bite.



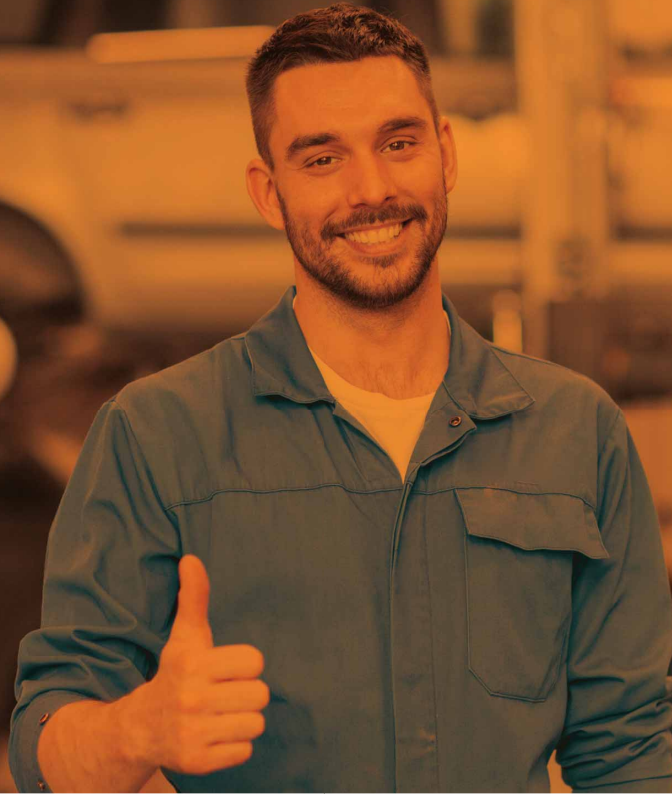
Omnicraft rotors and drums feature high carbon casting for enhanced heat dissipation and extended brake life. They have a high resistance to thermal cracking and fade, low noise propensity and resistance to brake judder. The rotor coating helps prevent corrosion and increases rust resistance while also providing a clean appearance for open wheels.

## Loaded Struts

**3** Omnicraft loaded struts are engineered for easy installation without the need for special tools. This eliminates the need to compress the spring. High-quality bearing plates and insulators optimize steering smoothness, provide quiet operation and help maintain proper front-end alignment.



OMNICRAFT PARTS ARE PRICED COMPETITIVELY AND WILL FEATURE WARRANTIES EQUAL TO OR BETTER THAN THE BEST OF THE AFTERMARKET IN EACH PRODUCT CATEGORY. THE WARRANTY ALSO INCLUDES THE ADDED BENEFIT OF LABOR REIMBURSEMENT FOR THE FIRST TWO YEARS.



The strut assemblies include coil spring, mount, insulator, bearing plate and attaching hardware, where applicable. They are calibrated to compensate for age and mileage wear.

Omnecraft loaded struts are available for most all-makes applications, and have custom tuned springs for corner-specific ride height and vehicle design.

### Oil Filters

**4** With coverage for 93 percent of vehicles on the road in the United States, these new oil filters are designed to perform with up to 96 percent efficiency at 20 microns.

The filter's cellulose media provides high-filtering capacity and strength, screening out abrasives to help prevent engine wear. Additionally, nitrile rubber anti-drainback valves resist high heat and keep oil in the filter to help prevent dry starts.

Other features include large pressure-relief valves to help maintain oil supply to the engine under extreme operating conditions, bonded end-plates to help keep

consistent pleat spacing enabling efficient oil flow, perforated steel center tubes for internal support and steel cases "ironed" for a precise fit and fluted for easy removal.

### Alternators and Starters

**5** Available for most vehicles, Omnicraft starters and alternators are 100 percent new components. The alternators are calibrated to protect against excessive charging. Premium brushes and components help lead to long service life, and the overall design is created to withstand the grueling under-hood heat and electrical demands. Our alternators are designed to remain compatible with sensitive electronics systems.

Omnecraft starters feature premium bushings and brushes for long service life, are coated to provide corrosion resistance on external components and have high tech seals and synthetic grease to ensure a long bearing life.

Both parts go through 100% end-of-line testing to help reduce comebacks. Complete

parts and components information is available at [www.OmnecraftAutoParts.com](http://www.OmnecraftAutoParts.com).

"This all happened under the leadership of Frederiek Toney," Boyer said. "A large part of the success in bringing a new all-makes brand to market was made possible by teamwork. Ford is a company that prides itself on teamwork and this is a great example of that attitude. We are excited to serve our customers with a greater range of parts offerings. Omnicraft is an excellent addition to our Ford and Motorcraft parts brands."

The new Omnicraft brand continues to grow in depth and breadth, providing Ford aftermarket business customers the benefit of one-stop shopping for all vehicle repair and maintenance parts needs. Omnicraft parts are priced competitively and will feature warranties equal to or better than the best of the aftermarket in each product category. The warranty also includes the added benefit of labor reimbursement for the first two years.

# Omnecraft.™ Our newest name in parts.

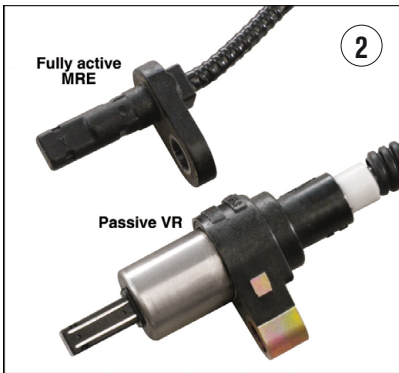
Meet the newest member of the Ford family of parts, Omnicraft. Affordable, quality parts designed for your non-Ford repairs. Now available where you buy Ford and Motorcraft® parts.

A trusted relationship just got better.



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of the carriers being forced sideways as well as forward. This sideways movement of the carrier crowds the conductor and decreases the effective area of the conductor, thus adding resistance to the conductor as well.

The material that is used for the conductor varies depending on the application of the sensor. Ferromagnetic materials are used widely due to their magnetic properties and their ability to work in high operating temperatures. One widely used magnetic material is a nickel-iron known as Permalloys. Permalloys consist of a blend of approximately 80 percent nickel and 20 percent iron; slight traces of other magnetic metals can also be used in the alloy. Permalloys' electrical resistivity generally varies within about 5 percent, depending on the strength and the direction of the applied magnetic field. Newer thin film technology uses a combination of layered materials of indium antimonide (InSb) or metallic n-doped indium antimonide (n-InSb) to increase the magneto-resistive ability of the conductor. Thin film electrical resistivity generally ranges from 5 percent to 20 percent depending on the combination of layered materials and their orientation.

With Permalloy or thin film, the sensor element is made into very thin rectangular strips. The resistivity of the element will be based on the material and the way that the element is constructed, the thickness of the element or

the cross-sectional area of the element, the magnetic strength applied to the element, the magnetic angular position of the element, and the distance of the magnetic force from the element. So if a stronger magnet is used, the air gap can be significantly larger, up to 3mm or 118 thousandths, while still consistently producing accurate high-resolution signals. These traits make the Magneto Resistive Element a very good choice to be used in the design of automotive sensors.

### Advantages over alternatives

The Magneto Resistive Element has been used in the design and construction of all types of sensing devices from pressure sensing and rotational sensing to sensing the earth's magnetic field. In automotive industries, use of MRE is primarily for rotational sensing.

When designing a system that will incorporate proximity sensing (non-contact sensing) for rotational sensors, there are several methods that can be utilized. Passive systems such as Variable Reluctance (VR) sensors, active systems such as Hall Effect and Magneto Resistive sensors, or optical sensors. The difference between these systems is that in a passive system the sensor produces its own output, whereas in semi-active or fully active systems, the electronic

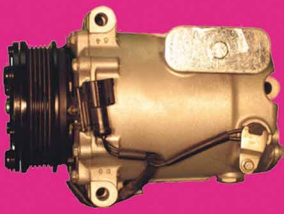
control module supplies current to the circuit so the sensor can produce its own output. In the past, Variable Reluctance sensors have been used predominately for sensing rotational angular position and angular speed. However, the VR sensor has many drawbacks in the design requirements of modern systems. The main drawback of the VR sensor is that it cannot be used to sense slow Rotations Per Minute (RPM). The VR sensor has a very small output at slow RPM and ultimately there is a minimum speed that can be detected. This is due to the magnetic field movement following the target wheel. If the target is moving slowly, so too is the magnetic field. This field moving across the turns of the windings in the VR sensor determines the output. The faster or quicker the magnetic field movement across the windings the greater the output of the VR sensor.

In modern designs, the size of this sensor is also a problem. The magnet in the VR sensor will need to be large in order for the sensor to work properly. This is reflected in the size of the sensor (Figure 2). In active systems, such as Hall-effect or MRE, these sensing devices have an output when stationary so the rotational speed can be tracked to zero RPM. The sensitivity of the active sensor to a magnetic field is substantially greater

**Comparison chart of various rotation sensing systems.**

Type	Sensing - type adoption criteria				
	Multi-pulse adaptability	Low rpm detection	Environmental resistivity	Operating temperature range	Cost
Reed switch	poor	good	good	good	good
Photo-coupler	good	excellent	poor	poor	fair
Variable reluctance	fair	poor	excellent	good	fair
Capacitance	good	good	poor	fair	poor
Hall device	fair	excellent	good	fair	fair
MRE	excellent	excellent	excellent	good	fair

20 pulses per revolution



JUNE 2017

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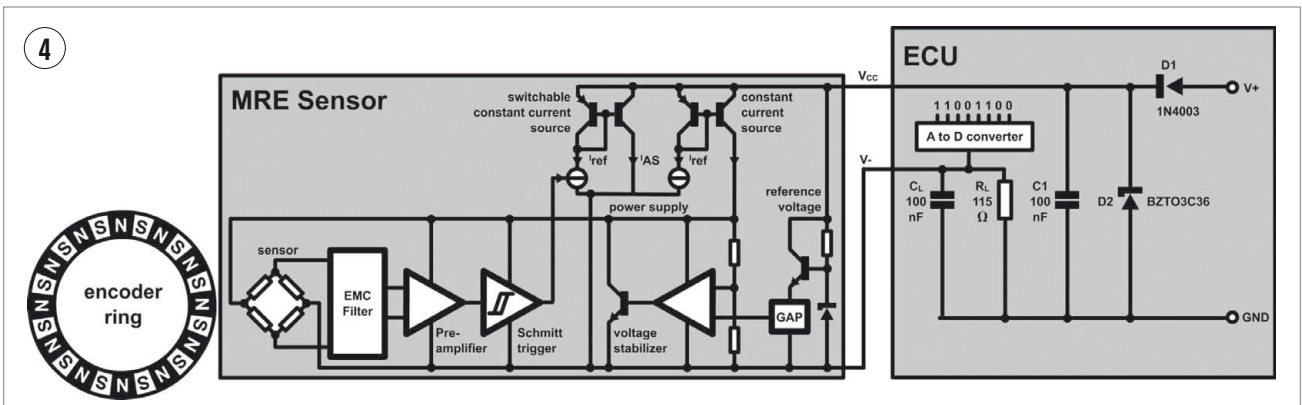


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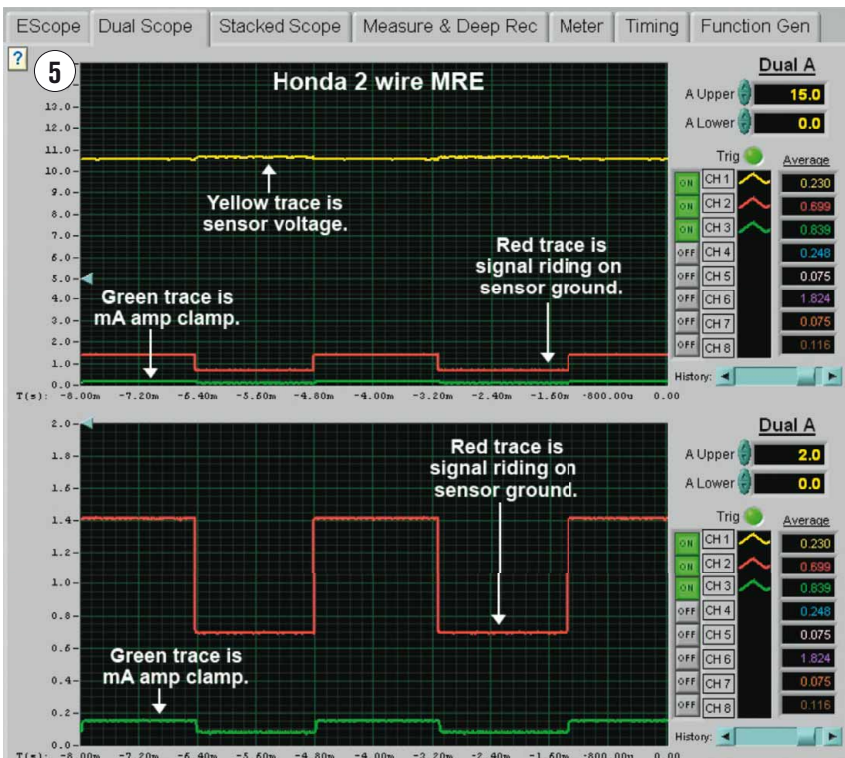


as well. This means that the active sensors can be packaged in a much smaller device, enabling changes to the overall design and placement of these sensors. The difference between a Hall-element and a magnetoresistive element is that the magnetoresistive element operating in a low magnetic field is 10 times more sensitive than that of the Hall-element.

It will be important to recognize this increased sensitivity that is produced from the MRE sensor. If a shaft has a small scratch in the trigger wheel area, the sensor can pick this up and make

a voltage output change based on this scratch. This in turn creates problems in the control system. Additionally, the Electromagnetic Interference (EMI), such as voltage spikes and reverse voltage tolerance, are better with the MRE sensor over that of the Hall-element. The operating working temperature of the MRE is much higher than that of that Hall-element as well. The benefits of MRE over all other types of sensing devices are clear and make this sensor one that you will encounter in your shop more frequently, as seen in Figure 3.

With the electronic revolution that has swept the automotive industry, electronic control units (ECU) are commonplace on modern vehicles. These control units collect and process data that are produced by electrical sensors in the vehicle. The sensors take readings of physical events and convert these physical properties into an electrical signal that can be interpreted by a microprocessor. In the case of sensing rotational angular position and angular velocity, the microprocessor uses software to calculate the change of these signals and compares them to a mapped value ideal for the operational conditions. The microprocessor then commands changes in the controlled function in order to minimize deviation from the ideal. The MRE sensor can be used in many applications where the electronic control system is gathering data based on physical events such as steering shaft rotational position and velocity, wheel rotational velocity (both acceleration and deceleration), transmission shaft rotational position and velocity, crankshaft and camshaft rotational position and velocity. When the MRE sensor has a second Wheatstone bridge added into the circuit, the rotational direction can be detected. This data can be used by the ECU for things such as brake application for hill holding, steering shaft rotation for stability control, crankshaft and camshaft reverse rotation for engine auto stop and start. In each one of these sensing criteria, the magnetoresistive



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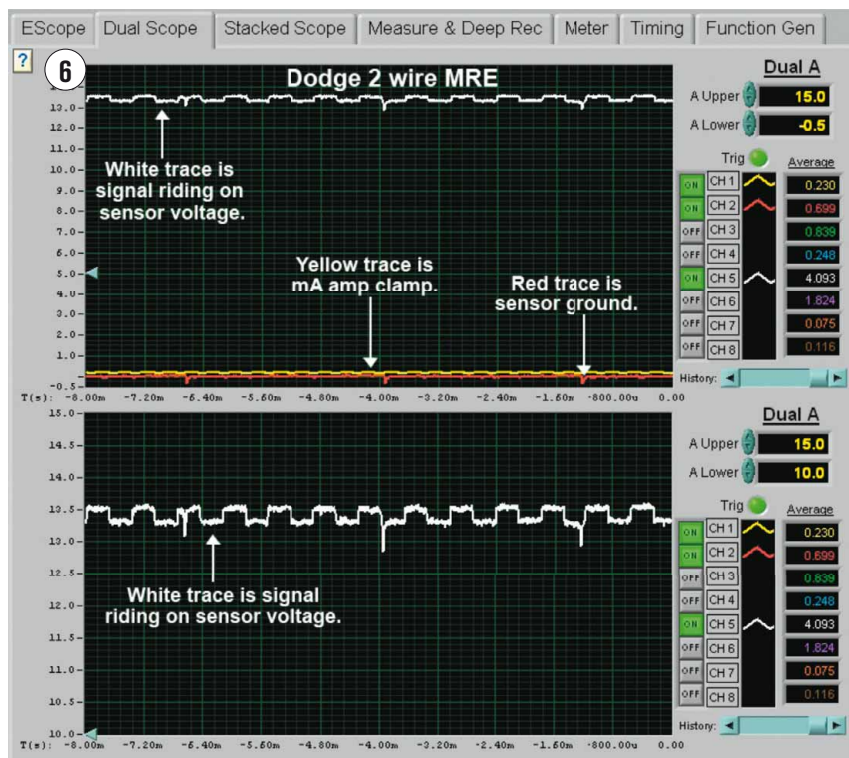
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element will be designed into a circuit that will best be suited to the data that is gathered for control of the system by the microprocessor.

### ABS applications and design

When sensing wheel speed for anti-lock brakes, traction control and stability control systems, the MRE can take on a unique circuit configuration. There are several circuits that are in current production, one of which is shown in Figure 4. In this two-wire circuit, the MRE sensor is configured to read current. This is accomplished by using a voltage divider circuit that is set up between the sensor and the ECU. The circuit's constant current draw is 7mA, which is increased to 14mA when it is switched on. Due to this circuit using current to sense rotation, a voltage stabilizer is needed. The voltage is stabilized by a band gap reference diode that supplies power to the sensor, amplifier and comparator. The sensor pickup consists of four magnetoresistive elements configured into a Wheatstone bridge. In the Wheatstone bridge, a magnetic field changes the linear voltage output, which is then converted to a digital output by a comparator. This digitized comparator output is fed to a Schmitt trigger, which is a digital triggering device to limit noise. As the voltage from the comparator increases, it reaches a turn-on threshold or operating point. At this operating point, the Schmitt trigger changes states, which allows a voltage signal to be sent out. The release point (turn off) is set at a lower voltage than the turn-on point. This transfer function controls the hysteresis (the turn-on point and turn-off point) of the output. The purpose of this differential is to eliminate false triggering, which can be caused by minor variations from the comparator. The Schmitt trigger is turned on and this output voltage is sent to a switchable current source, which when turned on, allows 7mA of current to flow through the circuit. This switchable 7mA

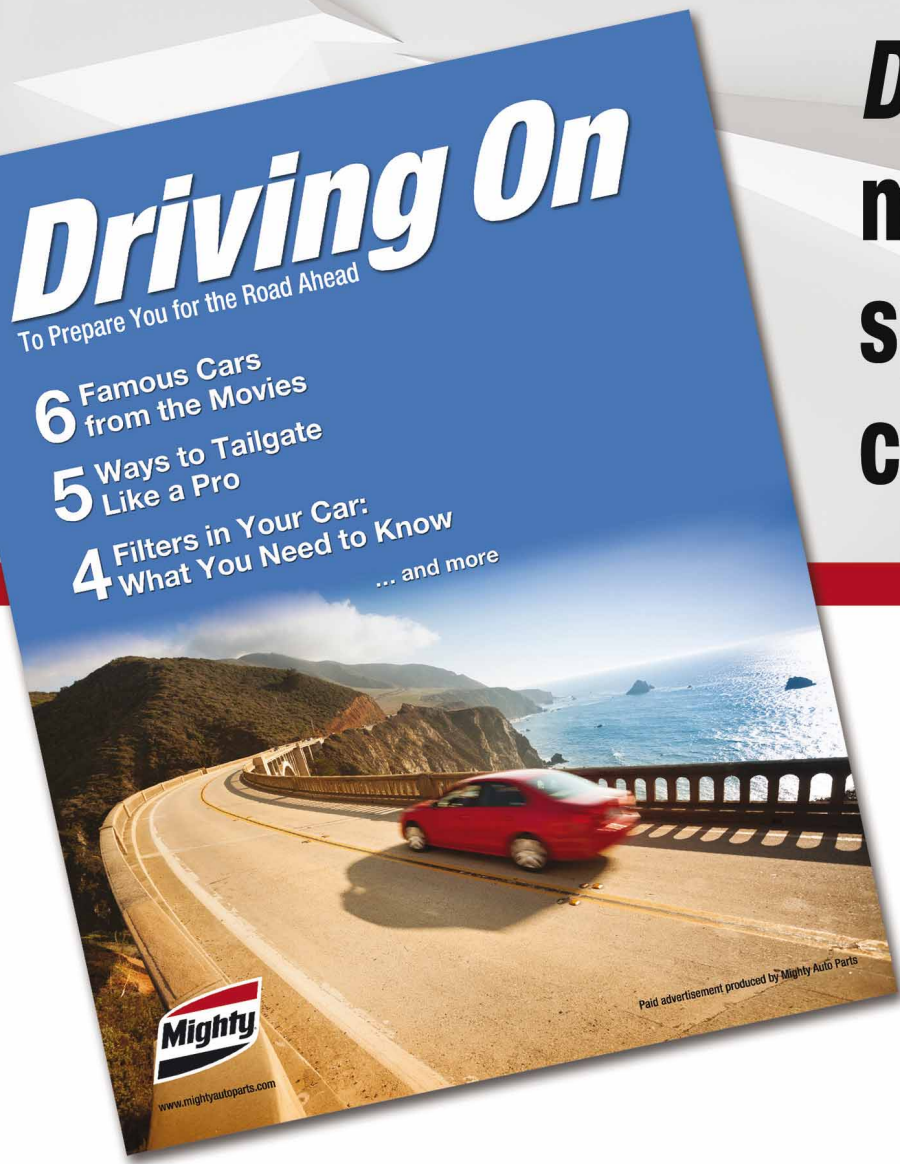


combines with the constant 7mA for a total current flow through the circuit of 14mA. The microprocessor has no way to read current, so a resistor is placed inside the ECU. This resistor sets up a voltage divider that allows the voltage to increase to about 700mV as the current increases to about 7mA, as can be seen in Figure 5. This configuration is based on the ground side of the circuit. However, this basic circuit that we have discussed can also be incorporated on the power side of the circuit, as can be seen in Figure 6. The ECU uses an analog to digital converter to process this voltage change. As the magnetic field changes so does the voltage, thus allowing the ECU to track the vehicle wheel speed.

It is quite possible for the technician to mistake this two-wire MRE sensor for a VR sensor. If the technician checks the resistance of the MRE sensor, it will show a reading of about 500,000 ohms, whereas a VR sensor will show a reading of about 800 to 1200 ohms, so it would be possible to think the sensor is bad if you do not re-

alize which sensor you are working with. Another source of confusion when dealing with MRE sensors is the location of the magnet. There are two types of magnets used in the design of the MRE sensor: semi-active and fully-active. In the semi-active style, the magnet is located in the MRE sensor. This style MRE uses the conventional target wheel made of a ferrometallic material. As the target teeth or slots pass under the sensor, the magnetic field is moved across the magnetoresistive element, which changes the voltage output. This sensor's circuit can operate on a two-wire, current-based output, as we have already discussed, or incorporate a third output wire. In this three-wire sensor, one of the wires will power the sensor, one of the wires will ground the sensor, and the third wire will produce a conventional square wave signal that can either pull the voltage to ground for the signal or output voltage for the signal. In the fully-active style, the magnet is located externally. The conventional target wheel is replaced by an encoder





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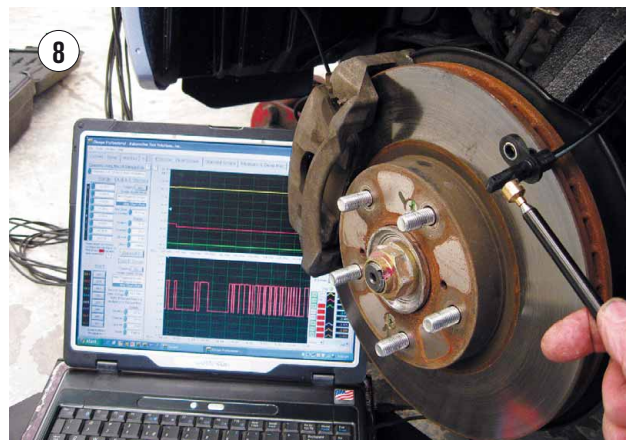
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ring that is produced with north-south magnetic fields that are embedded into an elastomeric ring that is bonded on to a steel base. The encoder ring is smaller than the bearing and is under .200 of an inch in thickness. This encoder ring is pressed onto the wheel bearing that is placed in the hub assembly. When looking quickly at the wheel bearing, the encoder ring looks like the grease seal on the side of the bearing as seen in Figure 7. This bearing can be installed correctly in the bearing hub with the encoder ring facing the MRE sensor or installed incorrectly with the encoder ring facing away from the MRE sensor. When the bearing is installed with the encoder ring facing away from the MRE sensor, there will be no signal from the sensor. Therefore, it is critical that the bearing be installed correctly. To be sure which side of the bearing is the encoder, hold the outside of the bearing (the part that presses into the hub) stationary and rotate the inner bearing (part that presses on the axle). The side that moves with the inner bearing is the encoder ring and must face the MRE sensor.

## Troubleshooting

When troubleshooting the MRE circuit, an oscilloscope is an essential tool as can be seen in Figures 5-6. The voltage level that is changing is very small and can be on the power side or the ground side. In some systems, the waveform

may not be a square wave at all, but be indicated by a narrow curved pulse.

- To test the two-wire semi-active MRE sensor, spin the shaft that is attached to the trigger wheel while watching the scope. If the sensor has no output signal and the power and ground voltage levels are correct, remove the sensor and move a steel object very close to the tip of the sensor. At this time if there is a signal output, the problem is with the trigger wheel; and if there is no signal output, the problem is in the sensor.

- To test a fully active two-wire MRE sensor, spin the shaft that is attached to the trigger wheel while watching the scope. If the sensor has no signal output and the power and ground voltage levels are correct, remove the sensor and move a small magnet very close to the tip of the sensor as seen in Figure 8. At this time, if there is a signal output, the problem is with the encoder ring, and if there is no signal output, the problem is in the sensor. The magnet that must be used to test the circuit is a small, weak magnet; if a powerful magnet is used it can flip the magnetization of the sensor in the opposite direction. This will change the characteristics of the MRE sensor. Some sensors incorporate a bias magnet to help stabilize the sensors' magnetic characteristic so that this does not happen. These sensors react to very small changes in magnetic fields, so a small magnet will work fine.

When the power, ground and signal voltage levels are incorrect, check for resistance in the circuit by testing the circuit for voltage drops. When there is no voltage output to the sensor from the ECU, one may think that the circuit is shorted or has a high current draw and the ECU is protecting the circuit by shutting down the voltage supply to the sensor. This can be true; however, an open circuit can give the same results. When the ignition switch is turned on, the ECU completes a circuit test by watching the voltage of the signal. This self-test will occur very fast and will be completed in just a few milliseconds, so have your scope connected to the circuit and running when you turn on the ignition switch. If this voltage is incorrect during the self-test, the supply voltage to the sensor is shut off, so it is important to watch the voltage during the self test in these situations. Now that you have a better understanding of the mysterious world of the inner workings of the Magneto Resistive Element, you too can correctly diagnose these sensing systems. *TL*



**BERNIE THOMPSON** is an automotive diagnostician and trainer, and co-founder of Automotive Test Solutions in Albuquerque, N.M. He is an expert at diagnostics and

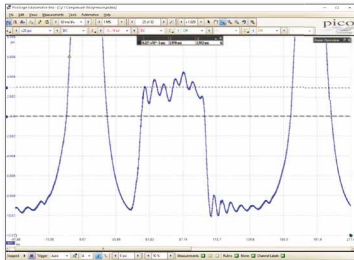
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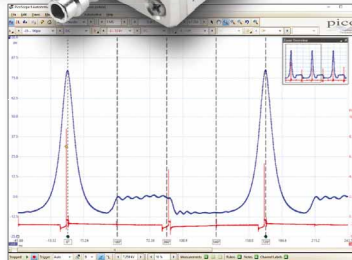
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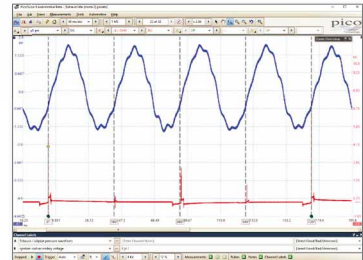
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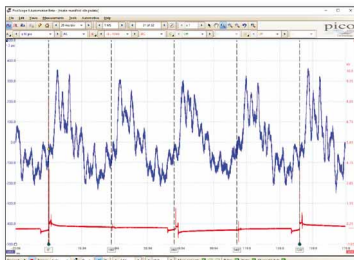
Exhaust back pressure



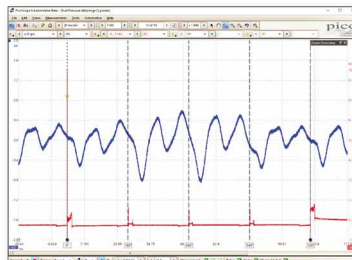
Running compression



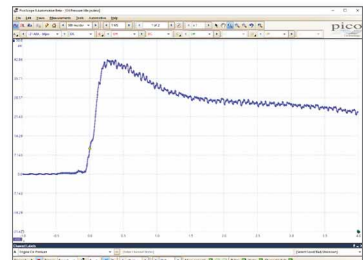
Exhaust pulses



Intake manifold pressure



Fuel pressure pulses

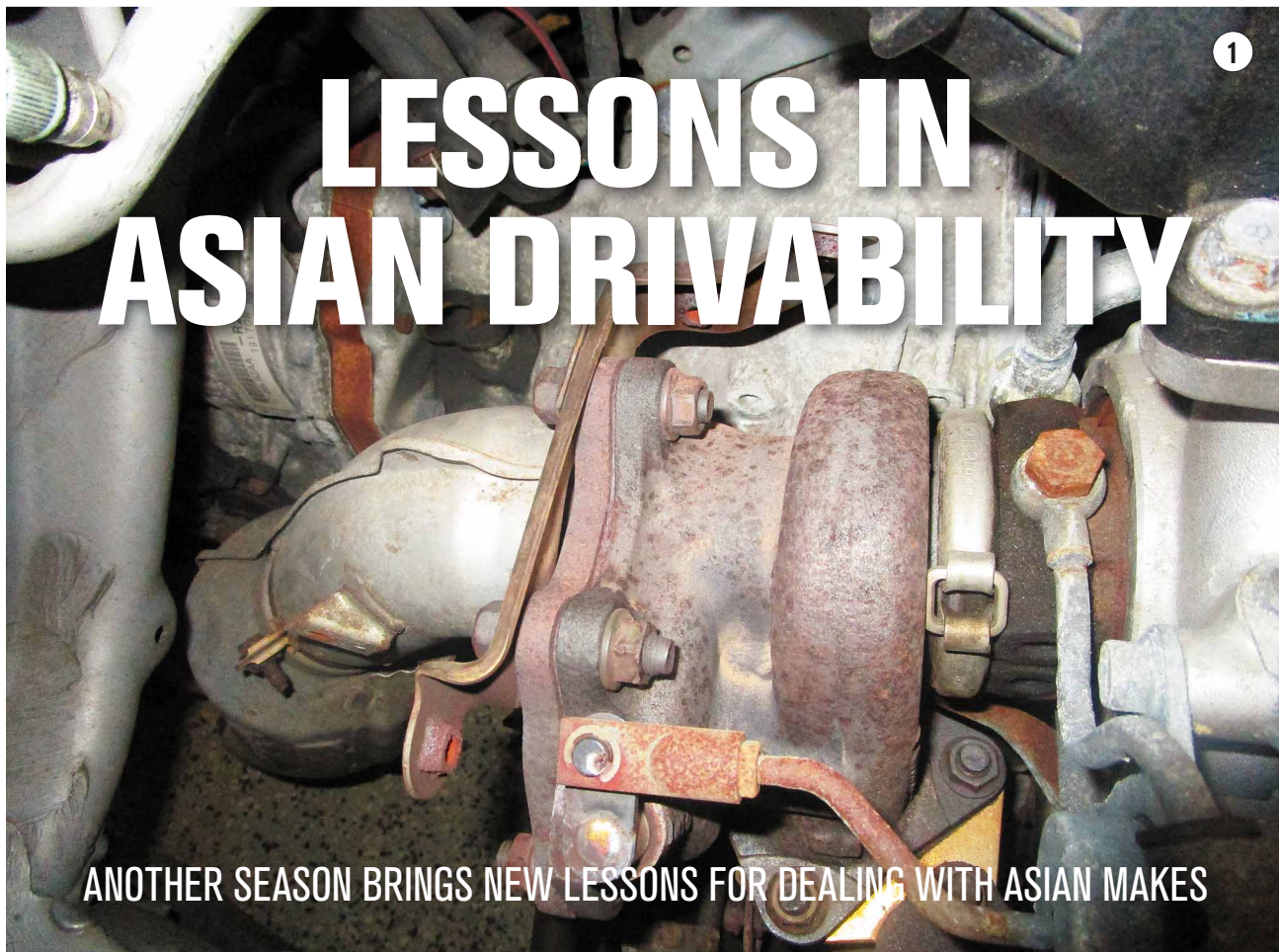


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# LESSONS IN ASIAN DRIVABILITY

ANOTHER SEASON BRINGS NEW LESSONS FOR DEALING WITH ASIAN MAKES

**G. JERRY TRUGLIA //**

Contributing Editor

**W**ith Asian vehicles being a very large part of the U.S. automotive market, more than likely you are already working on a few of the different brands. This article will describe some of my recent experiences with Asian vehicles and what I did to diagnose and repair them. Let's start out with a 2009 Subaru Forester 2.5 DOHC turbo that came in with a complaint of low power.

## A sagging Subaru

Since this vehicle had 171k miles, it just may be in need of some normal service. A vehicle check of this Subaru revealed that the Check Engine light was not illu-

minated and there were no codes stored in any computer system. The vehicle owner's complaint was an intermittent noise from the engine as she was driving. Our normal routine when checking out a vehicle is to always check the basics first since any one of these can potentially cause a problem. Prior to the previous checks and test we had performed a visual inspection, TSB look up, Identifix search and a system scan of the complete vehicle. Our next step on this Subaru was to check the mechanical condition of the engine by performing a relative compression test using one of our labsopes. Believe it or not, we still use our old Fluke 98 labscope since it turns on just by pressing a button and goes right into the relative compression test with a few clicks of a button.

The test is easy to perform, since all

we have to do is connect the labscope leads with a filter to the positive and negative leads of the vehicle's battery post. Once the labscope is connected to the vehicle's battery, the fuel is disabled by either the Clear Flood method or removing the fuel pump relay, followed by cranking the engine over for 30 seconds or so while the test results are being displayed on the screen. We make sure to perform the test two times, making sure that the test results are the same whether the results indicate a good or a bad condition. If the test indicates a cylinder problem we then proceed to connect another scope channel so we can sync to the firing order, via number one ignition. The reason to sync the scope is to confirm what cylinder in the firing order (1-3-4-2 in this case) would be identified

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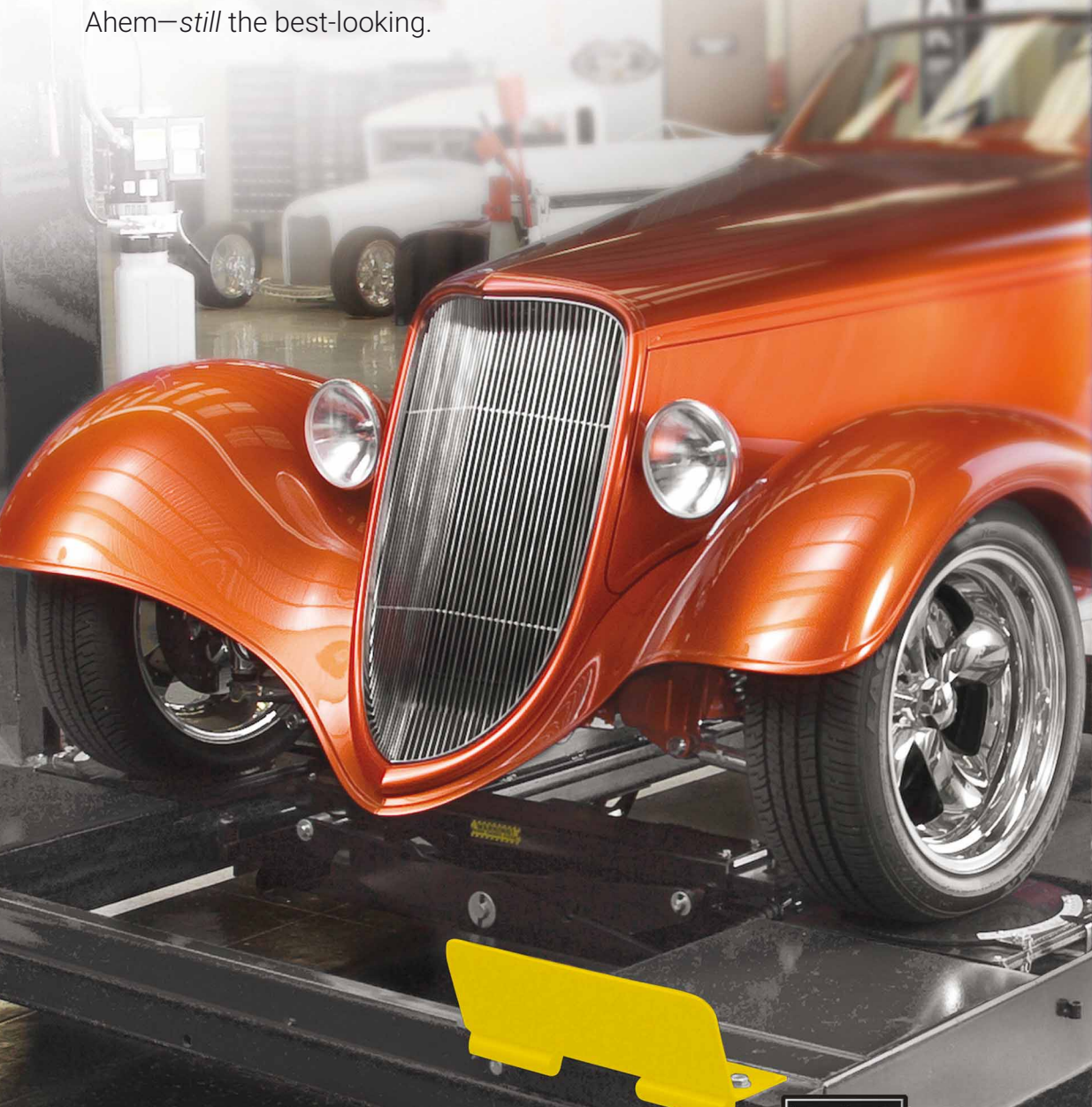
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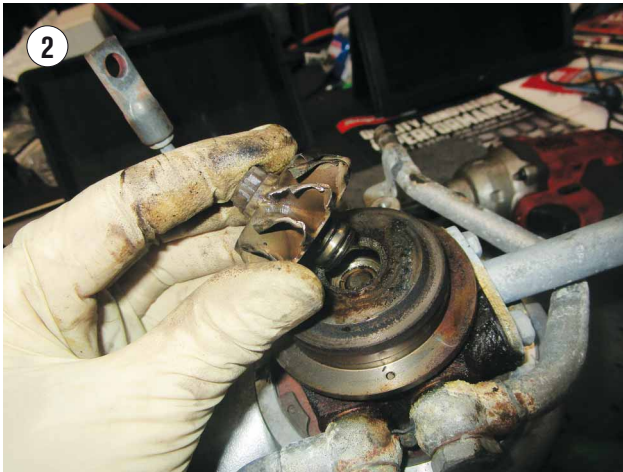
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as the problem cylinder. When we locate the weak cylinder, we request more time from the vehicle owner to perform a dry and wet compression test followed by a cylinder leak down test, so we can pin down the cylinder that has the issue.

Since the Subaru engine's relative compression test was good, we could rule out an engine issue and continue to look elsewhere for the noise. We road tested the vehicle and thought that we heard a noise, so we returned to the shop and set the vehicle up on the lift. To pinpoint the exact area of the noise, Franklin drove the vehicle on the lift while Bill and I were underneath the Subaru confirming the area the noise seemed to come from. The noise seemed loudest at the turbo, so Bill unbolted the rusty exhaust and here is what he found (Figure 1). As you can see, the turbo was in bad shape (Figure 2) and needed to be replaced. To make sure the new turbo would not fail prematurely, the oil lines were checked for proper oil flow along with the banjo bolt that connects the line to the turbo. FYI, the banjo bolt does not come with the turbo, so make sure you order it or the new turbo will fail prematurely. Subaru will not warranty the turbo if you don't install that new bolt! So, on this Subaru, we replaced the oil feed tube along with the banjo bolt that connects to right front of the engine head. Remember that the bolt is crucial for proper lubrication since



the small filter that is inside it is prone to clog up. Once the repair was completed and an oil change was performed, the Subaru was test driven and ready to be billed out.

### No charge

Our next Asian gem at first seemed like a typical alternator failure that needed replacement. Over the years, we have all replaced our share of alternators without encountering any real problems. Well this 2002 Toyota Camry with 222,861 miles on it with the original alternator may change your mind. It's not what you're thinking — it wasn't difficult to remove because of rust or broken bolts. In fact, it was an easy removal and install. The problem was that after the alternator was installed in the vehicle it did not seem to charge and the idle seemed low. The white wire at the sensing terminal on the alternator had 11.6 volts at idle, while all the other wires had battery voltage. This is where you start to question the quality of the replacement alternator and your install. Since the alternator was a quality NAPA alternator (Figure 3) that has never let us down in the past and my top tech Bill was working on it, neither one was likely the problem.

This is where information systems come into play; in this case when we encounter something like this we go directly to Identifix. If there is no informa-

tion in Identifix we go to iATN, Mitchell, ALLDATA, Motologic, YouTube and Google. As we searched Identifix we found the problem that we encountered listed right on their main page of our search. They provided the following test procedures: 1.) Voltage drop the white wire to see why it is only 11.6 volts. Run a jumper wire between the battery and the white wire at the alternator and re-check to see if the alternator will charge. 2.) Clean the battery terminal connections and clean the battery cable ends at the transmission and the body connections. 3.) Check the alternator and try a new source if the new alternator is faulty.

We performed the recommended procedures and found all of them to be in specification. We followed the Identifix suggestion of performing a throttle body cleaning procedure as described. Once we were finished with the cleaning the idle returned to normal and the alternator was charging normal. It seems hard to believe that a dirty throttle body could cause a charging and low idle issue. Remember that you don't know what you don't know; we learn something new every day, and that day we certainly did.

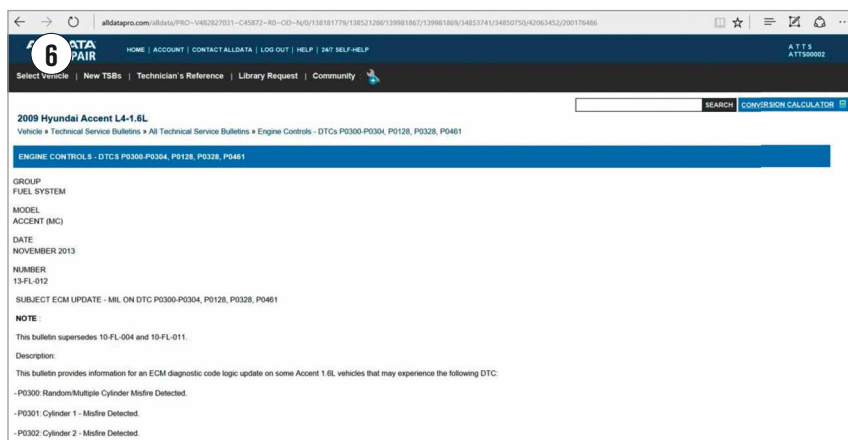
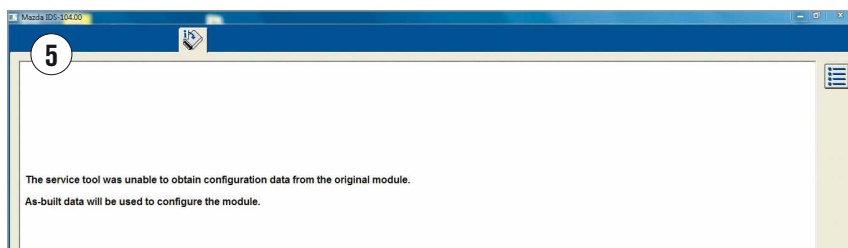
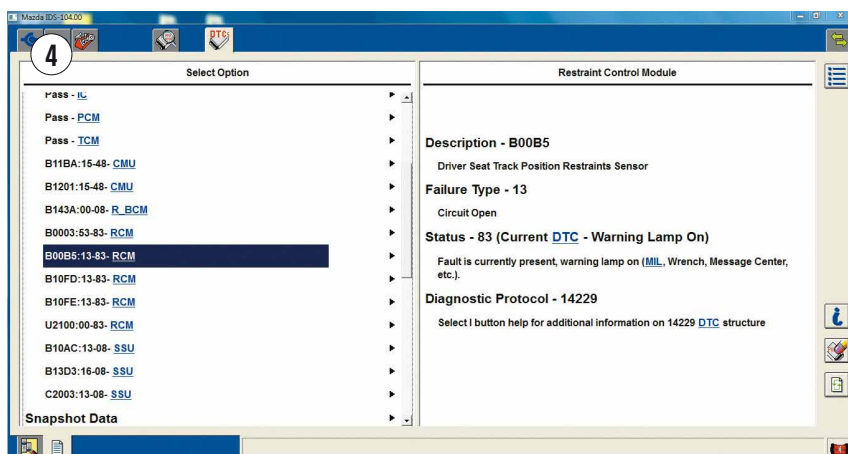
### An after-crash-repair repair

The next vehicle came in from one of the body shops we do work for that had nine body, one network and one chassis DTC

(Figure 4). The vehicle was a 2016 Mazda CX-5 with 8,800 miles that was involved in a collision and had been repaired. The dash had the airbag, seat belt and a couple more icons illuminated. Knowing that the vehicle was new, we decided that the only scan tool that would be capable to perform a complete and accurate vehicle scan would be the Mazda IDS. We needed to perform a test on the SRS system then initialize components and perform other resets that only would be available with factory software.

After we performed the vehicle scan, we identified the problems and tried to perform coding and resets that are commonly performed. On this new Mazda, the coding and reset functions would not reset the airbag, seat belt or other systems or extinguish the illuminated lights. The only way we could reset all the DTCs, and let the computers realize that the new parts were installed, was to go into the scan tool programming functions. This was a change from the normal way that we usually get the vehicle back to proper operation. We now had to change direction and go into module configuration (Figure 4) and find the As Built Data (Figure 5) to complete the operation. This is a similar function that is used by Ford Motor company since they both use the same scan tool manufacturer. Once we completed the programming we were able to perform a seat belt calibration, steering wheel, audio pack, crash event, driver seat track, driver/passenger side peripheral sensor, to name a few, resets.

The lesson learned with this vehicle is that on some of these newer vehicles you may need to have the OE scan tool and the ability to think out of the box. When no directions are available on how to reset a system or component you have to draw down on your past experience and come up with a different approach. Trying something different than just a reset or calibration that re-



fused to work led me to reprogramming the modules that restored this Mazda to new condition. With so many different scan tools and OEs using many different methods, you need to take your time and carefully explore all the functions in their scan tools or you won't fix the vehicle.

### A hiccupping Hyundai

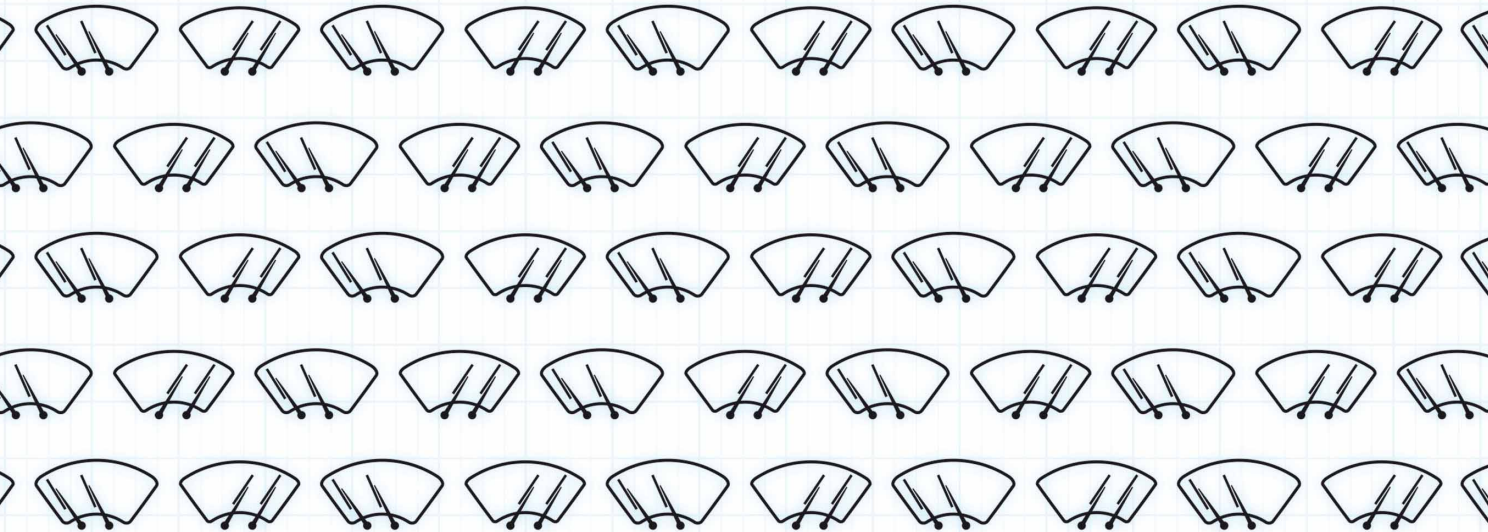
A 2009 Hyundai Accent 1.6 L with 79k on it came in with an illuminated MIL. The vehicle was already to a local shop for a tune up that replaced the plugs,

coils, air filter and performed an injection cleaning service. The vehicle owner did not understand why the vehicle was still illuminating the MIL so she decided to have us diagnosis it. After checking the vehicle out, we found that the wrong spark plugs were installed, so we suggested that they be replaced with the OE plugs for starters. We also found a TSB in ALLDATA (Figure 6) that pertained to engine misfire, stating a P0300 to P0304 could all be displayed as a result of a software issue. We recommended to the vehicle owner that we update the





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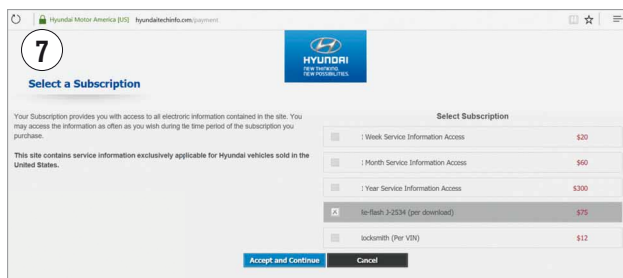
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software to get her computer up to date.

We prepared the vehicle for the update program by first making sure that everything was working properly on the vehicle and making sure to shut off everything so the computer programming would not be interrupted. Next, we installed a battery maintainer, connected the Drew Tech M box to our laptop and the vehicle's OBD II connector then downloaded the Hyundai J2534 (Figure 7) software. Once the software was installed we made sure to check for DTCs along with checking the Drew Tech Tool Box to see if there are any special procedures such as crank/cam relearn that would be required. The procedure went well, so we disconnected the equipment and test drove the vehicle. We reconnected the scan tool to confirm that there were no DTCs, misfires, or Mode 6 failures. We explained the repairs to the vehicle owner and provided her with pictures of the reprogramming confirmation screen and the TSB. Now the vehicle was ready to hit the road with its happy owner.

### An unhappy Kia converter

A 2005 Kia Sedona 3.5L came in with a P0430 Catalytic Inefficiency DTC due to a few issues. Remember the cat just doesn't decide to die. Rather, it's been poisoned for a while before failing.



In the case of this Sedona we found that the LTFT was at -19 on both banks that logged high numbers at idle and in the middle of the Fuel Trim graph on our EScan. We also found that MAF sensor voltage at idle was 0.9 V when the specification is 1.2 V, so we performed a Volumetric Efficiency test (Figure 8) on the EScan. The test failed.

If you don't have the EScan, just look at any generic scan tool and select the Calculated Load PID, select graphing, followed by pressing the pedal to the metal. When WOT is obtained (I do a rolling start and graph the PID, waiting to catch it at the 1-2 shift) you can expect to see at least 90 percent or better if the MAF and intake system is functioning properly. Since we know that extra fuel is what kills the catalytic converter, we now found our defective part that was causing the problem.

We installed a new MAF sensor, but the converter still failed the test. We called the vehicle owner and explained the converter also needed to be replaced; he agreed so we replaced it. Now the vehicle would have a better chance of passing the OBD II emission inspection.

Unfortunately, even after replacing the parts the vehicle still had a problem with a high negative Fuel Trim on both banks. We know normally that only mechanical conditions cause the PCM to issue a command to reduce the amount of fuel being delivered to the engine. We had to continue looking for any mechanical problems that could be the cause such as high fuel pressure, bad fuel pressure regulator, leak-

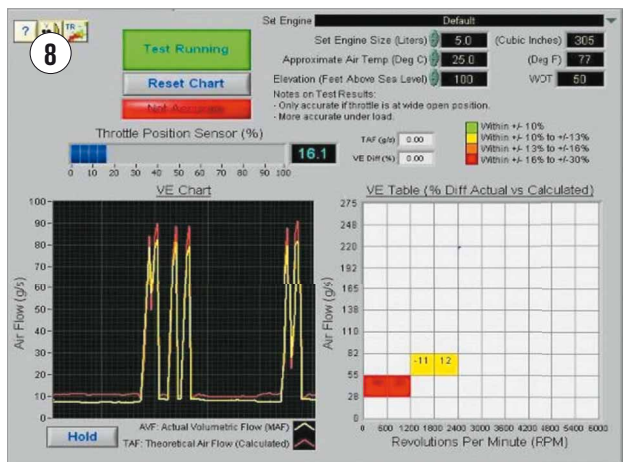
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ing injectors, open EVAP purge valve, timing issues or even a bad computer. The first place for us to start was checking fuel pressure to make sure it was at 39 psi, which it was. Now we moved on to the EVAP Purge solenoid making sure that it would open and close all the way while watching STFT readings. The test results for the EVAP solenoid were also good, so we now moved on to test the fuel injectors.

We decided to perform a hydrocarbon per cylinder test since it is the easier of the two injector tests that we can use on this engine. We removed the ignition coil, wire and spark plug to each cylinder and inserted our gas analyzer probe in the cylinder (engine off) while observing the HC readings. We found that two of the cylinders were particularly out of range with a reading of 2,000 PPM HC versus 100 PPM HC in the other cylinders. With the HC reading at 2000 PPM in those two cylinders it indicated that the injectors were either leaking or not spraying the fuel properly, causing puddling.

To confirm the previous test results, we decided to perform an injector balance test. The injector balance test requires a fuel pressure tester that was previously installed on the fuel test port along with a special injector tester that is connected directly to the fuel injector. The next step was

making sure the tester was set to the 500 ms (Figure 9) setting, while pressing the activation button on the tool. We observed the pressure drop reading on the fuel gauge and recorded the results. After the initial pressure drop, the ignition key was cycled so the fuel pressure could build back up to the normal limit before repeating the test. After the second test, we started the engine up to prevent hydrostatic lock and came up with the same two cylinders that had the high HCs. The two bad injectors dropped the fuel pressure over 2 PSI while the maximum reading is 1.5 PSI. The other four injectors dropped the fuel pressure by 1 PSI and passed the test.



Since we have a fuel injector flow bench we were able to test the injectors for volume while confirming the results of the previous test. The two failed injectors were not spraying the fuel in a conical pattern but rather in a stream. We removed the small injector screens from the top of the injectors and ultrasonically cleaned the injectors. After the injectors were finished being cleaned we installed new injector screens and flow tested all injectors for proper spray pattern and volume. Now that all the injectors were spraying properly it was time to reinstall them in the engine and check the fuel trim numbers again.

The trim numbers were still out of range, although better at a -14 reading for both banks. Ruling all the mechanical components out we had to look elsewhere. Checking TSBs, we located a PCM update that displayed the PCM calibration that were several software updates out of date. We tried three different J2534 programming tools to perform the software update but the PCM refused the request each time. Just to make sure we did not miss anything we checked powers and grounds making sure they were all in specification. Now our only choice in getting the fuel trim numbers back to normal was to install a new computer in the vehicle and program it with the latest software. With the new computer and software installed, the vehicle ran perfect. The vehicle passed the inspection and ran the way it was designed. **TZ**



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# THE ASIAN DIESEL DILEMMA

ASIAN DIESEL OFFERINGS FOR THE U.S. MARKET WERE EXPECTED TO POUR IN A YEAR AGO. INSTEAD, WE HAVE A TRICKLE.

**THE MAZDA CX-5** with Skyactiv-D diesel is slated for launch in late 2017.

**DAVE MACHOLZ //** Contributing Editor

**H**ere at *Motor Age* we like to keep content on the cutting edge, and as we planned for this month's feature, well over a year ago, we were hopeful that diesel technology would be appearing across the Asian vehicle product lines, particularly in platforms such as the Toyota Tundra and Tacoma, as well as other vehicles whose market segment has been screaming for a diesel powerplant in the U.S. for years. Fast forward to today and we have yet to see the Asian vehicle diesel materialize. The Nissan Titan XD is the only one currently in production, and just one more, the Mazda CX-5, is on the way. We'll spend some time taking a closer look at them

both, and we'll discuss some of the reasons that the expected diesel flood has instead been a slow trickle.

## Nissan

Leading the way in Asian market diesel offerings is the Nissan Titan XD Pickup with an optional lightweight Cummins 5.0-liter V-8 Turbo Diesel. This diesel engine comes in at 1.7 liters shy of its Ram truck counterpart, the 6.7, and is rated at 310 horsepower with 500-600 lb.-ft. of torque, making this mid-size pickup capable of towing a maximum load of 12,314 lbs. This power plant is the one that made Toyota truck fans giddy as rumors suggested that a similar unit could wind up in a Tundra at some point.

The technology on this Cummins

power plant includes a proprietary M2<sup>®</sup> two-stage turbo designed to work at both low and high engine speeds, a Bosch high-pressure, common rail (HPCR) injection system and two-stage filtration system to capture any contaminants larger than 4 microns, protecting the HPCR system. The 5.0 also sports maintenance-free advanced glow plugs for cold startability.

Emissions on the Cummins engine include Cummins M2<sup>®</sup> Two-Stage Turbocharger, cooled Exhaust Gas Recirculation (EGR) and Cummins Emission Solutions Aftertreatment System, which includes a Diesel Particulate Filter (DPF) and Selective Catalytic Reduction (SCR). According to Cummins this results "in near-zero oxides of nitrogen (NOx) and particulate matter

(PM) emissions while delivering better performance and fuel economy.”

Overall, this diesel power plant seems to get the job done but is unfortunately paired with the worst-selling pickup truck on the market. Give Nissan credit, however — they are at least trying to satiate the desires of the market segment that has been asking for an Asian diesel truck. Reviews of this truck since its inception have been fair to poor at best with complaints ranging from poor handling and fuel economy, excessive diesel exhaust fluid consumption due to a low capacity tank, and styling that is less than imaginative (some have called it an F-150 copy).

Mechanical issues include poor transmission performance as well as a variety of other issues uncovered by a simple Google search of “Nissan Diesel problems.” Poor pickup is also a complaint of the Cummins-powered Titan. Interestingly, there were not many problems listed with the Cummins itself. Most of the complaints were typical of those we have seen from technicians who, over the course of working on the Nissan product line, have begun to regard them as a distant cousin to Toyota and Honda in terms of quality and reliability. Some other complaints are issues with failing radiators, door lock actuators and window motors.

While major issues on these Nissan trucks remain to be seen, it is always a good idea to be prepared. The Nissan

platform has been known for needing re-programming and as such, a suitable J-2534 device is required. Some have also moved to the CONSULT-III, the factory tool for Nissan/Infiniti in order to ensure a cleaner programming transaction.

### Mazda

The Mazda CX-5 Diesel is slated for sale in late 2017. The CX-5 will be the first diesel offering here in the states for Mazda and will feature Mazda Skyactiv-D technology. Mazda claims this engine to be “the world’s lowest compression ratio diesel” at 14:1 and boats this to be a clean, highly efficient engine that “will comply with strict exhaust gas regulations globally without the aid of expensive NOx (nitrogen oxides) aftertreatment systems.” According to Mazda, features of the Skyactiv-D platform include “20 percent better fuel efficiency thanks to the low compression ratio of 14:1.” Mazda does not specify what the 20 percent is in comparison to, which makes it difficult to judge what the rated fuel economy will actually be. Also featured, and similar to the Cummins offering, is a newly developed, two-stage turbo charger. This dual-stage trend is also making its way into other brands, such as Lexus (on the



**THE MAZDA** Skyactiv-D Sports a two-stage turbo.

NX 2.0), but the Mazda will be the first proprietary two-stage on a diesel here in the U.S. Mazda claims this turbo will also lend itself to providing superior throttle response and torque in all RPM ranges. Emissions on the Skyactiv-D “Comply with global emissions regulations (Euro6 in Europe and the Post New Long-Term Regulations in Japan), without expensive NOx aftertreatment,” according to the automaker.

Mazda to-date has been light on actual specifications, but they do provide some insight into the technology that will be a part of the Skyactiv-D package. The leading technological advancement is the use of the lowered compression ratio. As a professor in an automotive program, I have always taught my students that compression ratios in a diesel engine can range anywhere from 18:1 to 21:1 in typical appli-



**THE NISSAN TITAN** is the only Asian truck to offer a diesel option.



PHOTO: MAZDA MEDIA

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cations. With such a high compression ratio, diesel engines utilize the heat of compression to create a combustion event. According to Mazda, “If fuel is injected under these conditions, ignition will take place before an adequate air-fuel mixture is formed, causing heterogeneous combustion to occur locally. As a result, the formation of NOx and, due to combustion with insufficient oxygen, the formation of soot are brought about.” Due to current emissions standards, many manufacturers utilize a strategy in which the combustion event is delayed (later injection); however, this decimates fuel economy. Enter a lower compression ratio: “When the compression ratio is lowered, compression temperature and pressure at TDC decrease. Consequently, ignition takes longer even when fuel is injected near TDC, enabling better mixture of air and fuel. This alleviates the formation of NOx and soot because the combustion becomes more uniform without localized high-temperature areas and oxygen insufficiencies. Furthermore, injection and combustion close to TDC result in a highly-efficient diesel engine, in which a larger amount of actual work (or, a higher expansion ratio) is obtained than in a high-compression-ratio diesel engine.”

Another impressive accomplishment by Mazda is the ability to lighten the diesel engine package. By running a lower compression ratio, Mazda was able to use less robust engine internals. “For example, it became possible to change the cylinder block’s material to aluminum, which saved 25kg (vs. current diesel). The cylinder head became 3kg lighter with thinner walls and an integrated exhaust manifold. As for the reciprocating parts, the weight of the pistons were reduced by 25 percent. The crankshaft had its main journal diameter reduced from 60mm to 52mm, achieving a 25 percent weight reduc-



**CUMMINS AND NISSAN** collaborated to offer the Nissan TITAN XD pickup.

tion. As a result, the mechanical friction was greatly reduced to the same level as an average gasoline engine.”

Two main problems face automakers as they attempt to follow the Mazda CX-5 in regards to lower combustion ratio diesels. The first is cold startability and the second, misfiring. Mazda is dealing with the first by using a piezo injector that is capable of nine injection events per combustion cycle. These events will happen in three main categories: pre-injection, main injection and post-injection. Mazda states it will use various injection patterns dependent on driving condition and claims “definite engine start even with a low compression ratio is attributable to this precise injection control and also the adoption of ceramic glow plugs.” In order to deal with the issue of misfires after cold start, Mazda has developed a variable valve lift system (VVL) for the

exhaust valves that will allow for the delay of the exhaust valve closing, keeping it partially open at the beginning of the intake stroke in order to keep much needed heat in the cylinder. The result of this is a more efficient combustion temperature that eliminates the misfire and smooths the idle.

## Cold feet

In 2012, Arvind Thiruvengadam, an assistant professor at West Virginia University, won a grant to research emissions output on diesel vehicles. Thiruvengadam’s lab was a modest, smallish space, but his results would have a profound impact. Let’s call him the David of our story.

As the story goes, David would come up against a giant named Goliath, or Volkswagen, if you would rather. It turns out that during the course of his research, our David discovered that Volkswagen’s diesel vehicles were not performing the way that Volkswagen had claimed in terms of their emissions. The lab at WVU tested BMW diesels without uncovering a problem but after repeated tests of the Volkswagen deduced that something was amiss. WVU called the Environmental Protection Agency and the California Air Research Board (CARB) and told



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PHOTO: MAZDA MEDIA

**THE MAZDA CX-5** with Skyactiv-D diesel is slated for launch in late 2017.

them what they had found. In order to get through emissions testing, a unique software program had to be designed and installed that would allow the vehicle to run within emissions standards while being tested, yet perform differently when under normal driving conditions. This type of scheme took thought and planning. This scheme has cost Volkswagen over \$18 billion and has resulted in a stock plunge from 253 Euros to just 92 Euros in a period of six months. As of June 1, 2017, the stock price was just 135 Euros, a shadow of where Volkswagen, at one point the world's leading brand, once was.

On May 23, 2017, the U.S. Justice Department filed a lawsuit against Fiat Chrysler Automobiles for allegedly building and selling diesel engine vehicles that violated pollution standards. FCA immediately responded that they had not intentionally tried to cheat emissions standards and would fight the allegation.

Put these stories together and you have a recipe for a U.S. Asian diesel market that has failure to launch. While Mazda and Nissan are sticking their necks out, it is hard to imagine that Asian vehicle icons such as Toyota and Honda will follow. Nissan and Mazda



PHOTO: CUMMINS MEDIA

**CUMMINS ALSO OFFERS** a two-stage turbo on its 5.0 Liter Nissan offering.

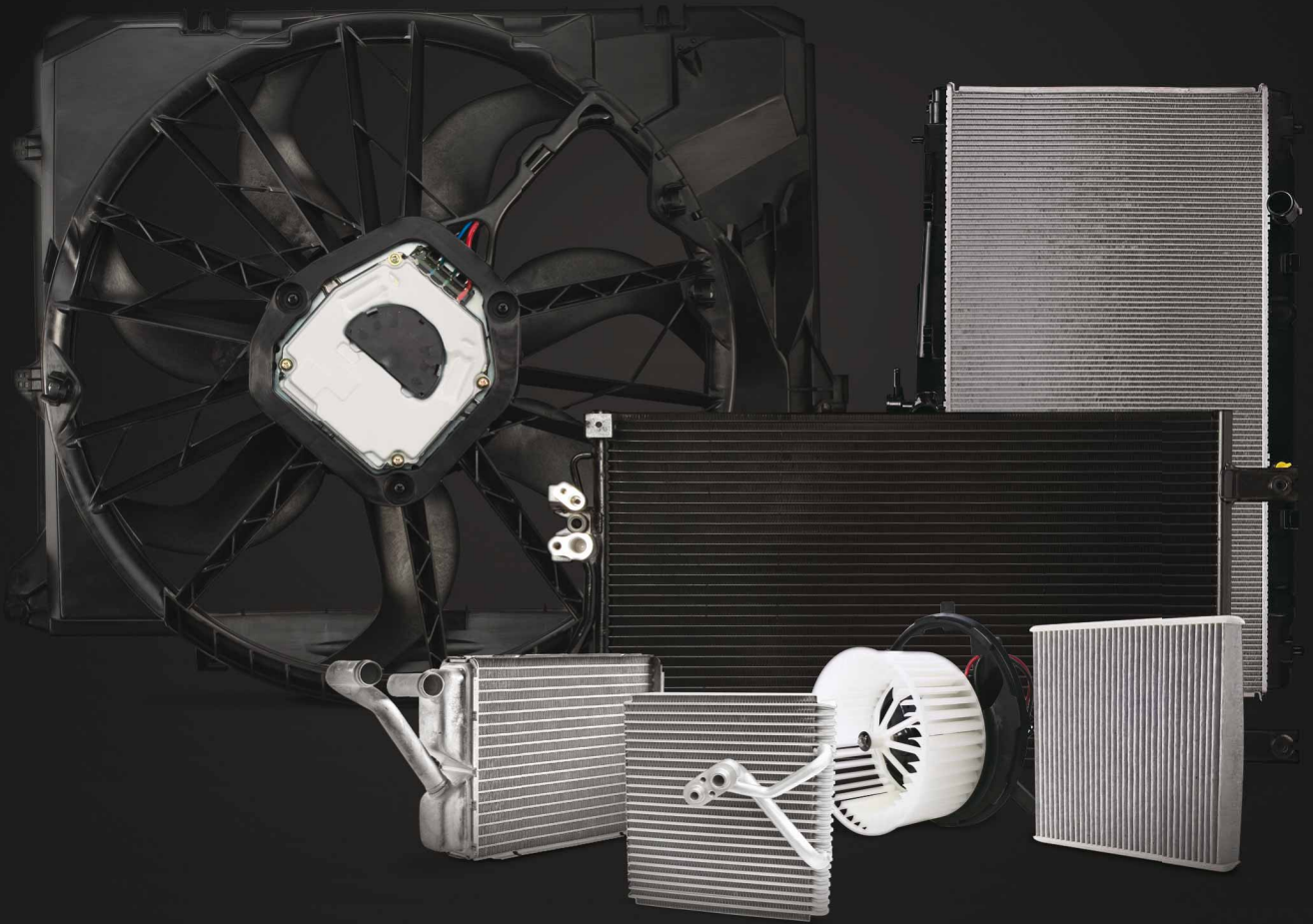
need to be proactive in order to continue to fight for market share, but Honda and Toyota simply don't need to sell a diesel in the U.S. It really is that simple. It remains to be seen what the future will hold, but for now the Asian vehicle manufacturers have cold feet. There is simply too much to risk to go down the same road that Volkswagen and potentially others have in order to meet a relatively small market segment demand. **TZ**



**DAVE MACHOLZ** is an instructor for the Toyota T-TEN, Honda PACT and general automotive programs at Suffolk County Community College in Selden, N.Y.

He is an ASE CMAT and L1 technician and holds a New York State teaching certification in vehicle repair.

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# IMMOBILIZER AND ANTI-THEFT SYSTEMS

## WHEN A “NO START” ISN’T CAUSED BY A BAD STARTING SYSTEM

**ERIC ZIEGLER //** Contributing Editor

**T**oday’s modern vehicles and the systems that make them work are becoming more and more complex; immobilizer and anti-theft system are yet another example of this. Advances in key encryption, the advent of systems like smart entry and smart key technologies have changed how we go about diagnosing, repairing and programming these vehicles. Furthermore, the proprietary nature of the OEM’s technologies and the restricting of access to repair information, tooling and security PINs is proving to make servicing these vehicles increasingly more difficult. In this article we are going to investigate some of the history of these systems as well as the operation and diagnosing of them when a problem occurs. Moreover, we will investigate some of the radical changes in how we obtain security information and what we will be required to do moving forward.

### Some background

First a little bit of history: St. George Evans and Edward Birkenbuel are credited with inventing the first anti-theft/immobilizer system in 1919. It consisted of three switches that were manually set by the driver that the ignition switch

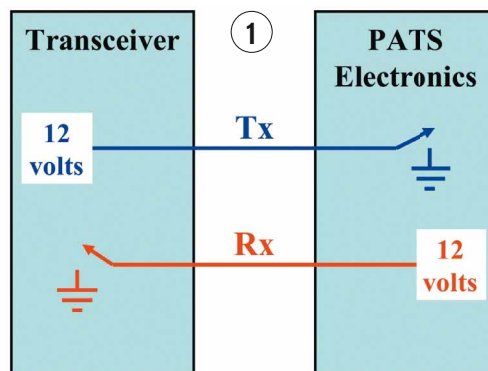
feed current flowed through, powering up the magneto/coil if correct or not allowing the vehicle to start and sounding the horn if incorrect. The setting could be changed by the driver.

European vehicles were mandated to have immobilizer technology as standard equipment by the end of 1998. Australia and Canada followed suit by 2001 and 2007, respectfully. Generally speaking, immobilizer systems incorporate the security technology either in the ignition switch/lock or in the key, either in the form of a low-tech resistor or a high tech RFID encrypted chip.

The first U.S.-manufactured vehicle to incorporate this technology was the 1985 Corvette using GM’s Vehicle Anti-Theft System (VATS). VATS was perhaps one of the first anti-theft systems many technicians were exposed to. VATS may have started in the ‘85 Vette, but it was used in many other GM platforms well into the early 2000s. The system is also referred to as Passkey.

### Passkey and Passlock

The technology was all incorporated in



the key, hence “Passkey.” The key had a pellet-style resistor integral to the key shank. There are 15 different key blanks with resistance from 402 to 11.2k ohms. The ignition switch had contacts that “read” the resistance via the generation of a resistive voltage drop of a 5-volt reference across the key’s resistor. The unique voltage drop was learned by the VATS module the first time the key was cycled leaving the factory and was “cradle to grave” or never changed. The system uses two tamper modes, short tamper and long tamper, which disabled the engine start or crank and a “fail enable” mode to keep the car starting if a failure occurs after the vehicle “passed theft.” An example of Fail Enable would be a vehicle that starts and





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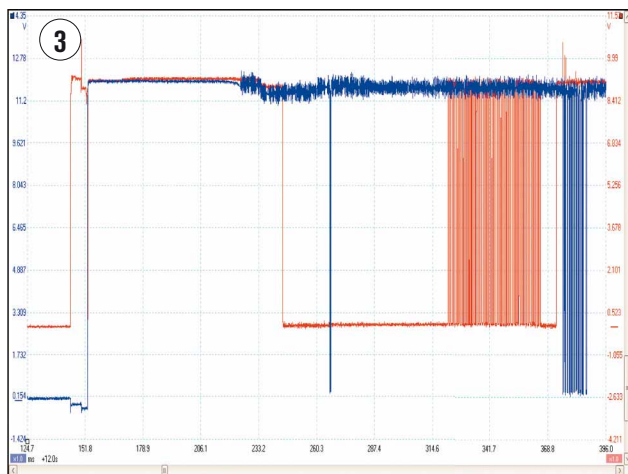
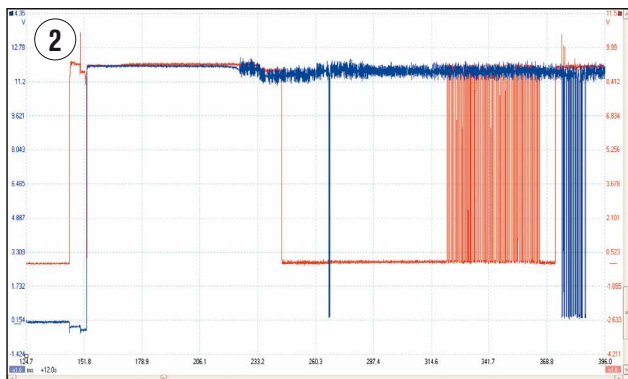
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runs and the wires from the ignition switch to the base of the tilt steering column break. The vehicle security Malfunction Indicator Lamp (MIL) will remain on solid, yet the vehicle will continue to start until the battery is disconnected or goes dead. The wiring, the contacts in the ignition tumbler and the pellet in the key were all subject to wear and were common failures with these systems. Tools needed to effectively diagnose these systems are already in every tech's toolbox — usually a DVOM and a wiring schematic.

Technology advances and security issues prompted the second generation of GM anti-theft system to be designed by incorporating the security apparatus in the ignition lock cylinder/Ignition switch. This system is known as Passlock. An easy way to differentiate between Passkey and Passlock is to remember where the security technology is incorporated. Passkey is in the key, whereas Passlock resides in the ignition lock cylinder.

Passlock used a regular non-security, mechanically cut key. The ignition switch/lock cylinder housing incorporated a special Passlock sensor. The Passlock sensor is a special Hall Effect switch, which is fixed to the housing. The ignition key tumbler assembly has a fixed magnet. When the key is rotated, the magnet is passed through the security Hall Effect. The Passlock sensor is a three-wire circuit consisting of a switched B+ feed, a ground and a 5-volt reference/signal wire. When the magnet passes through the powered Hall Effect, the 5-volt reference is pulled low through a unique resistor and the voltage known as a "R-code" is generated. The R Code is learned by a process known as Vehicle Theft Deterrent or VTD learn, which stores the learned R code in the module in charge; usually the BCM, IPC or TDM. Many techs are probably familiar with the 10-minute VTD, which was performed by turning the key to the start position and letting it spring back and waiting 10 minutes until the security MIL went out. The Passlock system was used in the late '90s, and through a lot of the 2000s the Passlock sensor had many issues and was commonly replaced. Scan data is usu-



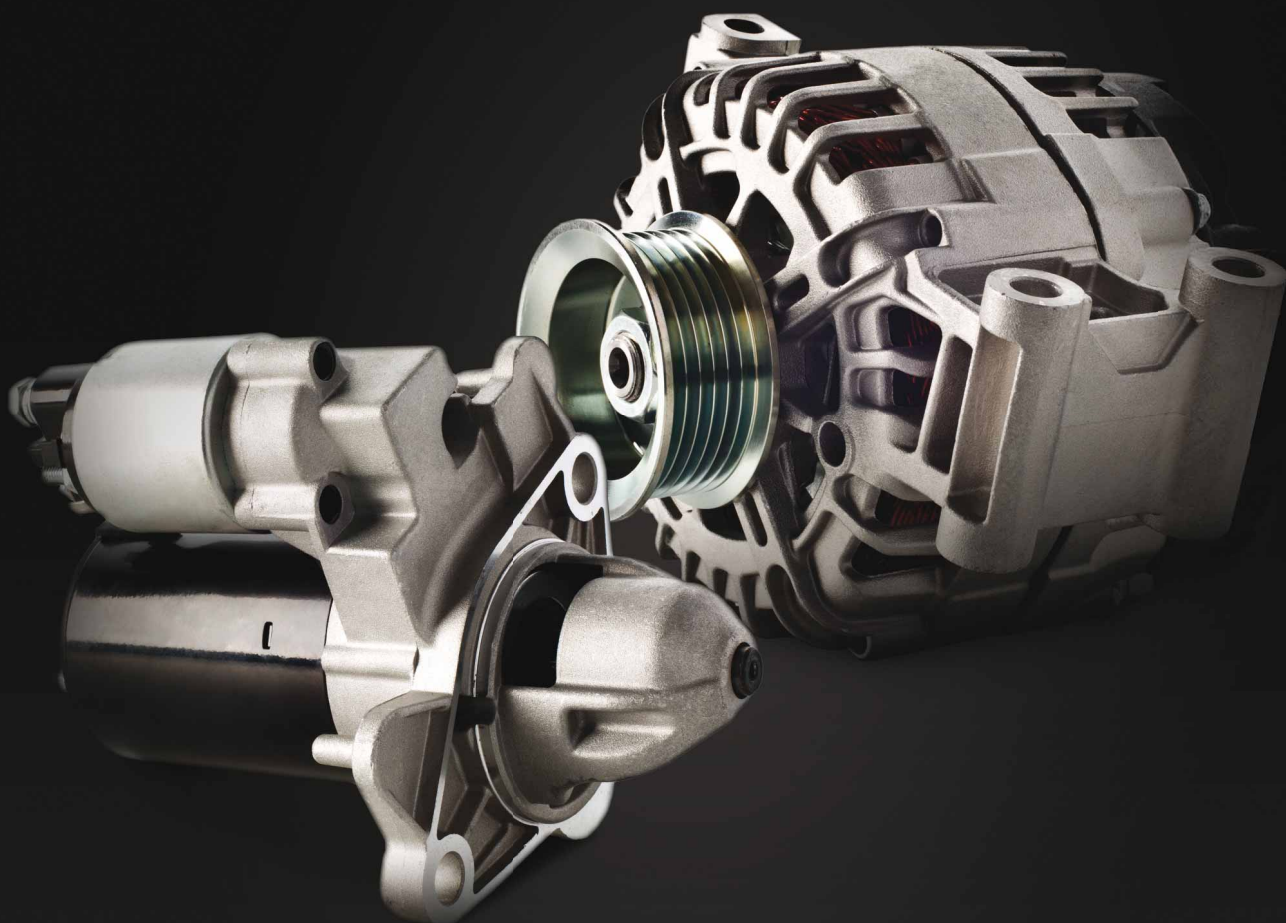
ally pretty solid on these vehicles. The R code is displayed as Passlock voltage; it should be the same every time the R code is generated and should remain at a fairly fixed value of within 0.10 volts.

GM finally went the way of many other OEMs, adopting encrypted key technology called Passkey 3 and Passkey 3+. The security mechanism again resides in the key in the form of a Radio Frequency Identification — or RFID — chip embedded in the head of the key. Many manufacturers have been using this technology in one form or another. Ford has been using this style system for many years and there is a lot of published information on how it works. There are many general similarities in most of these types of encrypted key style systems. Let's examine Ford's PATS system and its operation.

**Ford PATS**

Ford Passive Anti-Theft System (PATS), aka SecuriLock in early Ford publications, was introduced in 1996. It uses a security style key that has an RFID chip embedded in the key head. Each RFID key generates its own unique ID, and there are over 72 billion different IDs — certainly an improvement to the 15 different resistor keys that GM Passkey used!

The PATS system components consist of the RFID-chipped key, the transceiver, the module in charge of making the theft decision, the PCM and the data communications network. The PATS transceiver broadcasts a 134 kHz signal through the exciter coil of the transceiver that "tickles" the embedded RFID chip in the key, and it broadcasts its unique identifier, which is picked up by the reader coil portion of the transceiver antenna. The key's IDs are stored or learned by the PATS module in charge, which could be the PCM, ICM, HEC, VIC, SCIL or a standalone PATS module. Always consult a wiring diagram to be sure the exact nature of the system you are working on. In addition to the keys being stored, there is



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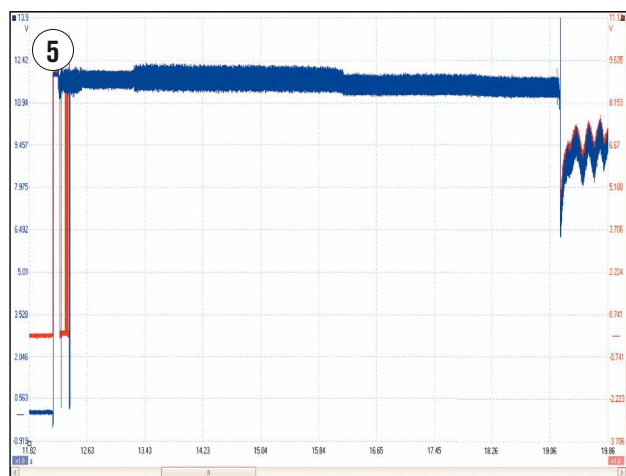


also a learned “handshake” between the module housing the PATS functions and the PCM.

There are two dedicated communication lines — the TX and the RX line (Figure 1) — which basically work on a “challenge and response” style protocol, as well as the vehicle’s data communication BUS that the “passed theft/correct key” response is sent to the PCM. The PATS transceiver bias the TX line with 12 volts and the module housing the PATS electronics pulls it low to talk. The module in charge of PATS bias the RX line with 12 volts and the transceiver pulls it low to communicate. This is the “challenge and response” protocol I refer to. Several manufacturers use a similar style system. While using a scan tool to pull codes and look into the data stream is always the first step in the diagnostic process and helps to gain some direction, I find that scoping on the TX and RX lines (Figure 2) and using some inexpensive tools to check the transceiver antenna may be necessary as well.

For example, let’s say the PCM houses the PATS functionality. When it is cycled from off to on, both TX and RX are at 12 volts, the PCM momentarily pulls the TX signal to ground and then the transceiver follows suit by pulling the RX signal momentarily to ground (Figure 3). As the next part of the challenge/response equation, the PCM rapidly toggles the TX signal to ground and then releases. If the key has responded, the transceiver follows suit and rapidly toggles the RX signal to ground to releases (Figure 4). If the key is the correct type and is programmed to the vehicle, both the TX and RX signal will latch high again around 12 volts and the theft decision will be made to crank and start the vehicle (Figure 5).

Obviously there are several components to the equation that have to be correct to have a successful start. If, for example, the key is bad or has no transponder chip in it, the point after the PCM rapid cycles the TX to ground (the challenge) and transceiver will not respond in kind by toggling the RX signal rapidly (the response) due to the key never

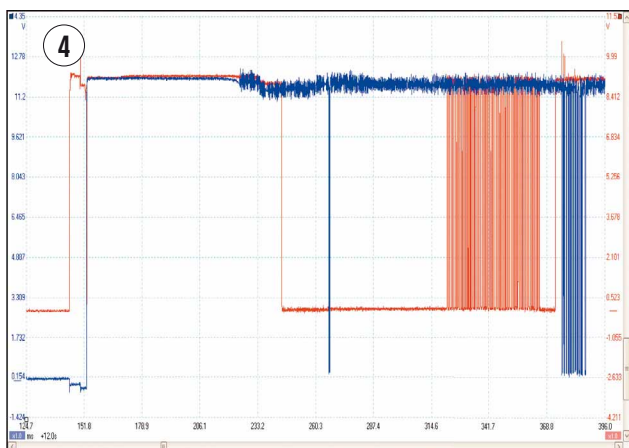


responding after the exciter coil sent the 134 kHz signal. The challenge portion will try again, again looking for a response that never comes. It usually has a distinct look about it as the challenge portion is repeated seven times before it gives up (Figure 6).

Another failure could be that the mechanical cut of the key is correct and the key has a chip in it, but the key is not programmed. This too has a unique signature when scoping the TX and RX lines to see the challenge/response action. The PCM pulls the TX down, the transceiver momentarily pulls the RX line down. The PCM now releases the TX line and rapidly toggles the transceiver start to pull the RX down rapidly by toggling it. The PCM recognizes that the key has the right transponder chipset, but is not programmed yet and quits after the single time for that key cycle. This signature looks similar to a good key without the dipped portion when the starter cranks after the theft decision has been made. In addition, code P1260 will set in the PCM and B1600 will set in the module in charge of making the theft decision.

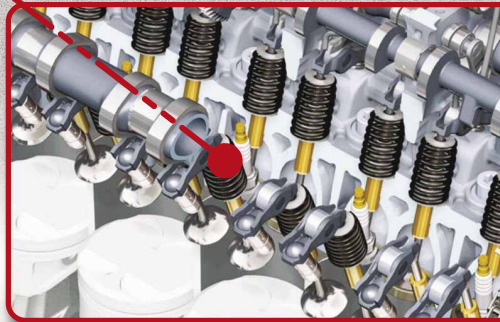
### When it doesn't work right

So let's look at some broken cars. The first vehicle is a 2001 Windstar that is a no start, theft recovery at a used car lot. The column was damaged in the theft attempt and the steering column was replaced with a salvage yard part. The shop requested key programming thinking that was the issue. The theft lamp is flashing rapidly and codes are pulled with a scan tool. The PCM has a P1260 and a B1600 has set in the module in charge of theft. The factory scan tool was installed, the 10-minute security lockout completed and security access was granted. The keys were erased and attempted to be programmed to no avail. The steering column clamshell covers are removed and the TX and RX circuits are scoped. The distinct pattern and some logic diagnostics tells the tale.





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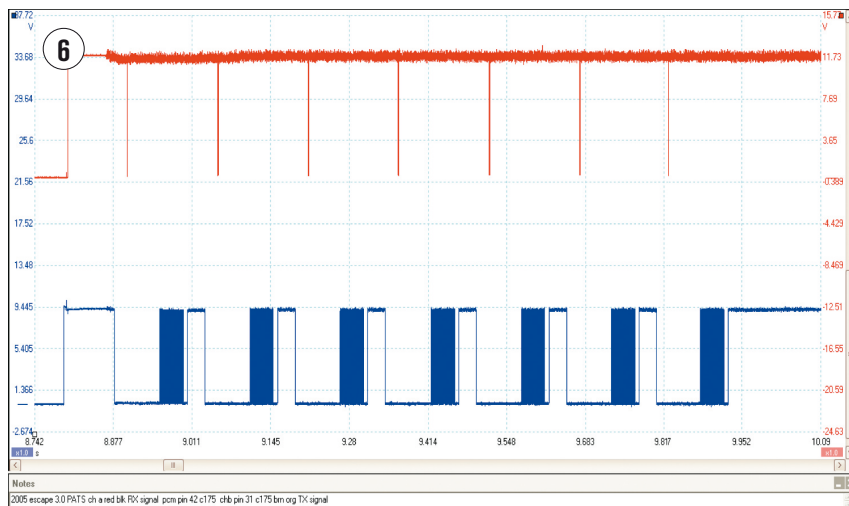
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The challenge/response pattern repeats itself seven times and then quits. As stated earlier, this pattern is from an incorrect key type or no transponders in key. After consulting the Ford PATS job aid document available from the [www.motorcraftservice.com](http://www.motorcraftservice.com) site, it is determined that the keys are the square-headed H72PT style keys with a 4C transponder used in 1998-2000 Windstar. This vehicle takes the domed-style H84PT key with a 4D63 transponder. The salvage yard was consulted and the used part indeed came out of a 2000 Windstar and not a 2001.

Let's examine another vehicle. The vehicle in question is a 2001 Ford Ranger that is a no start, and the Theft MIL is flashing rapidly. The shop suspects a key issue and changes out the lock cylinder and two keys. Programming was requested and the keys fail



to program. Codes are pulled and a P1260 is present in the PCM, indicating there is a PATS issue causing the vehicle not to start and B1681 PATS Transceiver signal not received. This is clearly not a key code. The TX and RX

are scoped and the waveforms examined. The PCM is doing its job pulling the TX signal down and rapidly toggling it; however, the transceiver portion does seem to respond (Figure 7). It clearly powers up, yet doesn't seem to be pulled low and toggled low. A transceiver checker is used and the antenna is broadcasting. Power and ground are present at the module. A continuity check from the PATS transceiver and the connector at the base of the column indicates there is excessive resistance in the RX circuit. Further investigation reveals an aftermarket remote start was installed and spliced in series to the RX circuit. The owner had purchased the vehicle used and was unaware of its presence. Disconnecting the remote start unit and repairing the wiring back to its original state allowed the key programming to go through without a hitch.

Having the right tools make any job easier. Immobilizer and anti-theft diagnostics are no exemption. I am a big fan of the OE scan tool too, but realize not everyone can afford or have access to one. There have been some sweeping changes that have been coming on for a while that are restricting access to security information like PIN codes, repair procedures and tooling. There

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# QUALITY CONNECTION SUMMER 2017 EDITION



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### IN THIS ISSUE

#### A REMOTE POSSIBILITY

Blown fuse may lead to remote harness replacement

#### POWER OUTAGE

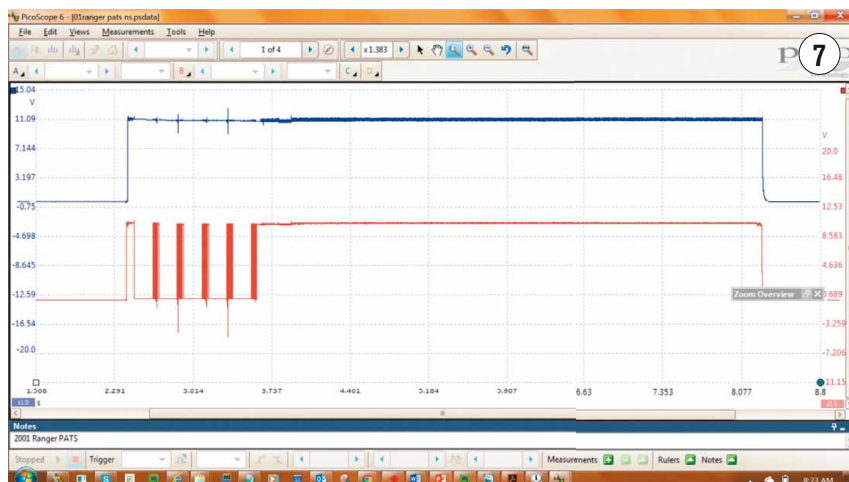
Sliding door may need a new remote controller actuator

#### TIMING IS EVERYTHING

When it comes to replacing a timing belt

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## TECHNICAL ELECTRICAL

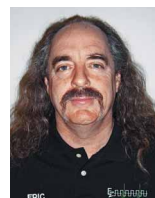


are locksmith tools that are designed for diagnosing the transceiver's ability to broadcast and check keys, however some of them require the proper credentials to purchase. However, there are some simple tools that can be used to verify the transponder halo is actually broadcasting. A quick Google check for "LED key antenna tester" should result in a low-cost method of verifying the antenna is broadcasting the signal to excite the key. Another clever method of checking transceivers, room oscillators and proximity sensors is to use a good old fashioned AM transistor radio. The 134 kHz transceiver signal is picked up by the radio in the form of "clicking" when placed close to the transceiver.

The proper credentials I mentioned earlier to have access to security information, tooling and security PINs is to become a Vehicle Security Professional (VSP) by obtaining an LSID. The LSID VSP application is handled through the National Automotive Service Task Force Vehicle Security Professional Registry. The requirements are to be an automotive service or locksmith professional, pass a criminal background check and carry a \$1 million commercial liability insurance in force. An application fee of \$75 and \$300 for a two-year license is also required. All

the information and detailed requirements are outlined on the NASTF website at [www.nastf.org](http://www.nastf.org).

We have discussed some of the history, the description and operation of some early systems, investigated a few similarities RFID systems share and discussed case studies involving broken cars. Anti-theft and immobilizer systems, like all modern technologies, continue to evolve and become increasingly more complex. I believe that if you can develop a sound game plan and have a step-by-step logical approach to diagnosing these systems, they can be tackled. Sometimes this means employing simple tools like an inexpensive LED antenna tester or an AM radio, or maybe it will require leveraging the technology of a labscope. But almost always it can be accomplished by using the greatest diagnostic tool in your arsenal — the one that rest on your shoulders! *ZZ*



**ERIC ZIEGLER** is an ASE Certified Master Tech who specializes in module programming, drivability, electrical and network systems diagnostics. He owns and operates EZ Diagnostic

Solutions Inc. and is a trainer for Automotive Seminars and The Driveability Guys.  
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# HIGH MILERS

THE ONES THAT JUST KEEP ON GIVING SOMETIMES NEED HELP

**RICHARD MCCUISTIAN //**

Contributing Editor

**T**hose of us who have been in this industry a long time can remember when a vehicle was pretty much used up at the 100k mark. Odometers “rolled over” after 99,999. I read somewhere that in the 1930s, most engines needed rebuilding every 10-20K miles. Technology has certainly improved, and there are more than a few brands out there that can rack up some stratospheric odometer numbers with very few debilitating problems along the way.

When I worked at the dealer, we saw more than a few Ford pickups and Jeep Cherokees with 300-400K miles. The folks with Jeep Cherokees would keep the one they had driven hundreds of thousands of miles and buy another one. A few years back, my department was given a 1997 Pontiac Grand Prix with 250k on the clock and it still runs like a new car, even though the interior trim has aged to the point of coming apart in places.

Some of the customers’ vehicles we work on in my department are low-mileage cars only a couple of years old, but we spend a fair amount of time on older ones. This time around there are several jobs to discuss; the most recent one we did yesterday. It was a high-mileage 2010 Ford Edge that had developed a serious transmission cooler leak after hitting a dog, and she had driven it until it was six quarts low on fluid before realizing that there was some serious dripping going on. As a side note, while it was on the lift, the lift itself

breached a hydraulic hose and started leaking, and we had to fix that too — my contention is that that the transmission leak on the Edge was contagious. That one got a transmission cooler and the six quarts of replacement juice and the lift got \$200 worth of new hydraulic hoses. Two crises dealt with in tandem.

Another recent one was a 2004 Trailblazer that rolled in with really high miles, an engine skip and a \$450 estimate another shop had given her to fix that skip. They had proposed those \$13 apiece Iridium spark plugs and a whole set of new coils. Well, this gal is a single mother and rejected that estimate out of hand. We pulled the codes, found a misfire on the No. 1 hole, did a compression test for good measure, then put a set of platinum plugs in there and a single coil. For grins, we also polished the headlights, which had taken on the color and cloudy opacity that might be compared to dirty lemon juice. And yeah, we don’t charge labor, but why does a vehicle that old need the most expensive plugs and a whole set of coils? There is such a thing as pricing yourself out of a repair.

## The Avalanche

A lady called me one week while I was off during a break and asked if I’d have a look at a 2003 Mazda B3000 she had sitting on the curb in front of her house. The story on that one was that it was her son’s truck and that it had failed to start one night in a parking lot, and they had tried to jump it off with no results. Figuring it was a bad starter, they simply parked it (strange, I know, but that’s what happened). It had been sitting



**THE 2004 CHEVY AVALANCHE**

there for three months when I opened the hood, noticed that the battery had been removed, connected my 30-lb. jumper cables, and fired it up. Faux jumper cable connections on crummy battery cables can derail a DIY diagnosis of a no-crank in short order. The B3000 ran like brand new and even had cold air, so she washed it and got it ready for a quick sale. A couple of weeks later it failed to start at the car wash, but that turned out to be a tripped inertia switch — somebody must have slammed the door or kicked it or something. But during the three months the Mazda was down, she had sold the boy her 2004 Chevy Avalanche and had bought herself a newer truck.

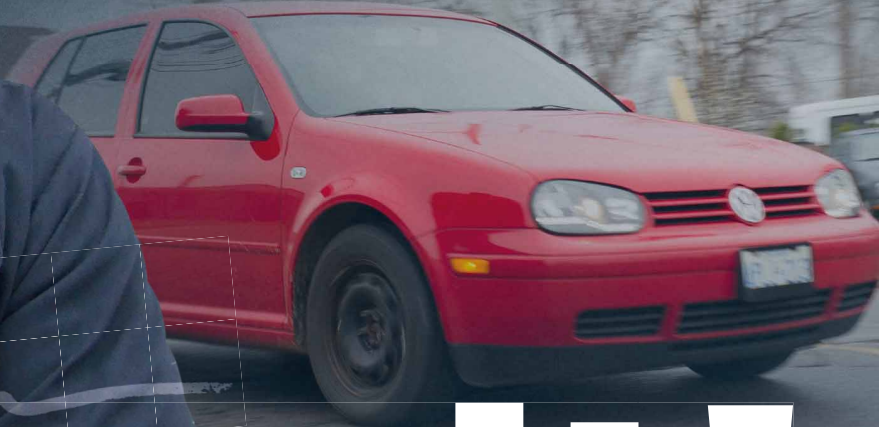
Now her son reported that the Avalanche, which boasted 268,587 miles, was leaking power steering fluid, and she wanted to know if we could check that out. I agreed, and when the truck arrived, we discovered that it had a dreadful engine oil leak that made the power steering leak look like a minor drip. It was odd that he was more concerned with having to add a half a pint of power steering fluid once a week than he was that the engine was bleeding oil to the point of what could be an early death. When I asked him how much engine oil he was having to add, it turned out



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to be a quart every two or three days. Yet the first thing on his mind was the power steering leak, probably because it'd whine and get his attention and he was tired of that. Squeaky wheel gets the grease, I suppose.

Well, we went after the oil leak first — it was dripping off the bell housing, but since that's the lowest place, the leak might be coming from the pan gasket, the oil filter adapter or the intake. The bell housing was dry on the outside leading up to the intake, and it didn't look like the oil pan was leaking (which these love to do). We looked closely at the oil filter housing before popping the small round cover off the underside of the bell housing, and through that hole, we found engine oil puddled in there, pointing to a rear main seal. We would attack that first, proposing the rear main, a torque converter seal and an oil pan gasket just for grins, since GM was kind enough to put a crossmember under the oil pan and make that part of it an easy fix.

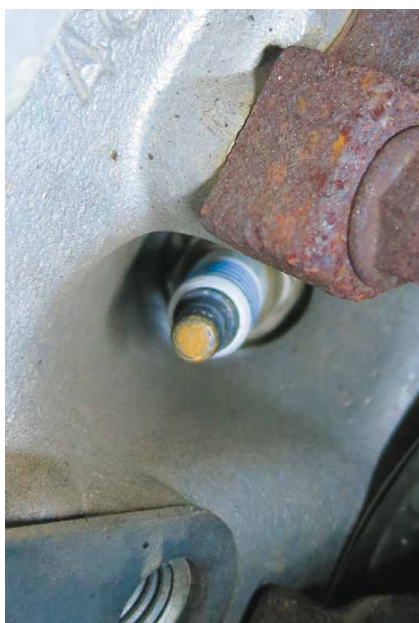
My guys plowed into that one, and we were extremely happy it wasn't one of those later model GM platforms with the stainless steel exhaust fasteners. Whoever came up with that idea should be chastised harshly. You can't cut those stainless nuts with a torch, and heating them doesn't help either. But I digress.

### The Explorer

This 2008 Explorer had been in who knows how many times for oil changes. The instructor who drives it makes a 120-mile round trip to work and back, and once a couple of years ago she came in with a bad engine vibration due to a busted cooling fan and two full-grown dead cats lying in the bottom of the fan shroud. On another trip, the pulley ring of her harmonic balancer had slipped back toward the engine so that the belt was riding on the naked rubber part of the balancer, and the crank sensor was being machined away by the misplaced



**THIS COVER PROVIDES** insight into the source of a leak. When we popped it out of there and found oil in the bell housing, it was a no-brainer that the rear main was the biggest leak.



**THIS 2008 EXPLORER** had been the equivalent of 10 trips around the world before the spark plugs were finally replaced, but it still ran like a champ.

pulley. We saw two of those slipped 4.0L balancer failures that same week and haven't seen another one since.

On a humorous note, we decided on one trip to check the fuel filter on the Explorer, which was almost completely blocked. I used that for an object lesson as to why it's always a good idea to check the fuel filter on a high-mileage vehicle. There was a time when Ford required the filter replaced every 15K on trucks. Later when I was changing the oil on my 2007 Taurus I decided to check the fuel filter and it was just as bad as hers was.

On the last oil change, I suggested we have a look at her spark plugs and it turned out that they were the originals

— with 238,000 accumulated miles, and this one was still running great with not so much as a flicker from the MIL. The plugs had the paint spot on the tip and on the way out they did that heavy-duty squeaking ancient spark plugs do when they've been in there forever. Furthermore, the business end of those plugs was textbook worthy.

### The Suburban

About the time we got the transmission out of the Avalanche, a high-mileage 2004 Chevy Suburban came rolling in with an engine skip that turned out to be on cylinder 4. This one was blessed with the trusty old 5.3L, which I like because of the

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camshaft-in-the block, but even without the overhead cams and all those nylon sliders and tensioners, this engine isn't without its problems. Camshaft lobes wear down and head gaskets blow. When we pulled the plug out of the misfiring cylinder, there was a piece of ceramic that had been cracked and shucked off the center electrode sheath by some catastrophic mechanical event (that according to the Denso chart anyway), and that cylinder had no compression. A cylinder leakage test fingered the exhaust valve, and I wondered if that chipped-off piece of ceramic might be stuck in some valve carbon holding the valve open, but it would seem to have been hammered to

bits and spit out the back, because that's what usually happens.

The prevailing question I had was what had caused the spark plug's ceramic to fail in the first place. Were there detonation or preignition events that cracked and damaged it or what? They had to go on a trip and opted to drive it that way, but in the coming month we'll stuff an engine in that one — the cool thing is that we can upgrade to a 6.0L if we want to because the 4.8L, 5.3L and 6.0L are plug-and-play engines.

### The '98 F-150

One of my colleagues owns an F-150 he inherited from a relative, and we got one of those laundry list requests — the fuel economy had dropped off, the passenger-side power window wouldn't work, the transmission needed servicing, the intermittent wipers were intermittent, and, of all things, the Check Engine light didn't work — and he wanted all of it fixed. A lot of people "fix" the MIL by covering it with a picture of somebody or by installing a piece of tape blocking the view of it, but this one had a breach in the wire between pin 2 on the PCM and pin 13 on the bulkhead connector, so we did an overlay on that one and brought the MIL back to life. Several of my people worked on that problem because it was a great troubleshooting and repair exercise in electrical systems, and it was a bug I didn't plant. For a truck this old, that re-



**THIS TATTLETALE RUST STAIN** was from a rattling alternator decoupler pulley on a Jeep Compass — the owner thought it was a bad A/C compressor and was pleasantly surprised at the easy fix.

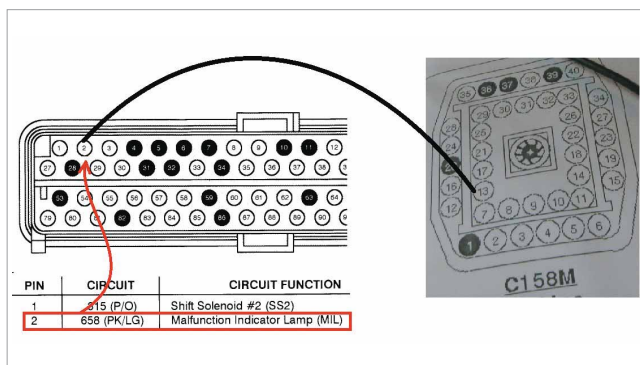


**WE WON'T KNOW** until later this summer what happened on the 2004 Suburban to cause this, but the cylinder it came from has almost no compression at all. And since the mileage is so high, we'll probably stuff an engine in it.

operational MIL might be problematic, because now, if the truck had issues of which he had previously been oblivious, he'd be swinging by regularly to have those issues handled. After we replaced the spark plugs, the passenger-side window regulator, the PRNDL indicator and the Combination Switch, the truck had no starter operation, and we tracked that



**THIS IS ONE OF THOSE STEALTH PROBLEMS** — one of my guys had replaced the radiator in this high mileage Ranger, and since the lower radiator hose clamp had seemed okay, he re-used it. What he couldn't see was that this clamp wasn't quite long enough; the screw was only holding a couple of slots, and they gave way one day about six weeks after the radiator was replaced and dumped the coolant.



**THIS '98 F-150** had a laundry list of issues — the least likely of which was the inoperative check engine light. We ran an overlay between the PCM connector and this bulkhead connector and got the light back online.

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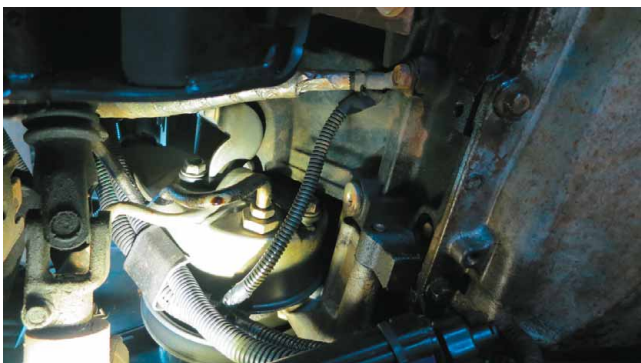
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**AT FIRST THE ONLY THING WE SAW** in the power steering area was this tantalizing drip (left photo), but as we ran it for a while we began to see power steering fluid dripping from between the master cylinder and the Hydroboost unit — and so it got one of those.

to the big C172 connector near the battery — one of the students had begun disconnecting that connector, gotten side tracked, and left it that way. In the end, that F-150 rolled out with no codes and no illuminated MIL, which was something of a surprise on such a high miler.

### The hunting truck and a Nissan

The Toyota pickup on which we had used head gasket sealer came back in for a timing belt and a water pump — it still wasn't leaking coolant any more, not



**THE TOYOTA HUNTING TRUCK** revealed this leak after we did a water pump and a timing belt. It was a tough shot to get, but in the real world you can see coolant trickling from under the right cylinder head. This stain told the tale.

even from the water pump, but the bearings in the pump were rattling, and so we stripped it down and did the kit thing — belt, idler, tensioner, water pump, etc. After we filled it with coolant and fired it up to do the final burp-out, I saw coolant leaking from the rear of the engine and discovered a head gasket breach that was trickling coolant down the bell housing. Whether he'll want to redo the head gasket sealer or replace the head gasket remains out with the jury, but he opted to take the truck and use it for a while, keeping a check on the coolant level. His prerogative, I suppose.

Then there was the 2000 Nissan Frontier with an A/C belt squeak after a few minutes of at-idle A/C operation. This was condenser airflow-related because the head pressure started out normal and slowly climbed until the compressor had to struggle. Checking for radiator and condenser fin blockage, we rinsed them out with soap for good measure but to no avail. When we put a fan in front of the condenser blowing through it, the pressures normalized, and when we tested the fan clutch by heating the bimetal spring, it never got any stiffer, so we fixed that one with a fan clutch.

### Finishing up the Avalanche

The power steering leak on the Avalanche was the last thing we tackled on that one. It wasn't leaking from the pres-



**THIS IS A SHOT** from a job on the campus forklift — the alternator wasn't putting out, and we found the lower bolt had almost worked its way out. All we had to do here was put the bolt back in place with a nut and a lock washer.

sure hose as we had figured. It was dripping fluid from the hydroboost unit, and so it'd need one of those babies to close out that job. We got one from the parts store, swapped it out, refilled everything, used the vacuum bleed cap I built to purge the air, I charged out the parts, and we put that one on the yard. Oh, yeah, we polished the headlights on that one too, and the whole truck looked better. "It's the little things," as one customer told us. We do what we can to breathe new life into those high milers, and it felt good to be done with another one. **TZ**



**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.  
[rwm19@mail.com](mailto:rwm19@mail.com)





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## TACKLING CATALYTIC CONVERTER DTCS

### SOMETIMES THE CATALYTIC CONVERTER IS THE CULPRIT, AND SOMETIMES IT'S NOT!

PETE MEIER // Technical Editor

Among the top 10 Diagnostic Trouble Codes (DTCs) techs deal with on a routine basis are the “Catalytic Converter Efficiency Low” codes; the P0420s and/or P0430s. If the vehicle is high mileage, it could be that the converter has lived its useful life, but odds are that it didn’t die a natural cause. There may be an underlying reason for its demise and unless that problem is pinpointed and corrected, that expensive replacement may have only months to live before it, too, is claimed as a victim.

First, we need to understand that the Engine Control Module has one primary task, and that is to protect that converter from harm. The catalytic converter is very capable of cleaning up exhaust emissions as long as the feed gasses it gets are kept within a very narrow range. Any internal issues that push those gasses outside of the “zone” will result in an



overheating of the substrate or contamination of the converter.

Second, we need to understand how the efficiency of the converter is determined by the ECM. Many OEMs use a comparison of the front and rear oxygen sensor signals but that is not always the case. To blindly pursue our troubleshooting based on generalized information is one sure way to have your

customer return with the same problem down the road.

In this episode of The Trainer, we’ll show you common reasons for these DTCs to set and how you can test for them as well as a few tricks for determining whether or not the cause of the “Low Efficiency” is a cat that died of natural causes or one that was “murdered” by an outside issue. Be sure to watch!

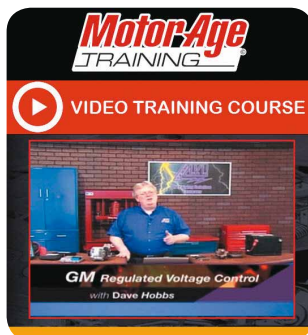


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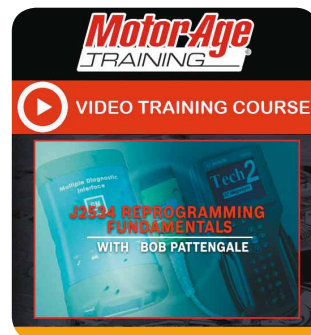
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## A REMOTE POSSIBILITY

Blown fuse may lead to remote harness replacement

## POWER OUTAGE

Sliding door may need a new remote controller actuator

## TIMING IS EVERYTHING

When it comes to replacing a timing belt



Genuine Parts

# It's a family affair

Major magazine names 2 Kias "best cars for families"

**K**ia prides itself on building family-friendly vehicles. Apparently, *U.S. News & World Report* agrees because it recently named the Soul and Cadenza as two of its "2017 Best Cars for Families." Moreover, the Soul also received the award last year.

According to the *U.S. News* website, choosing the right family car is about "striking a balance." Addressing its methodology, it says, "Each of the award winners have the best combination of positive reviews from professional car critics, safety ratings, space, and available tech features."

Emphasizing the tech point, the *U.S. News* website also says, "All of the winners have available advanced driver assistance features, like blind spot warning, forward collision warning, and automatic braking, to help prevent a collision."

Orth Hedrick, vice president, product planning for Kia Motors America, says that Kia is thrilled with the awards "because they speak to the effort we put into creating vehicles that families will love. It's part of Kia's global commitment to offer attractive, reliable and dynamic vehicles with tremendous value." He



The Kia Soul has been awarded two years in a row.

concludes, "Being awarded Best Cars for Families by *U.S. News & World Report* is testimony to those efforts and we couldn't be more proud."

The Soul was noted for outstanding ergonomics and tech features. "The ride height is neither too low nor too high, making it easy for both little kids and grandparents with limited mobility to get in," says *U.S. News* Autos managing editor Jamie Page Deaton. "Parents of teen drivers can get some peace of mind with the Soul's UVO system, while Apple CarPlay™ and Android Auto™ keep families connected with limited distraction on the road."<sup>1</sup>

As for the Cadenza, Page Deaton says that the same luxury features that are attractive to adult drivers are meaningful for families. "Rear sunshades keep backseat passengers cool so they can ride or nap in peace." And as with the Soul,

she emphasizes the practicality of Kia's advanced car technology for the Cadenza. "UVO teen-driver controls make it easier to hand the keys over to new drivers, and Apple CarPlay™ and Android Auto™ make it easier to access common smartphone functions without having to learn a new operating system."

At some point, you may see Kia Souls and Cadenzas in your shops. For best results in serving them, we recommend keeping things "all in the family" by using Genuine Kia Parts to service and repair them.

## Kia Motors America, Inc.

*All trademarks and tradenames are the property of their respective owners. 2017 Kia Soul Turbo shown on the cover and above with optional features. Not all optional features are available on all trims. Some features may vary.*

<sup>1</sup> Warning: Driving while distracted can result in a loss of vehicle control that may lead to an accident, severe personal injury and death. Always drive safely and use caution.

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### A remote possibility

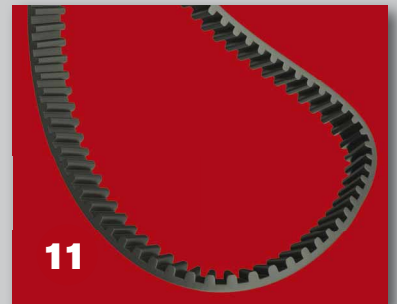
Blown fuse may lead to remote harness replacement



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### Power outage

Sliding door may need a new remote controller actuator



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### Timing is everything

When it comes to replacing a timing belt



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# A remote possibility

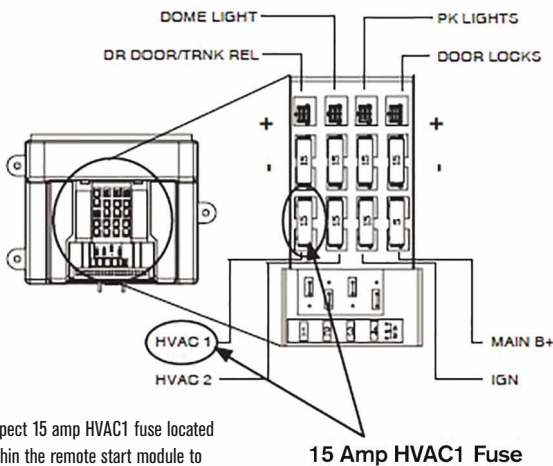
## Blown fuse may lead to remote harness replacement

 As an automotive technician servicing Kia vehicles, you may encounter a 2011/2012 Sorento vehicle in which the heater/blower motor is not functioning when the remote start is used. This issue may be caused by a blown 15 amp HVAC1 fuse located within the remote start module. Follow the remote harness removal and replacement procedure in this article to remedy the issue. (Note: The replacement harness utilizes a load reduction design.)

» **NOTICE:** This procedure should only be conducted if a customer has a specific issue with RES, i.e., that the HVAC fuse blows in the RES module, otherwise this procedure is not required.

» TSBs may be updated from time to time. Please refer to TSB EL 016 at [www.kiatechinfo.com](http://www.kiatechinfo.com) for the latest procedures.

» All images are for illustration purposes only.



Inspect 15 amp HVAC1 fuse located within the remote start module to determine if it is good.

### AFFECTED VEHICLE PRODUCTION RANGE

Model	Production Range
Sorento (XM)	MY range 2011-2012

### REQUIRED PARTS

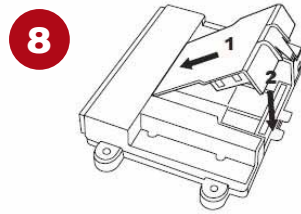
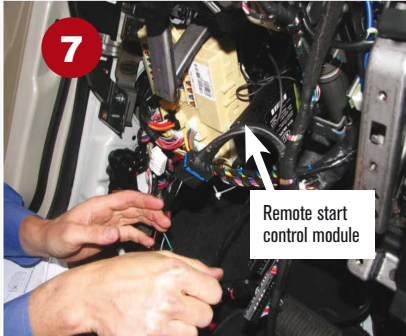
Part Name	Part Number	Figure
Remote Start Harness Kit	U8561 1U002	



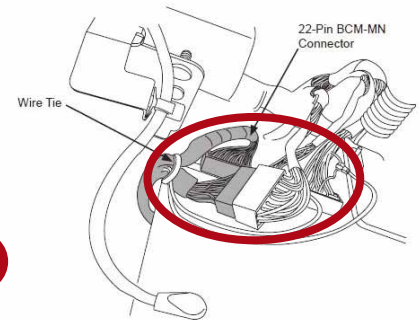
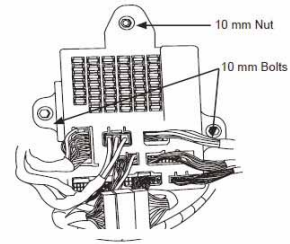
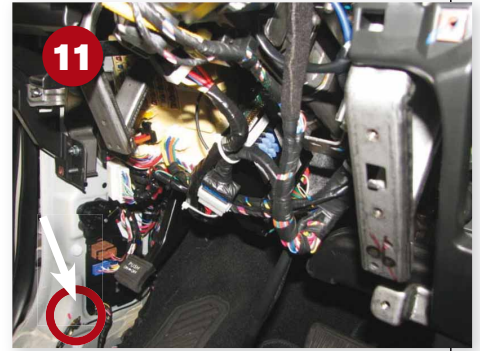
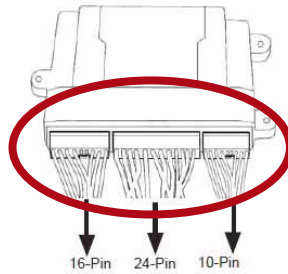
### Remote harness removal service procedure

1. Before starting service procedure: Record radio station presets and disconnect negative battery terminal.
2. Remove the driver's side front door step sill trim by inserting the trim removal tool under the trim panel and carefully prying upward to release the four push clips.
3. Carefully pull the weatherstrip away from the side of the driver's side kick panel as indicated in the photo. Then remove the following: the hood release lever by pulling toward the center of the vehicle; the plastic nut located near the vehicle dash wall, if equipped; and the driver's side kick panel from the vehicle by pulling upward to release the push clip and prying toward the center of the vehicle to disengage the two clips. Remove the driver's side dash end-cap panel by prying outward to disengage the four clips.
4. Remove the lower-dash finish panel by removing the four Phillips screws from the bottom of the panel. Using a trim removal tool, carefully pry outward to release the five clips. Remove the OBDII connector from the panel. Disconnect the remaining connectors, if equipped.





**Caution:** Be careful not to bend the mating pins of the multi-pin connector when installing the DNA card.



**5.** Remove the five 10 mm hex bolts and one 10 mm hex nut securing the steel knee bolster panel as indicated by the arrow. Remove the steel knee bolster panel from the vehicle and set aside.

**6.** Remove the three Phillips screws securing the steering column shroud (one underneath and two behind the steering wheel). Turn the steering wheel for access. Pull down to separate (use trim tool, if necessary) and remove the lower steering column shroud from the vehicle.

**7.** Locate the remote start control module mounted to the factory brace supporting the fuse box. Remove the existing DNA Module by pressing the tab at the back of the DNA Card and then lifting the DNA card from the back side.

**8.** Remove and inspect the 15 amp HVAC1 fuse to determine if it is good; replace it,



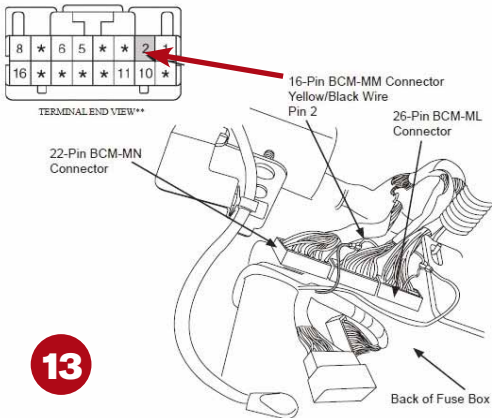
if necessary. Install the DNA card into the remote start control module. Press the center release tab on each connector to disconnect all three wire harness connectors from the remote start control module.

**9.** Cut the two small wire ties securing the Black ground wire to the existing factory harness. Arrows in the photo indicate the general location of the wire ties. Cut the three large wire ties (arrows) securing the remote start harness.

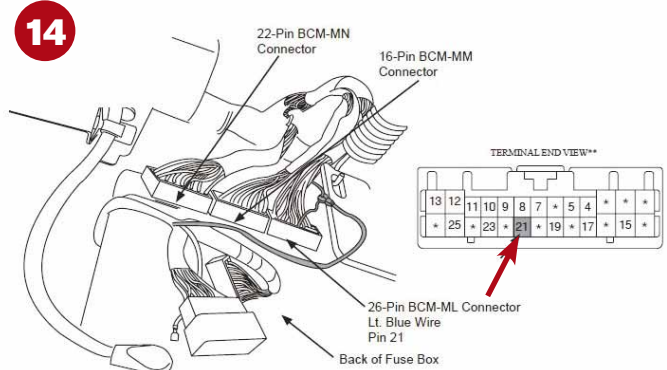
**10.** Cut the one large wire tie securing the remote start harness to the existing factory harness. Cut the three small wire ties securing the disarm/programming button to the remote start harness.

**11.** Locate and remove the 10 mm hex ground bolt in the left kick panel area. Remove the remote start harness Black ground wire with ring terminal from the bolt.

**12. Notice:** Remove the two 10 mm hex bolts, and the one 10 mm hex nut securing the fuse box, and then tilt it forward for better access to the BCM connectors. Cut the one small wire tie securing the Lt. Blue (Parking Light Output) wire, Yellow/Black (Driver Door Unlock Output) wire and the 22-pin male and female BCM-MN remote start harness connectors to the remote start wire harness. Disconnect the remote start harness 22-pin male and female connectors.



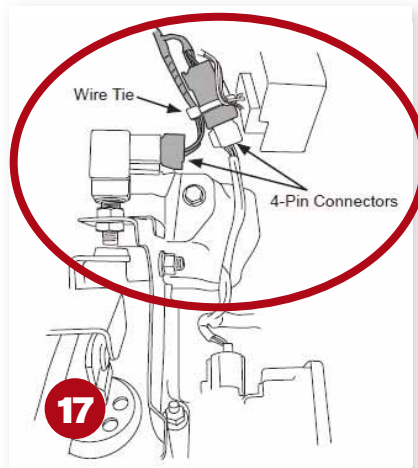
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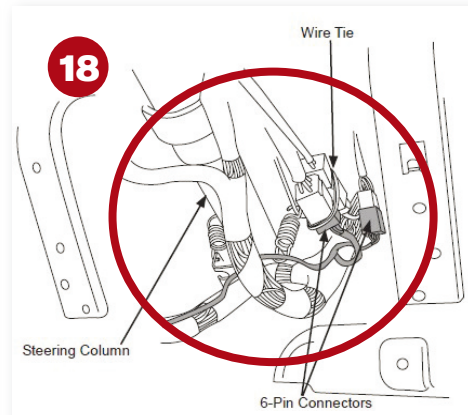
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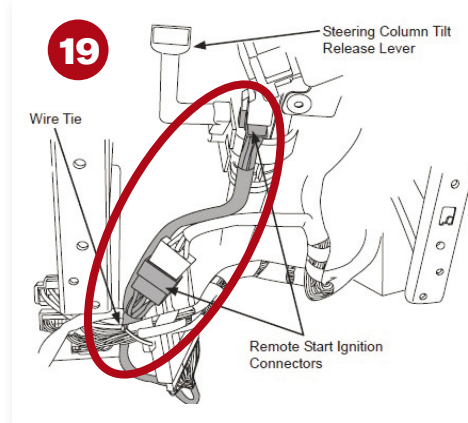
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17



18



19

**13.** Disengage the 16-pin BCM-MM connector from the back side of the BCM, if necessary. Remove the remote start harness Yellow/Black (Driver Door Unlock Output) wire from the Yellow/Black wire (Pin #2 of the BCM-MM connector) by disengaging the T-Tap.

**14.** Disengage the 26-pin BCM-ML connector from the back side of the BCM, if necessary. Remove the remote start harness Lt. Blue (Parking Light Output) wire from the Lt. Blue wire (Pin #21 of the BCM-ML connector) by disengaging the T-Tap. Disconnect the remote start harness 26-pin male and female connectors at the front of the fuse box.

**15.** Remove the remote start harness Green/Orange (Tachometer Input) wire from the Green/Orange wire (Pin #26 of the I/P-E connector) by disengaging the T-Tap.

**16.** Remove the remote start harness Gray (Rear Defroster Output) wire from the Gray wire (Pin #17 of the I/P-F connector) by disengaging the T-Tap. Remove the remote start harness Red/Black (Hood Ajar Input) wire from the Red/Black wire (Pin #16 of the I/P-F connector) by disengaging the T-Tap.

**17.** Cut the one small wire tie securing the factory male CHG 39 brake switch connector and the remote start harness female brake switch connector to the remote start harness. Disconnect the remote start harness 4-pin male and female brake switch connectors.

**18.** Cut the one small wire-tie securing the factory male M37 key-in-sense connector and the remote start harness female key-in-sense connector to the factory connector. Disconnect the remote start

harness 6-pin male and female key-in-sense connectors.

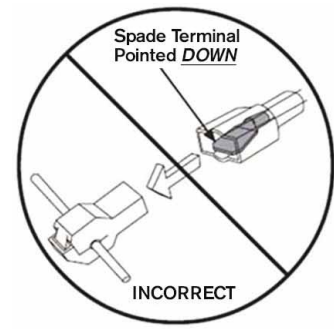
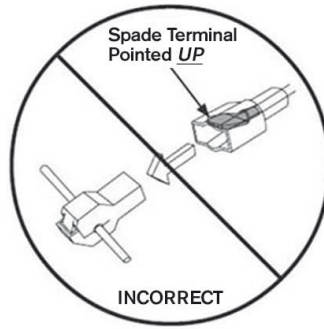
**19.** Cut the one large wire-tie securing the left side of the remote start module to the factory wire harness. Disconnect the remote start harness 6-pin male and female ignition switch connectors. Remove remote start harness from vehicle.

## Remote start harness installation (T-Tap installation procedure)

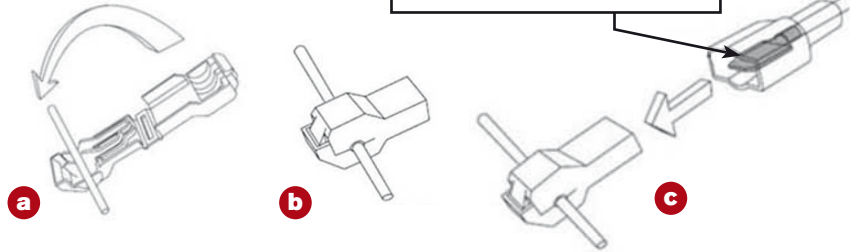
Factory wire harness colors are subject to change, please use the specified pin # in the harness connector to identify the correct wire for T-Tap installation.

**Only perform the following procedure if a T-Tap was removed during harness removal:**

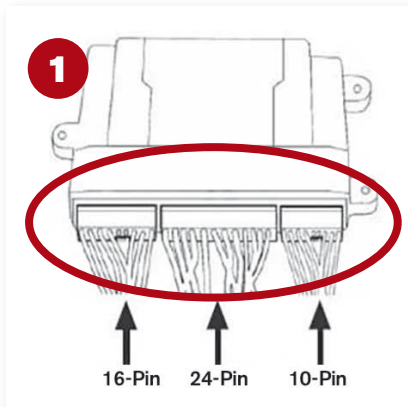
- Place T-Tap on vehicle wire;
- using pliers, close and crimp T-Tap around vehicle wire; and
- insert harness wire with male spade terminal and into T-Tap.



**CORRECT**  
Spade terminal *CENTERED* inside connector



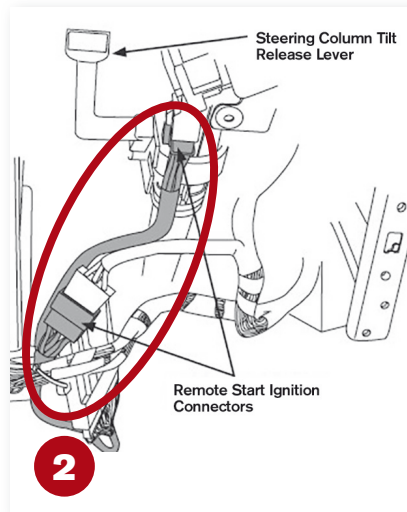
Extreme care must be taken to ensure that the male spade terminal is inserted in the T-Tap properly.



**1.** Plug the wire harness connectors into the remote start module before mounting. Ensure all connectors are properly locked into position.

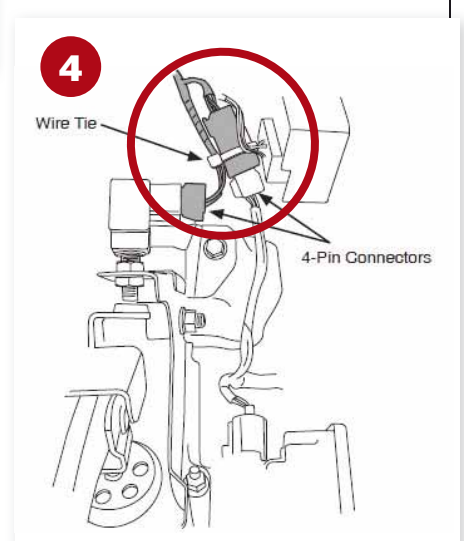
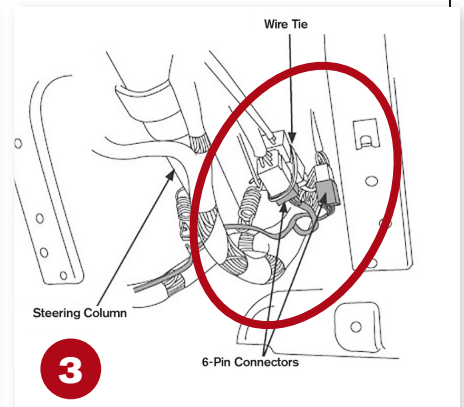
**2.** Route the remote start harness 6-pin male and female ignition connectors upward to the ignition switch. Connect the male 6-pin M15 ignition connector and plug in the corresponding remote start harness connectors.

**3.** Route the remote start harness 6-pin male and female key-in sense connectors along the factory harness toward the factory 6-pin connector, located to the right of the steering column.

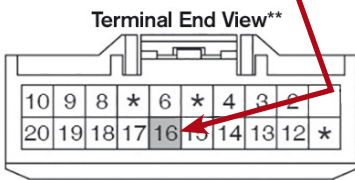


Connect the male 6-pin M37 connector and plug in the corresponding remote start harness connectors.

**4.** Route the remote start harness 4-pin male and female brake switch connectors under the steering column to the brake switch. Connect the male 4-pin CHG 39 connector and plug in the corresponding remote start harness connectors. Secure the factory male connector and the remote start harness female connector to the remote start harness with one small wire tie. Trim off excess wire tie.

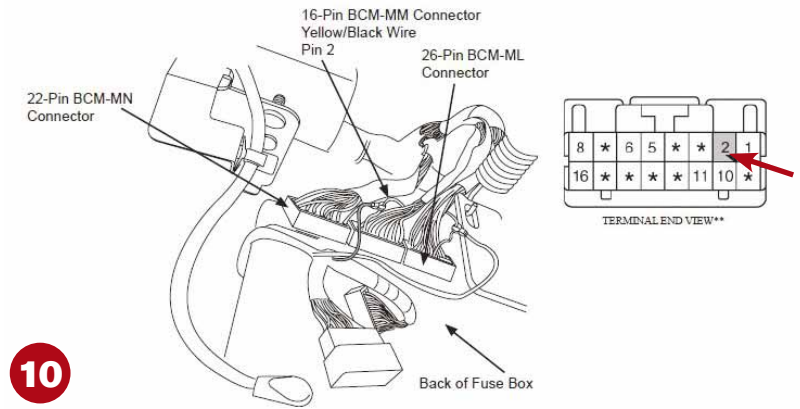
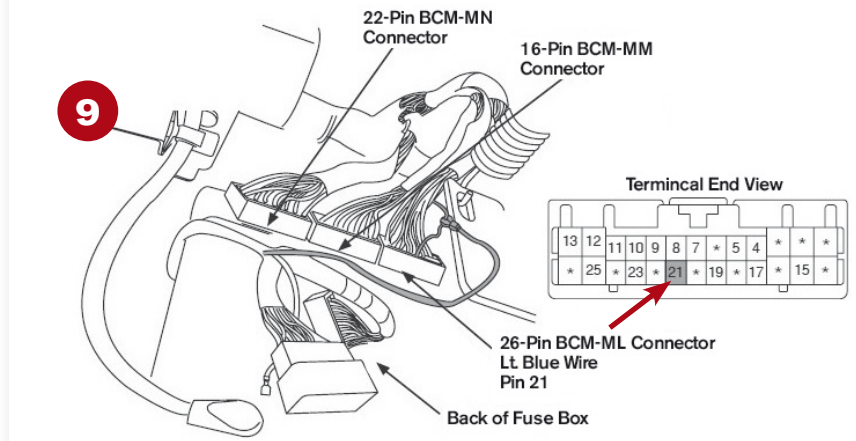


# Mechanical



**5.** Route the 26-pin male and female connectors, Red/Black and Gray wires toward the fuse box. Attach the Red/Black wire to the #16 pin of the 20-pin I/P-F male connector. If Removed: Using pliers, crimp a T-Tap on the Red/Black wire located in pin #16 of the I/P-F male connector. Connect the Red/Black (Hood Ajar Input) wire from the remote start harness to the Red/Black wire (Pin #16 of the I/P-F connector) by engaging the T-Tap.

**6.** Attach the Gray wire to the pin #17 pin of the 20-pin I/P-F male connector. If Removed: Using pliers, crimp a T-Tap

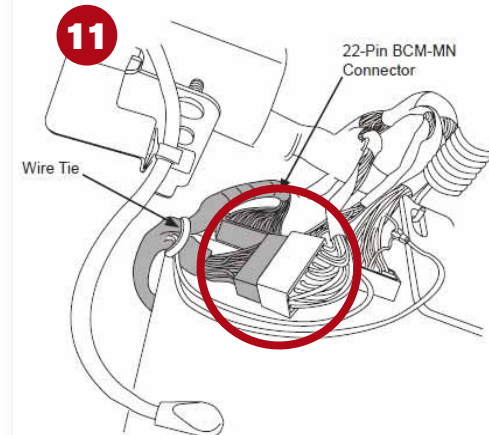


on the Gray wire located in pin #17 of the I/P-F male connector. Connect the Gray (Rear Defroster Output) wire from the remote start harness to the Gray wire (Pin #17 of the I/P-F connector) by engaging the T-Tap.

**7.** Attach the Green/Orange wire to the #26 pin of the 26-pin I/P-E male connector. If Removed: Using pliers, crimp a T-Tap on the Green/Orange wire located in pin #26 of the I/P-E male connector. Connect the Green/Orange (Tachometer Input) wire from the remote start harness to the Green/Orange wire (Pin #26 of the I/P-E connector) by engaging the T-Tap.

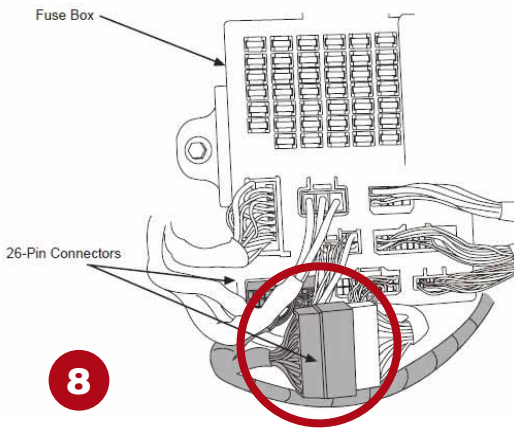
**8.** Connect the factory male 26-pin BCM-FK connector at the fuse box and plug in the corresponding remote start harness connectors.

**9.** Route the portion of the remote start harness containing the Yellow/Black wire, Lt. Blue wire and the 22-pin male and female connectors along the right side of the fuse box to the BCM (located on the back side of the fuse box).



Locate the Lt. Blue wire in pin #21 of the 26-pin BCM-ML male connector. If Removed: Using pliers, crimp a T-Tap on the Lt. Blue wire located in pin #21 of the BCM-ML male connector.

Connect the Lt. Blue (Parking Light Output) wire from the remote start harness to the Lt. Blue wire (Pin #21 of the BCM-ML connector) by engaging the T-Tap. Engage the 26-pin BCM-ML connector from the backside of the BCM.



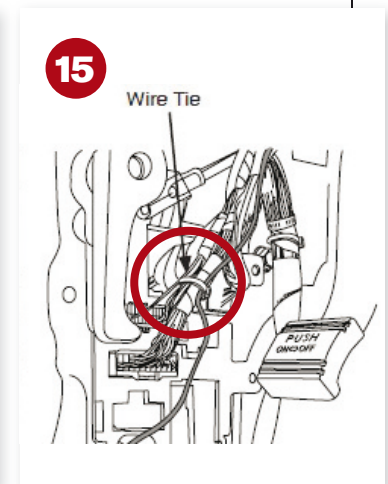
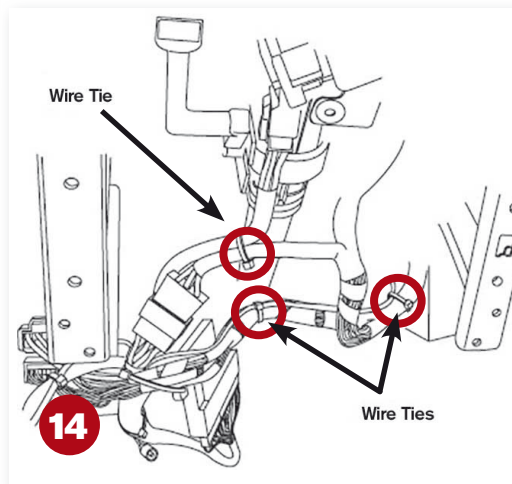
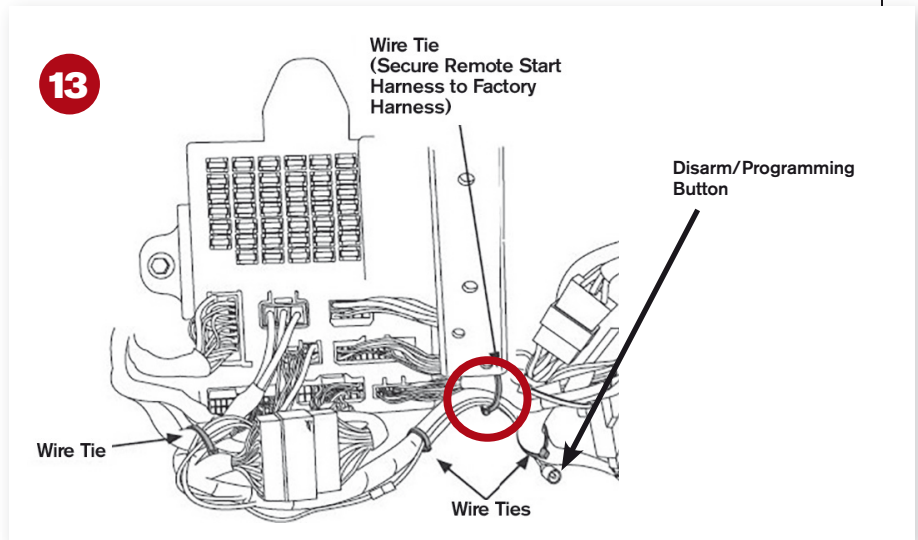


**10.** Locate Yellow/Black wire located in pin #2 (arrow) of the BCM-MM connector. Using pliers, crimp a T-Tap on Yellow/Black wire. Connect the Yellow/Black (Driver's Door Unlock Output) wire from remote start harness from the Yellow/Black wire (pin #2 of BCM-MM connector) by engaging T-Tap.

**11.** Connect the factory male 22-pin BCM-MN connector at the BCM and plug in the corresponding remote start harness connectors. Secure the Lt. Blue (Parking Light Output) wire, Yellow/Black (Driver Door Unlock Output) wire and the 22-pin male and female BCM-MN remote start harness connectors to the remote start wire harness with one small wire tie. Trim the wire tie.

**12.** Route the Black wire with ring terminal down along the factory wire harness to the factory ground location. Install 10 mm hex bolt. Position the Black wire with ring terminal over the bolt and reinstall with factory ground wires.

**13.** Connect the disarm/programming button to the corresponding remote start module connector (if disconnected). Secure the disarm/programming button to the remote start harness with three small wire ties. Trim off excess wire ties. Ensure disarm/programming button is secured to the remote start harness in a



manner that allows for future serviceability. Secure the remote start harness to the existing factory harness with one large wire tie. Trim the wire tie.

**14.** Secure the remote start harness with three large wire ties. Trim off excess from wire ties.

**15.** Secure the Black ground wire to the existing factory harness with one small wire tie. Trim the wire tie.

**16.** Verify all connections are secure as per the installation instructions. Turn the ignition key to the ON position. Reconnect the negative battery cable. If the horn begins sounding, press the disarm/programming button with the ignition ON to disarm the system. Battery cable terminal torque spec: 3.6 lb-ft +/- .7 lb-ft (5 Nm +/- 1 Nm)

Start the vehicle with the key and



verify that no Diagnostic Trouble Codes have been triggered. Any DTCs should be reset before proceeding to the next step. Turn the ignition key to the OFF/LOCK position. Reinstall all interior components (steps 1-7 of removal procedure) in the reverse order of removal. Check remote start function. **KIA**

# Power outage

Sliding door may need a new remote controller actuator



Power Sliding Door Remote Controller Assembly  
P/N 81447 4D500 Actuator Motor Shown Externally

**AFFECTED VEHICLE PRODUCTION RANGE**


Model	Production Range
Sedona (VQ) with Power Sliding Door Options	All MY 2006 -2010 Sedona (VQ)

**REQUIRED PARTS**

Part Name	Part Number	Figure
Remote Controller Motor	Part Number 81447 4D500	

» TSBs may be updated from time to time. Please refer to TSB BOD 048 at [www.kiatechinfo.com](http://www.kiatechinfo.com) for the latest procedures.

» All images are for illustration purposes only.

 You may come across a Sedona (VQ) that has a power sliding door (PSD) that won't open when using the overhead console switch, B pillar switch or remote control button. If you do, the PSD Remote Controller Actuator may need to be replaced (on the affected side only) with Part Number 81447 4D500. Note: Do not replace the Remote Controller Assembly for this issue.

**Disassembly procedure**

**1.** If it is determined that the power sliding door remote controller motor is defective, follow the instructions provided in Kia's Global Information System (KGIS) to remove the door trim and controller assembly before bench repairing the controller unit. Removed PSD remote controller is shown here along with the location of release motor drive assembly.

**2.** Remove the seven screws holding the cover and drive assembly in place.

*Notice: There are four short screws and three long screws. The longer screws attach the motor assembly to the controller.*

**3.** Carefully separate the cover from the drive assembly as shown. Be especially careful not to damage or misplace the seal.

*Notice: It is not necessary to remove the complete drive assembly from the remote controller.*

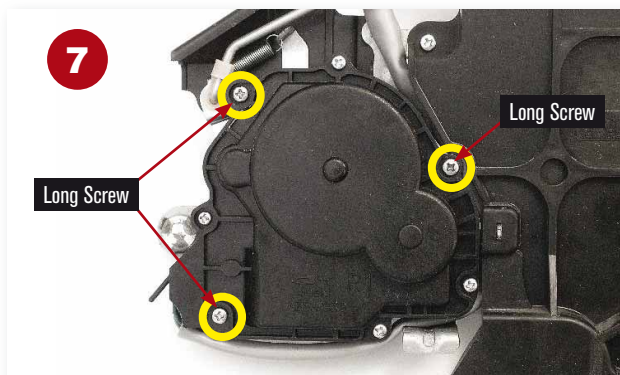
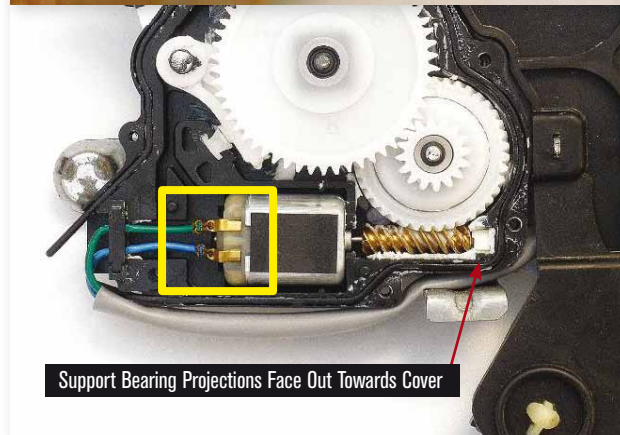
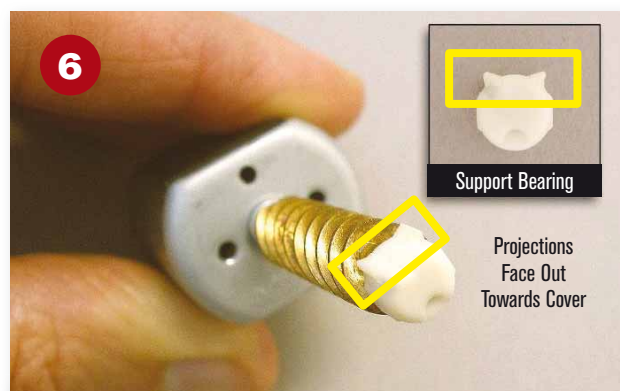
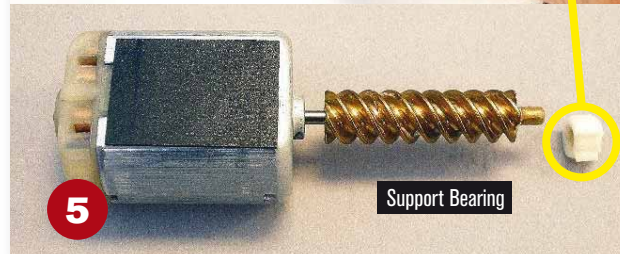
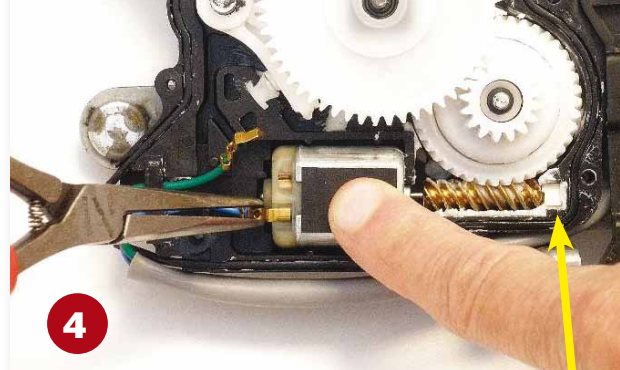
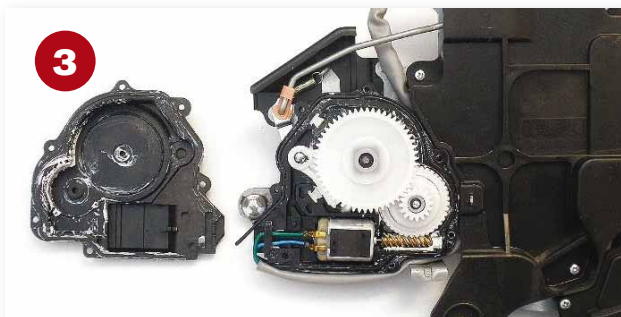
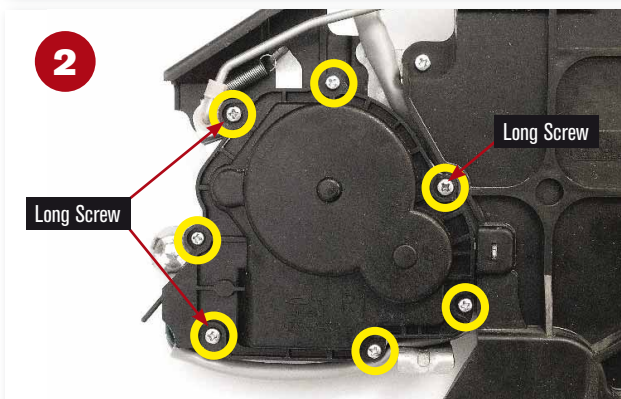
**4.** While holding the motor in place, use small needle-nose pliers to carefully disconnect the wiring from the motor. The blade style connectors easily pull straight up and out.

*Notice: Note the wire's color and position for reinstallation. If the wires are switched, the remote controller will not operate correctly.*

**5.** Remove the motor from the drive assembly.

*Notice: Be careful not to misplace the motor's white nylon end support bearing.*





## Installation procedure


**6.** Reinstall the motor making certain that the small nylon support bearing is properly installed as indicated above. Reinstall the wiring observing proper polarity, otherwise the drive assembly will not work properly.

*Notice: While reinstalling the motor, make sure that the white nylon support bearing projections are facing out towards the cover. Failure to do this may result in noise and/or gear damage.*

**7.** Reinstall the cover making sure the seal is properly in place, and that the proper length screws are installed in the proper positions. Do not pinch the wiring between cover and housing.

*Notice: The shorter screws should be fully installed first, then the longer screws, as the longer screws both seal and attach the motor assembly to the remote controller assembly.*

**8.** Reinstall the remote controller and all door trim in the reverse order of removal. Erase any codes that were generated by the previous faulty motor assembly. Test the power sliding door for proper operation using the center overhead console switch, the B pillar switch, and the remote control button. **KIA**



THE TIMING FOR SOME MAINTENANCE and repair items might be able to be stretched, but the replacement of a timing belt is not one of them.

Timing belts can last longer than their recommended service schedule; however, your customers run the risk of catastrophic engine failure if they wait too long to replace them. Most Kia vehicles have interference engines, which means if a timing belt fails the valves may hit the pistons.

Because the process of replacing a timing belt offers access to other parts, you can recommend their replacement, if appropriate. First up are the timing belt tensioners and pulleys. From there, water pump replacement is possible. And depending on a number of other factors, your recommendations can range from replacing the serpentine belt to the spark plugs.

And let's not forget about those Kias with timing chains. Generally speaking, they last longer than timing belts as long as their engines are serviced regularly. This means using the correct oil and maintaining the correct oil level for sufficient oil pressure for gears and tensioners. In the event that you have customers with high mileage Kias that may have worn and noisy timing chains, they may also need new tensioners, guides, and other associated parts.

Please refer to factory recommended maintenance schedules in the Kia owner manuals for proper service for timing chains and belts.

Whatever your customers' timing belt or timing chain needs are, Kia offers Genuine Kia Parts to keep their Kias running like Kias. Your service recommendation just may be perfect timing for them.

**Contact your local Kia dealer today for assistance and delivery of your parts.**

# TIMING IS EVERYTHING

when it comes to replacing a timing belt



| Genuine Parts