

# Motor Age

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PRINTED IN U.S.A.



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Motor Age (Print ISSN: 1520-9385, Digital ISSN: 1558-2892) is published monthly, by UBM 131 W. 1st Street, Duluth, MN 55802-2065. Periodicals postage paid at Duluth, MN 55806 and additional mailing offices. POSTMASTER: Send address changes to Motor Age, P.O. Box 6019, Duluth, MN 55806-6019. Please address subscription mail to Motor Age, 131 W. 1st Street, Duluth, MN 55802-2065. Canadian G.T.S. number: R-12421313R1001. Publications Mail Agreement Number 40612608. Return Undeliverable Canadian Addresses to: IMEX Global Solutions PO Box 25542 London, ON N6C 6B2 CANADA One-year rates for non-qualified subscriptions: U.S. \$70.00; Canada/Mexico \$106.00; International surface \$106.00. For information please call (866) 529-2922 (Domestic inquiries); (218) 740-6395 (Canadian/Foreign). Printed in the U.S.A.

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NEW PARTS BRAND

## FORD LAUNCHES ALL-MAKES PARTS BRAND OMNICRAFT

**BRIAN ALBRIGHT //**  
Contributing Editor

→ Ford is making a big play for the aftermarket parts market with the launch of its new Omnicraft brand for all makes of vehicles. This is the first new brand offered by the Ford Customer Service Division (FCSD) in 50 years.

The move will put Omnicraft in competition with GM's ACDelco brand, in addition to traditional aftermarket parts providers. Ford hopes to tap into the \$500 billion-plus auto parts market

that has been created as a result of consumers keeping their vehicles longer. The average age of the vehicles on the road is rapidly approaching 12 years. By 2021, the parts and service market could be worth as much as \$950 billion.

"We're well overdue for this," says Frederiek Toney, president of Ford's global customer service division. "We have been looking at what's transpiring in the industry for some time and recognize that there is tremendous growth. For us to be able to participate

>> **OMNICRAFT CONTINUES ON PAGE 6**

**BREAKING NEWS**

AFFORDABLE TRAINING

## UBM, INDUSTRY PARTNERS TO DELIVER SCHOLARSHIPS

→ To provide more affordable training, the UBM Community Engagement Program has joined with Automotive Management Institute (AMi), National Automotive Technicians Education Foundation (NATEF) and Technicians Service Training (TST) to provide scholarships for NACE Automechanika Chicago covering travel expenses, training costs and access to trade show product discovery.

NACE Automechanika, the largest U.S. trade show dedicated to high-end technical and management-related training for automotive service and collision repair shops, will take place July 26-29 at McCormick Place West in Chicago.

Scholarships will cover travel and hotel expenses for recipients as well as any costs associated with training courses during NACE Automechanika Chicago. **MZ**

**TRENDING**

**SEARS OPENS NEW AUTO CENTER**

Sears has opened its first "DieHard Auto Center Driven by Sears" in San Antonio, Texas, which aims to be a leader in automotive service innovation and provide new services.

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>> OMNICRAFT CONTINUED FROM PAGE 4

at the levels that we need to, we needed to offer a full portfolio of parts so that customers can have one-stop shopping at Ford. In order to do that we need to have an all-makes strategy, including non-Ford parts, service and repair capability support.”

Ford’s branded dealerships will be able to offer the parts to non-Ford service customers. Dealers (for all nameplates) have been expanding their service departments to cover all makes and models as part of an effort to boost fixed operations revenues. Ford dealerships in particular have added Quick Lane service facilities as part of that initiative.

The dealerships will serve as the primary channel for the parts initially. An important opportunity for Omnicraft in that space will be providing parts to dealerships that sell certified pre-owned vehicles and refurbish those cars. The more than 1,000 Ford Quick Lane locations will also use the Omnicraft parts, and Toney estimates that 35 percent to 40 percent of vehicles that come through the Quick Lane shops are non-Ford brands.

“We’re going to get that parts revenue and make it easier for our dealers to acquire the parts they need,” Toney says. He added that Ford would be very competitive against independent repair shops and aftermarket suppliers and that the parts would be priced competitively.

Beyond the dealership base, Ford wants to be able to service customers based on their preferences. “So we really want to be able to address the older model vehicle owner in a much broader way, and we’ll use Ford authorized distributors to help us,” Toney says, adding that the parts will “definitely” be available via independent distributors and repair shops in the future.

“We see our biggest opportunity with independent repair shops who did not

## OMNICRAFT MEETS THE SWEET SPOT FROM A QUALITY AND PRICE STANDPOINT TO ALLOW OUR INDEPENDENT REPAIR SHOPS TO MAKE A REASONABLE PROFIT WHILE APPLYING A QUALITY PART. – FREDERIEK TONEY

have the option to call on Ford with a one-stop shop proposition,” Toney says. “This makes us much more appealing to them and will help create demand for Omnicraft as well as Motorcraft.”

Ford hopes to expand its service business and also improve customer retention and increase the touchpoints the company has with car owners. The company hopes to grow its parts business by 30 percent to 40 percent over the next five years. The new parts line will allow Ford dealers to service between 85 percent and 90 percent of competitive makes.

“We’re responsible for providing 100 percent of the parts support for the Ford brand, and it’s easy for us to augment our existing infrastructure and take advantage of the access we have through our thousands of dealerships around the world,” Toney says. “That gives us a unique logistics advantage that rivals anyone else you can think of.”

Ford’s traditional suppliers will manufacture the parts. The parts and labor on Omnicraft jobs will have the same 24-month parts and labor warranty that is available with Ford’s Motorcraft parts. The new line will not include collision parts. (Ford has been a particularly vocal proponent of OEM parts for structural and collision repairs, and pursued patent infringement claims against a number of aftermarket suppliers.)

As of late January, the company had already sold roughly \$2 million worth of the parts to dealerships.

Ford will focus Omnicraft on the most commonly requested parts, beginning with oil filters, brake pads and

rotors, loaded struts, starters, and alternators, among others. At launch there were 1,500 part numbers available, with plans to cover 30 parts categories with 10,000 parts.



**Frederiek Toney**

The parts will be available at Ford and Lincoln dealerships, and will roll out to other Ford authorized distributors throughout 2017. The goal is for Omnicraft to contribute a double-digit percentage of the company’s parts sales over the next decade.

“We want to go from essentially zero percent of our revenue associated with non-Ford parts to having that grow to 10 percent to 15 percent of sales,” Toney says. “We know that will be challenging, but the appeal we want to make is for customers to take another look at Ford and our offerings. We are extremely competitive, and [Omnicraft] meets the sweet spot from a quality and price standpoint to allow our dealers or independent repair shops to make a reasonable profit while applying a quality part. We won’t have the cheapest part, but it will be among the best for overall value.”

Expanding further into the aftermarket is part of that growth strategy. “We want to meet customers on their own terms,” Toney says. “Customer retention is a key part of our strategy going forward. Today we do a really good job on one- to three-year-old vehicles. We want to expand that coverage.” **ZZ**

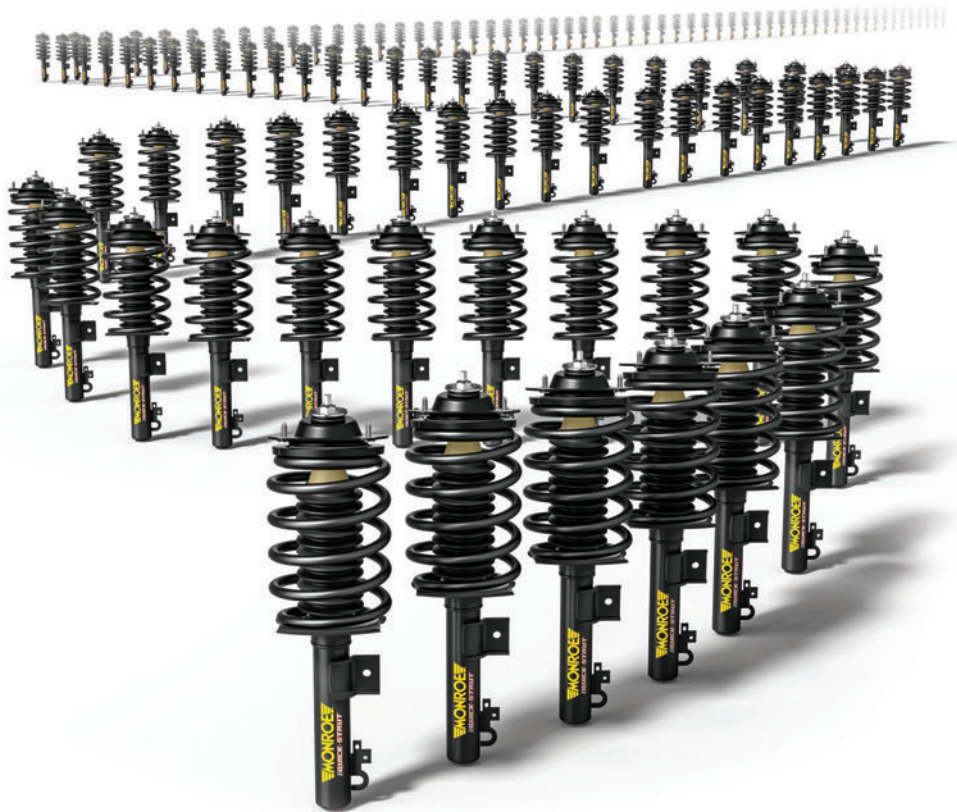




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# Expecting the worst stifles success

Don't let your fear of failure prevent you from implementing new strategies

**O**ver my past 40-plus years helping shop owners grow their business, I've found that one thing will never change — your beliefs based on the experiences you have witnessed or heard of in business. The problem with belief systems is that you might have developed a belief that a certain strategy doesn't work because you tried to implement it at the wrong time or simply incorrectly. Or, you might have never tried it at all because you heard from someone you respect that it didn't work.

The fear of something bad happening to you might keep you from implementing the one thing you really need to improve your, and your family's, life. I heard Coach Geoff Berman explaining to a shop owner how to overcome this obstacle, and his advice may help you try new strategies.

Geoff began by saying: Can you remember a time when you were a child and something bad happened? You were scared to death that your parents would find out about it, because you knew the consequences would be bad. You imagined the absolute worst. Images of punishments or loss of toys were going through your head. You were scared, and watching this horror movie playing over and over in your mind exacerbated your fear. You prayed this would never come to light, but somehow it did. Oh no, they found out.

So what happened? Was it as bad as you imagined? I'm betting it wasn't. What does that tell you about this horror movie we play in our minds? It's fiction. That's right — fiction! Recognizing it is fiction is

the key to ignoring it. You will never get where you want to go if you don't recognize this. Stop listening to untruths.

Here is a quote to help you remember to ignore the fiction: "The devil in your mind is always worse than the devil you actually face!"

## **I can't do that. It won't work here!**

While on the phone with a client one day I was asked this question, "Geoff, the shop seems to consistently have busy days followed by slow days. What can I do to fix that?" This is a great question and one a lot of shops struggle with. I replied, "One of the best ways to improve that situation is to schedule the customer's next appointment as they are leaving today's visit."

## **THE DEVIL IN YOUR MIND IS ALWAYS WORSE THAN THE DEVIL YOU ACTUALLY FACE.**

"That won't work here. My customers won't like that!" he tells me. What is his devil telling him? "I'll upset customers if I do that, and they won't come back." Fiction, right? It is very easy to react to our horror movie and say, "I can't!" But what if you took the "How can I do it?" approach instead.

The conversation might go something like this. "Geoff, I've tried that before. It didn't work out so well. If you think this will help regulate our day, maybe you can help me see what I did wrong. I really need to do a better job controlling the violent ups and downs of

our days." Which shop owner is going to see more success?

The fact is that many shop owners *do* schedule the next appointment as the customer is leaving and are very successful. What if your customers come to enjoy the convenience and peace of mind knowing they don't have to worry about getting their next service done on time, because they know you're on top of it for them? This happens all the time in the shops that get it right. Why not yours?

## **How else are you holding yourself back?**

Have you ever had an employee you held onto longer than you should have (maybe years longer) because your devil told you that if you lost him all kinds of bad things would happen? Then all of a sudden he was gone and life actually got better. You asked yourself why you didn't let him go sooner.

How about your pricing policy? Your devil tells you, "You can't charge that! If you do you will lose business!" Yet the guy down the street is and he has been in business longer than you have.

What about selling maintenance? There was a time when your devil told you, "You can't do that because people only want what they came in for. You'll lose business." But if you have made the transition, you have come to realize that not only can you sell those services, but people actually want them.

These are things that rob your shop of its productivity. They hurt you and more importantly, they hurt your staff.

Take the time to recognize how dangerous your devil is when he rears his

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## 10 THINGS A POSITIVE GAME CHANGER NEVER SAYS



By **MIKE JONES**

No matter who you are, you are a game changer. A positive game changer is a person who alters the future in a positive way.

Here are 10 things a positive game changer NEVER says:

1. "I don't have a choice." No matter who you are or what your circumstance, you have a choice. Don't allow your belief system and circumstance limit your perception of choice.
2. "There's nothing I can do about it." Initiate action by recognizing the wide array of strengths at your disposal. Research suggests that the average person only realizes 10 percent of the potential available to them professionally or personally.
3. "I am the victim." Take ownership. There are victims and volunteers. Accept personal responsibility for whatever is going on. Don't ask, "Why me?" Instead ask, "What will I do to get to the outcome?"
4. "It's not my fault." Whether your actions caused the problem or not, focus on finding a positive solution, rather than looking for someone to blame. If the initial approach didn't work, change the approach to change the results.
5. "We need better communication." Commit to understanding others, rather than criticizing others for not

communicating or doing things the way you would. Seek to understand the concerns of others to help connect and give them what they need.

6. "It's not my job." Fully commit to the team's success. This team-focused mindset destroys the silo mentality that often has departments working toward conflicting purposes.
7. "If I only had more time." In today's fast-paced, 24/7 business environment, there are constant demands that stretch us thin; however, use your time wisely. How we use it determines our level of success.
8. "Someone should hold him accountable." Accountability cannot be demanded or imposed. If it is, that is blame. True and sustainable accountability is personal; it begins with gaining agreement from others.
9. "They need to change." You can't change others; however, you can engage others by honoring who they are and what they care about. This can be done authentically with a foundational understanding of yourself. In other words, say, "Change begins with me and the actions I take to create positive outcomes."
10. "Can you fix this?" Focus your energy on creative solutions and results, not the problem.

ugly head. When you are able to do that, you will stop saying, "I can't" and start asking, "How can I?"

### What can you control?


Now let's take this a step further. It is very difficult to control what you see and hear while the hustle and bustle of your day is happening. It is also difficult to control how these things make you feel as they enter your brain. What is 100 percent in your

control is how you respond or react to what is coming in. Choose to change the thought of "I can't." This simple thing will be hard at first, but if you practice, not only will you respond to things in a more positive way, but the people around you will, too. The only person you can change is you.

### Overcome productivity robbers

Embrace the idea that there are no bad

ideas. Become curious about solving problems and ask, "How can I?" Learn to ignore the devil in your mind and not be afraid of what might happen. Realize that it is never as bad as you expect. The first step is to identify "productivity robbers" and then start facing them, one at a time. It's easier to start the journey with a single step.

If you would like a "Self Check" of the Productivity Robbers that may be getting in your way, you can get it for a limited time at [www.ationlinetraining.com/2017-03](http://www.ationlinetraining.com/2017-03). 

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Chris "Chubby" Frederick, CEO



**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 Geoff Berman. [chubby@autotraining.net](mailto:chubby@autotraining.net)

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# Build a strong relationship with your parts distributor

How do you measure up as a customer for your parts distributor?

**T**he aftermarket industry has changed dramatically in the past five years. Therefore, the independent service shop and parts distributor need to clearly understand their role in the industry, and more importantly, understand that they must develop a different kind of relationship than that of the past.

The amount of mistrust in the industry between the independent service shop and the parts distributor has grown over the past 10 years. Many retail shops seem convinced that every parts distributor out there is determined to take advantage of them. They don't — and can't — trust their parts distributor company. Nothing today could be further from the truth. Many good parts suppliers do exist across the country.

It is time to address and change the business relationship between the independent service shop and the independent parts distributor.

In business today, successful shops build confidence and trust between themselves and their customer to get and keep the client's business. To do this, shops communicate, educate and understand to whom they are selling and then build a plan tailored to that customer.

The better parts distributors today also understand that they must learn everything possible about the shop owners' segment of the industry, earn their trust and build a relationship of open communication, education and provide comprehensive support for their customer.

Times have changed dramatically. Both parties are clearly now in the rela-

tionship business and need each other more today than ever before.

These are realities, yet the independent service shop and the independent parts distributor have failed miserably at the art of communication and education about each other — then again, each party never asked.

## THE AMOUNT OF MISTRUST IN THIS INDUSTRY BETWEEN THE INDEPENDENT SERVICE SHOP AND THEIR PARTS DISTRIBUTOR HAS GROWN OVER THE PAST TEN YEARS.

The parts distributor never clearly communicated that they are in the commodity business. Commodity businesses need volume, and they need cash. Distributors never communicated that they can easily carry an inventory that can range in value from \$500,000 to \$3 million; they never communicated that they must strive to turn over their inventory four times a year, and, due to the growth in number of skews, in the future may be striving to turn it 2.5 times a year. Poor inventory management in the parts distribution business increases costs dramatically. Too many distributors are operating on an overall business margin of only 26 percent to 33 percent. The better distributors need an average of 40 percent in order to bring real value to their service shop clients. Too many distributors make 50 to 60 deliveries per month to each service shop customer delivering \$6,000 or less per month in purchases.

You can do the math; it doesn't add up. Too many distributors carry accounts receivable in the \$100,000 to \$500,000 plus range, yet they must pay their wholesale distributor in full each month.

These are but a few of the very basics of the parts distribution business, yet the service shop owner never asked, and the parts distributor always seemed to keep everything a big secret, too. The bottom line is that both parties need more net profit to their business, yet everyone goes around thinking if you made a profit from me, you "screwed me over." This must change if we are to grow and prosper.

Let's take a look and see how your service shop business measures up to your parts distributor's needs:

**P** is Positive, and **N** is Negative.

**P** — Do you have a solid relationship with one main parts supplier by sending them 85 percent to 90 percent of all purchases? Volume counts in the parts distribution business.

**N** — Do you deal with a distributor only because of the best price and discounts they offer?

**N** — Do you try to build your shop's net profit mainly on the margin of your parts and other hard goods you sell (oil, tires, batteries, etc.) because you are among the lowest labor rates in your area?

**N** — Do you usually spend time on the phone or online and shop three or five different distributors to save a few bucks?

**P** — Do you pay your statement in full each month? Cash is king in the commodity business!

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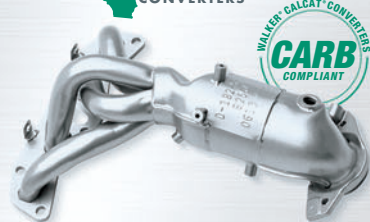


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## MAXIMIZE DISTRIBUTOR RELATIONSHIPS

**GREG ZEIGLER & JOE RODRIGUEZ**, LORD Corp.

➔ Maximize the benefits of the distributor relationship by selecting a distributor that carries the best, OEM-recommended products from manufacturers and suppliers. Service is another important aspect — look for a distributor interested in forming a partnership: providing service, training and business advice.

“One-stop” shopping is another ideal objective to consider. The distributor you choose should be able to provide all of the products you will need for effective, cost-efficient vehicle repair.

Of course, competitive pricing is always a consideration when buying products from a distributor. Be cautious of a distributor who sells products at the “most inexpensive” price. Are they selling at minimal prices while offering less or no service? There are some distributors that have scaled back on service levels because they are “locked-

in” by low-margin contracts with product suppliers. For the repair shop, just getting the cheapest product price might not bring the best level of service with the deal.

A forward-thinking distributor should be keeping up with the latest advances in automotive repair products and sharing that knowledge. Larger distributors can often offer continued training, hands-on in-shop demonstrations, certification classes, streamlined purchasing options, and a number of other cost-saving features.

Consolidation in the distributor industry makes it more difficult for the smaller distributors to offer competitive prices. However, consolidation has also lessened the distributorship choices available to shops. Therefore, it is important to choose a distributorship that offers good product availability, along with other services, such as product and cost tracking and training. Developing a true working partnership between a distributor and a repair shop offers success advantages to both.

**N** — Do you pay only a portion of your monthly statement because you haven’t managed the business properly in order to pay all of your accounts in full when due?

**N** — Do you blame your supplier for your mismanagement of the business?

**N** — Do you insist on consigned inventory? If you don’t take ownership, your supplier is financing your inventory at a cost to their business.

**P** — Do you communicate with your parts distributor your inventory requirement needs? When your supplier can buy right and you stock right, you and they can make more money.

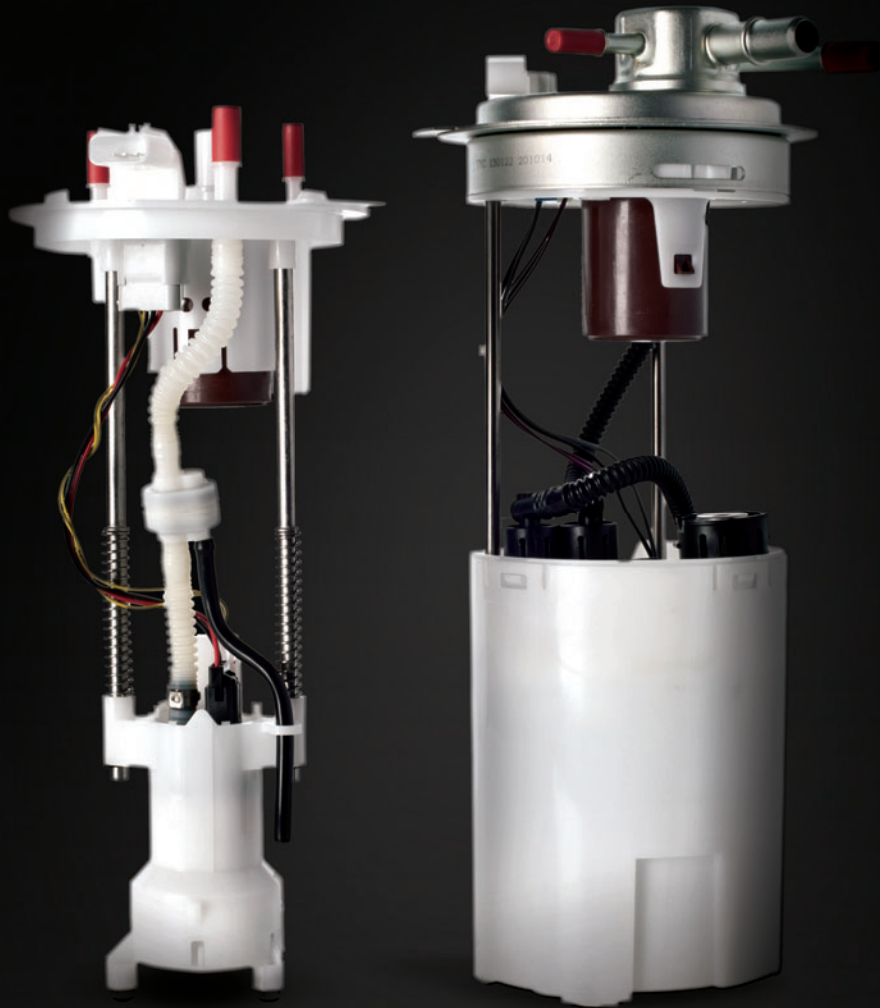
**P** — Do you support all your supplier’s initiatives or do you just pick and choose only what is of immediate ben-

efit to you? Supporting your supplier in various initiatives they may have is critical to their attitude towards you. Attitudes can dictate a level of support, can’t they? If an initiative doesn’t fit you, clearly communicate why it doesn’t fit your business; don’t just say, “no time,” “too busy” or “not interested”. Clear communication brings in the right initiatives for your business. It takes a lot of time to set up various initiatives, and time is money or cost in the parts distribution business.

**N** — Do you blame your supplier for a failed part because your business installed it incorrectly; thus you claim it is a warranty issue? Take responsibility for your company’s actions.

**P** — Do you keep all of your commit-





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ments you make to your supplier? Your word as your bond is a great credibility builder.

**N** — When ordering parts for a specific job, do you ask the parts distributor to send out every possible variable on that job because you are not sure, and then send back what you don't need? Adjusting all the paperwork for your experiments is a huge cost to any distributor.

**P** — Do you insist on quality parts from your parts distributor? Quality parts reduce comebacks. Comebacks are a cost to the service shop and to the parts distributor.

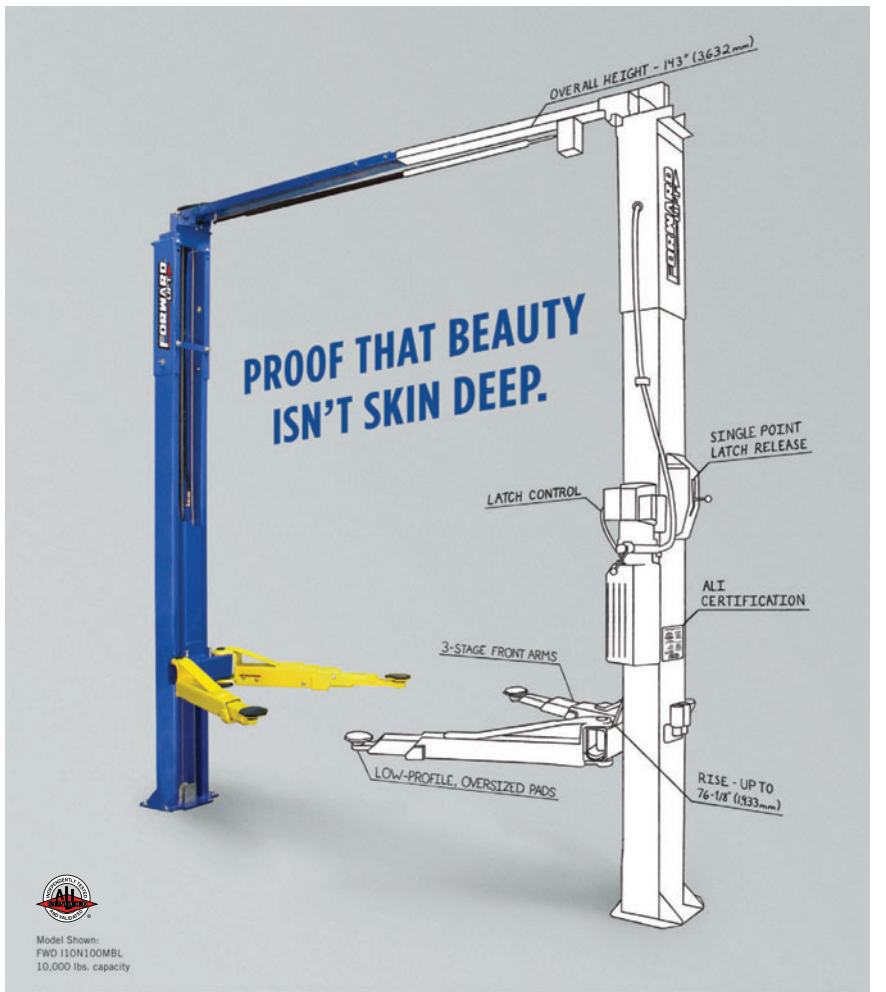
**P** — Do you have a mutual positive, professional, trustworthy relationship with your parts distributor?

Too many shop owners do not want to develop the relationships that are

required to be successful in business today. There is a saying — “If you always do what you’ve always done, you’ll always get what you’ve always got.” When a shop owner is not prepared to change their thinking about companies that are truly trying to make a positive effort and contribution to the industry and support that thinking with their actions, perhaps it really is time to get out of business. If we don’t change and do things differently than we all have done in the past 10 years, what truly is the alternative? Change in today’s business is not an option.

Good independent parts distributors are realizing that they can’t sell to every service shop out there. They want to choose who they do business with, build a credible business relationship and receive all that client’s monthly business, get paid in full each month, allowing them to move their own and their clients’ business forward. This is a fabulous way to do business for both entities, and it sure does a lot to reduce the stress in our industry. Many people in the industry think this is “pie in the sky.” That’s part of our problem. Too bad, because the parts distributors and service shop owners that have discovered it and how both parties can work together have an entirely different outlook on their business and life, and their financial statements support it.

Become a “positive service shop business” to your chosen parts distributor. Open up the communication floodgates, build a credible, knowledgeable, business relationship and watch your business change for the better. **ZZ**



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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.

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# Prescription for perfection

ASE Blue Seal certified shop offers quality service

**ROBERT BRAVENDER** // Contributing Editor

➔ The good ‘doctor’ — otherwise known as Frank Chamberlain, founder of Auto Physicians in Maryville, Tenn. — was recently up in Michigan touring a Ford plant. “We use quality parts,” he proudly reported from Dearborn, “and we order a lot of Motorcraft.” So much so that he won a contest set up by his parts wholesaler.

Of course quality is implicit with Chamberlain, whether it’s Ford or any other brand; as he asserts, they’ve been the only ASE Blue Seal certified shop in Blount County for the last five years. “ASE means a lot,” he stated. “Because of where the industry is going right now as far as the complexity, our techs have to be certified so people feel confident to bring their cars to us. We just put a Ford Fusion back together, a little 4-cylinder hybrid that’s a whole different (technology), so we go to a lot of the schools to make sure we stay trained.”

Chamberlain went to work for a dealership after a stint in the Army, however with the economic downturn in 2008, the dealer shut the doors, compelling Chamberlain to open his own. Along with some partners, equipment bought off the now-defunct dealer and some rented space, he only needed a name. “We didn’t want to be ‘Frank’s Auto Repair,’” he related. “I wanted something that would stand out, that I could build a logo with and people would remember.”

Starting from scratch, at first friends and family came in to help keep the business going, but eventually Auto Physicians achieved critical mass. “Our base is solid enough that we stay busy even though they may come in only two times a year for major work — oil changes, things like that,” said Chamberlain. “We found out if you can give good service, quality parts and a good warranty, you get the trust of your customers; that customer base will grow — and we’ve been growing like weeds.”

When they branched into other brands, “we did some TV and community service stuff, just to get the word out,” recalled Chamberlain. “Naturally if they brought their Ford in, they would ask if we could work on their Honda too. It wasn’t a tough transition because each company has their own ways of doing it as far as sensors, injection, etc., but they’re basically all internal combustion engines.”

But diagnostics was another matter, so Chamberlain bought the equipment in phases. “We started with the IDS from Ford, of course,” he related, “then we got the VERUS from Snap-On,



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Maryville, Tenn. // [www.autophysicianstn.com](http://www.autophysicianstn.com)



**Frank & Cheryl Chamberlain**  
Owners

<b>7</b>	No. of bays
<b>5,000</b>	Total square footage of shops
<b>\$350</b>	Average repair order
<b>1</b>	No. of shops
<b>9</b>	Years in business
<b>9</b>	No. of employees
<b>5</b>	No. of techs
<b>60</b>	No. of customer vehicles per week
<b>\$1 million</b>	Annual gross revenue

which covered a lot of different brands. That was okay, but we wanted something that did more, so we went and got some Bosch tools with the VCI. Since a lot of diagnostic tools from GM are by Bosch now, with VCI we can pay subscriptions to GM, Ford, Toyota, whatever, and just have the one machine.”

Auto Physicians has ventured into other markets as well. “We do tires as a convenience to our customers,” Chamberlain noted. “They’ll bring their car in for a tune up and ask, ‘do you



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do tires?' I put it on our website, but we concentrate more on the repair service. That's why we became a NAPA Auto Care Center." To help fill those extra demands they've acquired a Hunter alignment machine, a wheel balancer and a brake lathe.

Eventually Chamberlain bought out his partners and purchased his own facility. "My perception of a repair shop is a very clean environment," something he could better control if he owned the property. "There are seven bays, a real nice waiting room with a children's area and comfortable recliners. There's a lot to being a repair facility nowadays; people don't want to bring a quality car to a dump. So we keep it clean, we've got flowers outside; we provide things to the customer to help them feel at home."

This also extends to being upfront with the client. "Now they know a repair is going to cost them money, so the less emotionally difficult you make it, the better," reasoned Chamberlain. "We believe in informing our customers about everything that goes on with their car, taking them out in the shop, showing them what's going on, or we can email them videos of what we're doing to their car, just to keep the customer informed so their experience is the least painful."

The internet plays a big part in their marketing strategy. "They've got those websites where you can design your own, but I never thought they looked very good," Chamberlain commented. "So we got a company to make ours and help us run it, keep it fresh. We've also got our Facebook page where we can put up event notices, like the charity car show we had."

Chamberlain reported that this particular show raised \$5,000 last year for Habitat for Humanity. "You put that on Facebook showing what you're doing and share it," he explained, "because we want the community to thrive and to do that you have to help out. The people see that you're in the community and that motivates them to like us; they respond to that."



And then there's the commercials. Having produced two that they put in rotation on local cable, at least one is always on their website. "We wanted something different on those [commercials], rather than have someone walking through the shop saying, 'here at Auto Physicians we do this, this and this,'" explained Chamberlain. "We wanted something with a little bit of comedy in it."

In both of the ads, a hapless individual tries to fix a car himself, with increasingly disastrous and hilarious results. "I told (the production company) the idea that I wanted, and they came up with how it should be [staged]," remarked Chamberlain. "We usually advertise on cable in the fall, because that's when I can get better rates."

Check 'em out — they're just what the doctor ordered. **ZZ**



**ROBERT BRAVENDER**

graduated from the University of Memphis with a bachelor's degree in film and video production. He has edited magazines and produced shows for

numerous channels, including "Motorhead Garage" with longtime guys Sam Memmolo and Dave Bowman.

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# Turn price-shopping callers into appointment-making customers

ONCE YOU GET YOUR SHOP PHONE RINGING, ENSURE CUSTOMERS GET THROUGH THE DOOR

**BILL HAAS** // Contributing Editor

**M**aking the phone ring at your shop takes tremendous effort. It's called marketing, advertising and brand awareness. Your business depends on people to respond to these efforts and reach out to you for help with their vehicle maintenance and repair needs.

People calling your store in response to your marketing is the primary reason for your phone to ring. For all the effort put into making the phone ring, a similar level of effort is required when answering the phone to achieve the desired outcome — to make an appointment.

The owner is responsible for making the phone ring; the customer service staff is responsible for turning that phone call into a car in the service bay.

Often, when a service adviser fails to make the appointment, they'll suggest the caller was a "price shopper." That label infers they're looking for the least-expensive price.

The real reason they called is the result of a referral, your website, a social

media post or your customer reviews. Any of which gave the caller an expectation that your store could help solve a problem. The caller asking, "How much is [a certain product or service]?" is often simply because they don't know what else to ask. So how do you respond?

I suggest you take the price inquiry as an invitation to have a discussion. Ask why they need that product or service. The caller will usually describe the situation they need help with, and you can shift the focus of the conversation away from price.

Instead, discuss how you can help resolve their problem and assure them you are capable of seeing the car quickly, resolving the problem and having them back on the road in a minimal amount of time. Time is today's currency.

The conversation with a true "price shopper" is different. The caller responds with the fact that they have their car with a certain shop and they've been told about a product or service and how much it will cost. They'll want to know how much you'll charge for it. The chances of the vehicle coming to your store depend strictly on price.

Unless you're desperate for work, this isn't the customer you're looking for.

When you have a sincere desire to help, callers know it. Allow them to tell their story and you'll learn what's really important. Focus on whatever that is. You aren't able, or expected, to repair the car in the course of your conversation. Find a way to alleviate the pain caused by time without their transportation, and you win. Leave the repair or maintenance to the techs in the shop.

Remember, there was something that influenced the caller to contact you in the first place. Chances are, it was not price. Your job is to confirm they find competent and qualified help to resolve their problem. *MZ*



**BILL HAAS** is a former vice president of the Automotive Service Association and now a coach and consultant specializing in business performance improvement. His

monthly blog, "Coach's Corner" — where this article first ran — appears on ASA's site at [asashop.org](http://asashop.org).

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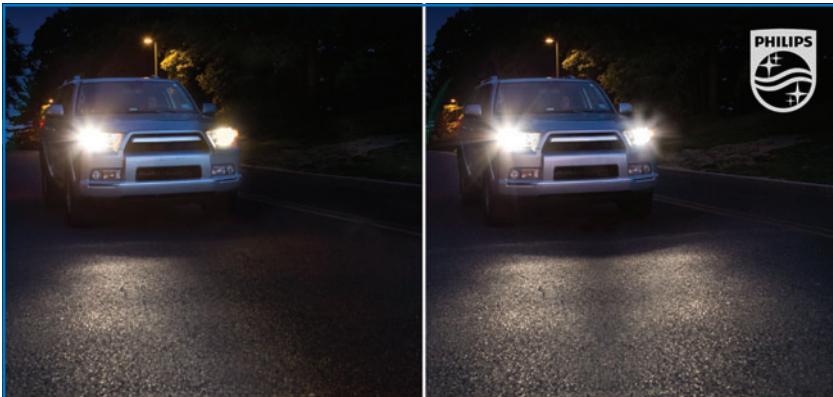
Tips for building your business

[Motorage.com/Build](http://Motorage.com/Build)



Forum: Must-attend training events of 2017

[MOTORAGE.COM/Train17](http://MOTORAGE.COM/Train17)



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## TRAINING EVENTS

**MARCH 25**  
**TST 14<sup>th</sup> Annual Technician Training Big Event**  
*Westchester Marriott Hotel*  
Tarrytown, New York

**APRIL 1**  
**Repair Shop Master; Automotive Management Institute**  
Kansas City, Missouri

**APRIL 18-24**  
**Up your voltage!**  
*Auto Career Development Center*  
Wayside Automotive;  
Seekonk, Maine

**APRIL 24**  
**National Automotive Service Task Force spring meeting**  
*Bourbon Orleans Hotel,*  
New Orleans, Louisiana

**APRIL 25-28**  
**ToolTech 2017**  
*Bourbon Orleans Hotel*  
New Orleans, Louisiana

**JUNE 9-11**  
**ASA Arizona Auto Training & Expo; WeKoPa Resort & Conference Center**  
Scottsdale, Arizona

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# DEALING WITH **COLLISION AVOIDANCE SYSTEMS**

**AS THE SYSTEMS CONTINUE TO INCREASE IN COMPLEXITY, HAVE YOU CONSIDERED THE POTENTIAL IMPACT FOR YOUR SHOP?**

**JEFF MINTER //** Contributing Editor

**W**hile collision avoidance systems are becoming somewhat of a buzz word lately, they really aren't all that new. In fact, General Motors acquired Hughes Aircraft Corporation back in 1985 in part to accelerate their development of collision avoidance systems. General Motors continued progress with the systems and eventually participated in a joint project with the National Highway Traffic Safety Administration (NHTSA), which ran from 1999-2004 to further refine and finally launch their first system, which was installed on a limited number of the model year 2002 Buick LeSabre for real-world testing.

Some of the technology used in collision avoidance systems is in essence a limited version of autonomous vehicle technology. The most common type of these systems currently being imple-

mented is automated cruise control. These systems are not new either, really; in fact, these were introduced years before the GM/NHTSA collision avoidance project. Early versions of laser-based automated cruise systems were introduced to the Japanese market in the early to mid-1990s by both Mitsubishi and Toyota. That was then followed by the first worldwide launch of a radar-based system on the Mercedes Benz S class around 1999, which included the U.S. market.

The number and complexity of these types of systems obviously prevents this article from covering them all. Instead, I'll focus on a few main types of systems that may impact how your shop handles even "basic" services such as brakes, tires and alignments.

## **Automated Cruise Control**

As I just mentioned, Automated Cruise Control systems are not exactly new.

That being said, however, they are beginning to become much more common, so the chances of you needing to deal with them are increasing almost daily. The basic concept with these systems is to help reduce the amount of driver input required once cruise control is enabled. The actual amount of assistance the vehicle provides, however, can vary widely. In the most basic systems that were first introduced, the driver was simply provided with a warning that they were approaching a vehicle that was moving slower. That progressed fairly rapidly to include a limited control system that would adjust the throttle in an attempt to adjust pace to the other vehicle, but didn't include active braking. Today, we can see any realm of these systems all the way up to the soon-to-be-released GM "Super Cruise" (Super Cruise is the working name GM is using for their automated driving systems). The Super Cruise system is capa-

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ble of not only pacing the vehicle to other cars (all the way to a complete stop if necessary), it can also keep the vehicle in its own lane through steering assist. That system was expected to be released in late 2016; however, it has now been pushed to sometime during 2017 with the first introduction expected to be on the Cadillac CT6. While it has been delayed, GM promises the technology is very close to production.

So, how might automated cruise control affect what you do every day? Probably the most likely impact will be if you perform alignments. I was working as a Mercedes-Benz dealership technician when their first Distronic radar-paced cruise control entered the U.S. market in 1999. The dealership was required to replace their alignment equipment at that point to ensure the system being used was accurate enough to maintain the required tolerances (and the system we



## Toyota Safety Sense

	TSS (P)	TSS (C)
	<b>Pre-Collision System (PCS):</b> Provides collision avoidance or damage mitigation support in speed ranges where rear end collisions are likely to occur	
	<b>Lane Departure Alert (LDA):</b> Provides notification regarding the risk of unintended lane departure	
	<b>Auto High Beams (AHB):</b> Vehicle detects lights of leading or opposing vehicles and automatically changes between high and low beam headlight settings	
	<b>Pedestrian Pre-Collision System:</b> Advanced sensor system helps to recognize pedestrians and provide collision avoidance support and/or damage mitigation	
	<b>Dynamic Radar Cruise Control (DRCC):</b> Follows the car in front maintaining distance between vehicles up to a set speed	

**TOYOTA SAFETY SENSE**  
Collision avoidance technology

PHOTO: TOYOTA

took out wasn't exactly old). You might be asking yourself how alignment could impact a cruise control system. With vir-

tually all of these systems, there are radar and/or laser sensors involved. Those sensors are typically mounted toward the front center of the vehicle (radiator core support area) and face forward. The goal of the sensors is to watch for other vehicles in front of, and in the same lane as, the vehicle being driven. The key part to that as it relates to alignments is that it watches for vehicles in the same lane. With the sensor(s) being mounted to the body, if the vehicle is "dog tracking" due to poor alignment, the sensor(s) may not be looking directly forward. Dog tracking is caused by the vehicle's thrust angle being incorrect. The incorrect thrust angle results in the rear wheels pushing the vehicle off to one side or the other. To keep the vehicle going straight down the road, the driver then corrects it by turning the front wheels until they are virtually parallel to the rear wheels, which would cause the steering wheel to be off center. If a two-wheel (front wheel) alignment is performed without correcting the thrust angle, everything could look correct to the driver (steering wheel straight, no pulling, etc.), but the automated cruise sensors could be pointing too far off to one side. That means either the thrust



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angle would need to be corrected or the alignment of the sensor would need to be adjusted to correct for the thrust angle in order for the system to work as designed.

### Electronic Stability Control

Electronic Stability Control (ESC, also referred to as EPS or DSC) has been required on vehicles in the U.S. market since model year 2012. Even with five years of full implementation (and numerous more years of limited implementation before that), the amount of technician knowledge on these systems still seems lacking at times. As a refresher, these systems were primarily implemented to help reduce rollover accidents. They do this by controlling the braking of individual wheels if a vehicle is beginning to skid. Of course, that means the vehicle needs to make very fast decisions about which brake(s) to apply, and how hard to apply them. To support those decisions,

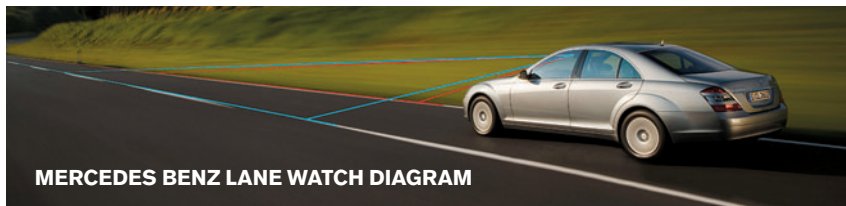


PHOTO: MERCEDES-BENZ

the vehicles have been equipped with additional sensors such as YAW rate sensors and steering wheel angle sensors. The YAW rate sensor monitors the vehicle's "sideways" acceleration (G force). It's important to ensure these sensors are mounted in the correct orientation when installed in the vehicle and that they are torqued properly to avoid any potential erroneous/inaccurate data. The steering wheel angle sensor is used to provide input about how fast the steering wheel is being turned, in which direction, and the relation to center. The relationship to center is the part that is likely to affect your servicing of the vehicle the most

frequently. Much like the cruise control systems mentioned before need to have thrust angles correct to function properly, the steering wheel angle sensor needs to be calibrated after an alignment. This ensures that what the vehicle recognizes as "center" for the steering wheel correlates to when the vehicle is actually driving straight forward. Without that calibration being performed, the ESC could potentially apply the wrong brake(s) during a skid. The calibration typically requires a scan tool and can include a fairly lengthy process. Some of the newer alignment systems, such as the Hunter HawkEye Elite, however are starting to build some of this steering angle recalibration (and even some of the cruise control sensor alignment functions) into their software. That likely will prove to be a very large time saver if you do a large number of alignments on late-model vehicles.

### Collision avoidance systems

Collision avoidance systems is currently a pretty broad range of technologies, and that range is still expanding. Some of the more common ones that are being implemented involve various ways to keep a vehicle in its own lane (either passively or actively) and provide automated or assisted emergency braking. The driving force behind these systems is the fact that most motor vehicle crashes are tied to human choice or error. In fact, the NHTSA estimated in 2015 that human error or choice accounted for around 94 percent of all vehicle crashes.

Lane departure systems can be a warning-only system that lets the driver know they are about to leave the lane or a more active system that will actually help keep the vehicle within the lane.



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Both types of these systems rely on at least one camera to monitor the lane position. It's important to have awareness of these systems and the locations of the camera(s) on vehicles you are working on. Because the systems rely on input from those cameras, anything you do that could impact the view those cameras have could cause the system to not work correctly. For windshield-mounted cameras, that could be something as simple as putting on the incorrect length wiper blade. If the camera is mounted up high behind the windshield, a shorter wiper blade could prevent the area in front of the camera from being cleared and/or cleaned when the wipers are activated. Another fairly common repair that you likely sublet out, if you do them at all, is windshield glass replacement. If you offer to have that service performed on these vehicles, you need to be aware of the OEM requirements and any addi-

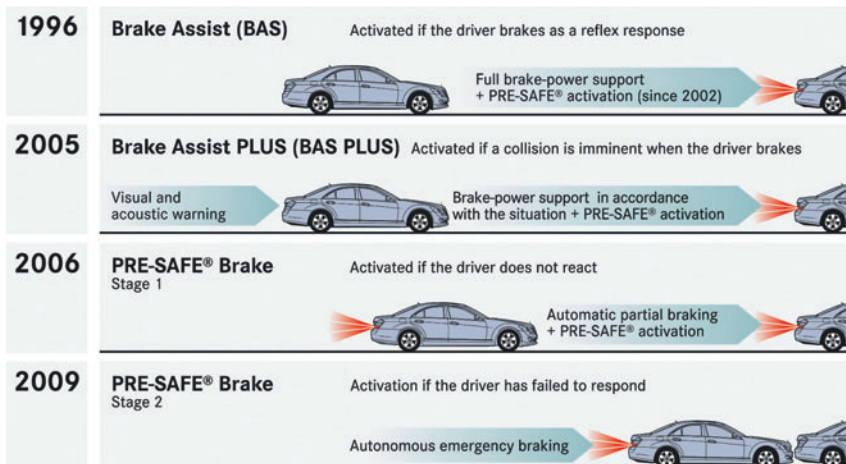


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**EVOLUTION OF MERCEDES-BENZ BRAKE ASSIST**

tional steps you may need to perform that the glass companies typically don't do. For instance, Honda has a Parts TSB (that's right — Parts, not Service) that specifically warns about using non-OEM glass in any of their vehicles with a forward-facing camera mounted behind the windshield. The concern is that any

other glass brand may not allow the camera to be focused properly since after all, the windshield is more or less serving as a second lens for the camera. And even if the correct glass is installed, it's highly likely these systems will all require some type of recalibration procedure that will almost definitely require a capable scan tool. If that recalibration isn't done, or an incorrect type of glass is used, it likely won't set a code right away. It could, however, impact the performance of the system and result in driver complaints that may take a lot of time to chase down (erratic lane departure warnings, etc.). The more advanced lane-keeping systems simply take it a step further. They process the input from the lane departure system and then act on the data provided to keep the vehicle in its lane. This can be accomplished through selective wheel braking, steering assist, etc. Ensuring all related systems on the vehicle are operating properly is critical to the operation of the safety system.

Active braking is another collision avoidance system with a wide range of implementation methods. As with many of the other systems, this isn't really a new concept, but rather one that is being implemented much more broadly and is becoming more capable. Mercedes-Benz actually introduced their BAS (Brake Assist System) back in 1996. That system would activate if a driver applied



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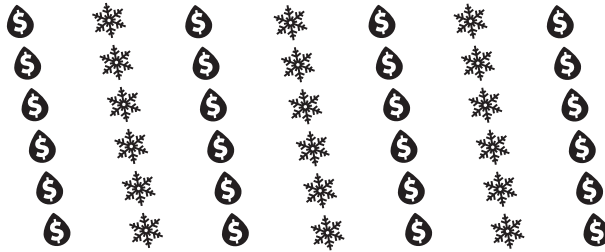
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the brakes in a method that appeared to be a panic braking event. It would then apply additional braking force to help bring the vehicle to a stop as rapidly as possible if the driver wasn't pushing hard enough on the pedal. Systems have since progressed to provide warnings to the driver (audible and/or visual), and even systems that will apply the brakes without driver input if the driver doesn't respond to the warnings.

So, how do these braking systems

potentially impact your service of the vehicles? For the most part it's not a lot different from taking care of a traditional braking system. It's important to ensure the core braking system is working properly. That means you also need to consider the quality and construction of braking components you are using to service vehicles. The systems are designed to operate properly given the OEM-specified brakes. Consider the possible implications if you install

brake pads that are not the same type and/or quality of the OEM pads. A low-cost alternative that may not provide the same stopping power could mean the system doesn't function to its full capability. Alternatively, an "upgraded" performance set of brake pads that actually grips the rotors more aggressively could possibly cause wheels to lock up, which may decrease the effectiveness of the automated braking systems as much, or more than, a set of "weaker" brake pads. There's definitely nothing wrong with using aftermarket parts, just be sure they meet the OEM specifications.

None of these new technologies will drastically change what you do on a daily basis; however, it does reinforce a few key things that I feel all shop owners need to maintain focus on at all times:

- ✓ Ensure your staff is continually attending updated training.
- ✓ Don't limit this to just your technicians; your service advisors also need to have a working knowledge of these systems to be able to explain what is needed to your customers.
- ✓ Ensure you have access to high quality service information.
- ✓ OEM service information is ideal to ensure accuracy on the latest models/technology.
- ✓ If using aftermarket service information, I prefer to have two or more sources available as a way to cross check the information if/when needed.
- ✓ Ensure your equipment is kept up to date.
- ✓ Whether it's scan tools, alignment equipment, etc. be sure you have the required tools to effectively service any vehicles you are taking in. **TZ**

**JEFF MINTER** is currently serving as the service director for a group of dealerships in the heavy duty vehicle industry. He is an ASE certified Master/L1/L3/F1 technician with OEM training from numerous manufacturers.  
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# NETWORK DIAGNOSTIC STRATEGIES

**TODAY'S INTERESTING TIMES ARE AN OPPORTUNITY TO LEARN AND THRIVE**

**ERIC ZIEGLER //** Contributing Editor

**M**ay you live in interesting times” is a quote that always caught my ear growing up. After Googling it, I found that it originated as an old Chinese curse. In the automotive repair industry, we certainly are living in very interesting times. Technology is advancing at such an alarming rate that technicians and shops are in a constant scramble to keep up. Some may regard this as a curse indeed!

Others — those who are willing to invest in themselves and are eager to adapt — hopefully see this as an oppor-

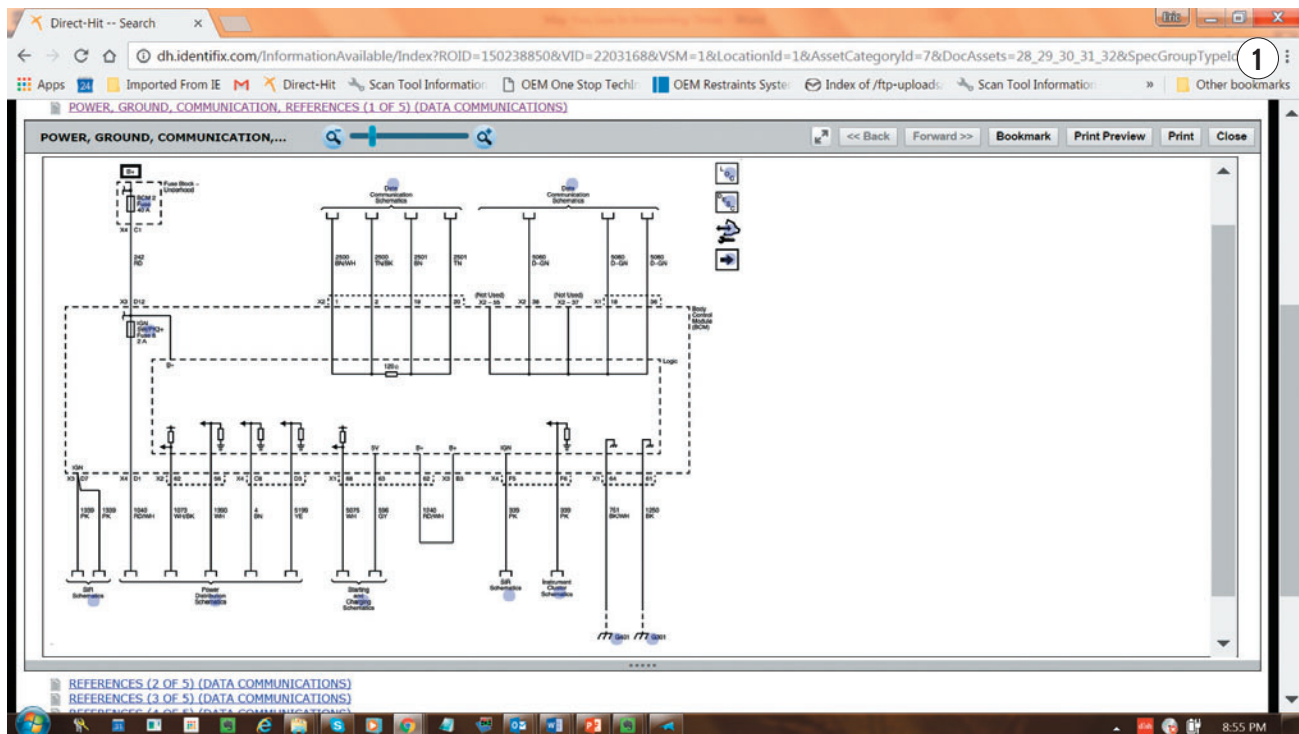
tunity to learn and to thrive. Communication networks and their diagnosis are a prime example of both the challenges and the inevitability of this technology moving forward.

## The trick to it all

Communication networks come in many different configurations and protocols. The trick, as I see it, is not to become overwhelmed or intimidated by the task or diagnosis at hand. Having a good plan of attack is one of the keys to reaching a successful conclusion. Having an understanding of how the network is

laid out and the protocol or protocols it communicates with are essential. A wiring diagram and a quick read of service information will usually provide a quick insight of the network's layout and communication characteristics.

I believe similar to any automotive electronic system diagnosis, the first step is to garner as much information as you can with the least amount of effort. For me, this is almost always by plugging a scan tool into the DLC to communicate with modules, pull codes and look at the data stream. But what do we do or how do we start if we can-



PHOTOS: ERIC ZIEGLER

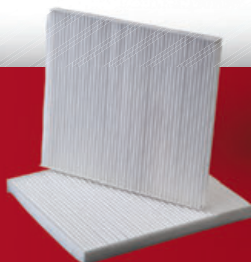


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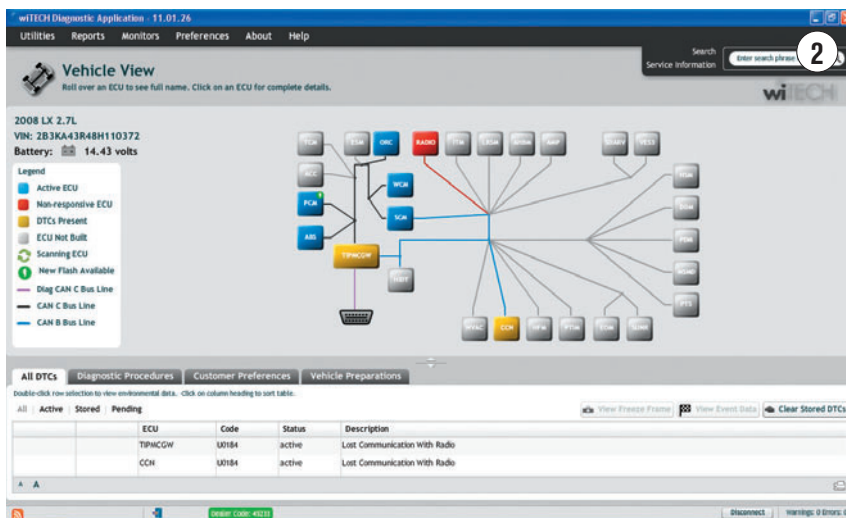


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not communicate with the network, certain modules are unresponsive, or we have those ever pesky U codes? We will examine some of these issues and some common sense approaches to develop a systematic plan of attack (POA) to aid us in no communication and U-code issues.

In general, if we can talk to other modules on the network bus, there should be some form of U codes set. The way I like to simplify it is this: the module with the U code is stating that “the problem is with u (you) and not me.” In other words, if a 2008 Cobalt PCM has a U0140 for communication fault with the Body Control Module, generally the fault is not with the module that reported the U code — in this case, the PCM. So in this example, our POA will concentrate our efforts and testing at the BCM. My POA would start simple with the scan tool and perform a network test



if offered. If not, I am going to attempt communication with the suspect module or, in this case, the BCM. Suppose I have the ability to do a complete vehicle scan and multiple modules report code U0140 and the network test is performed and all the modules are on the bus ex-

cept for the BCM. These results alone tell me quite a bit if I employ the diagnostic tool on my shoulders. I know that the bus cannot be dead or shorted to power or ground due to the fact that I can communicate with other modules on the bus and that they have pointed the finger at the unresponsive BCM. This greatly helps to streamline my process, doesn't it? Now I go direct to the BCM and do my testing there.

One simplification or universal rule of thumb I use is that all modules require at the very least three things. In order to communicate, all modules require power, ground and the physical layer for data communication or the serial data line (network bus integrity). Some modules may also require a “wake up” signal and some modules will lose communication if a sensor voltage supply circuit is shorted. This being said, I will reference my SI for a diagram of the 2008 Cobalt's BCM (Figure 1). I want to verify that I have power and ground. I like to use a headlight or a headlight bulb to load the circuit and perform a loaded voltage drop test. If I have solid power and ground, my next step is to verify the network connection or the integrity of the serial data bus between the BCM and the rest of the vehicle. I prefer to use a lab scope for this, but a wiring diagram and multimeter could also be used. If the power, ground



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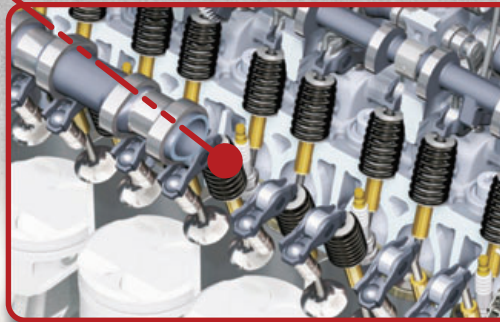
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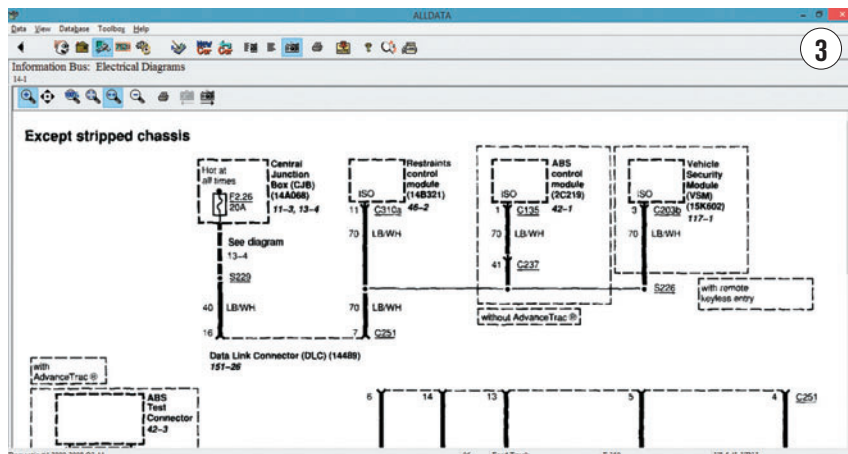


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and serial data circuits are good and I have no communication with the scan tool and have U codes for the BCM in other modules, the BCM is most likely the issue. This is a fairly fundamental failure of a module that is pretty straightforward in its diagnosis. Things can get a lot more challenging, so let's look at some others and some tools and techniques that will aid us in our diagnosis.

### Multiple modules

Perhaps my failure is several modules that do not communicate or that I have multiple U codes for communication issues on a vehicle with a standard CAN High and Low Bus. Something to consider — a lot of standard Controller Area Networks, or CAN networks, use some sort of termination resistance on the bus. Most use 120 ohm resistors at either end of the bus. The resistors can be built into a module or a physical resistor that



is plugged into the bus or even the fuse block. Ohms Law tells us that the result of these two 120 ohms resistors wired in parallel is 60 ohms, so if we were to disconnect the battery and place an ohmmeter across pins 6 and 14 of the DLC connector, that's the resistance I should read. Remember to use a DLC breakout box (or BOB) or the correct test terminal

in the DLC connector to avoid creating terminal tension issues (Note: There are exceptions — like Dodge vehicles. Always consult a wiring diagram). If I see 60 ohms of termination resistance, I have a fairly good idea of the integrity of the CAN bus. If I see 120 ohms, I know I have some testing to do. I could be looking for an open in the bus, a blown termination



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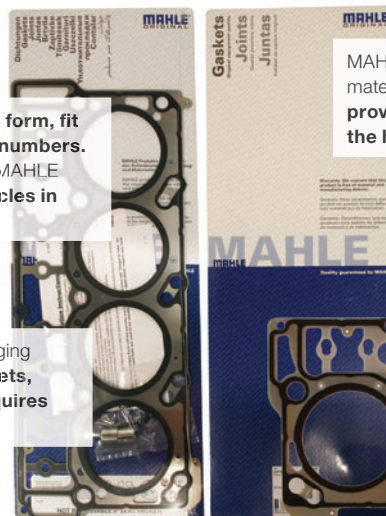
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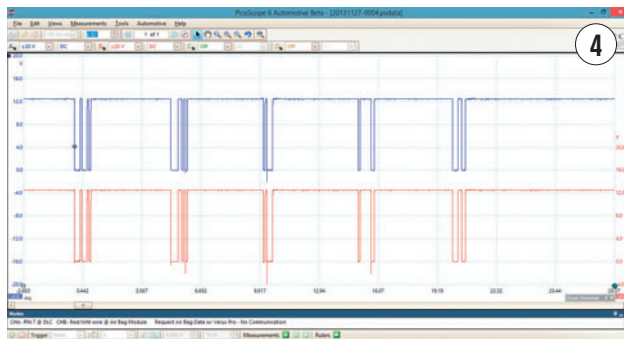
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resistor or a defective mode that houses the termination resistor that is open internally. I can also use a decade box or a 120 resistor and my wiring diagram to strategically substitute while observing the termination resistance at the DLC.

If I have two different modules with 120 resistors in them and I read 120 ohms at the DLC pins 6 and 14, I could have either a module that is open or the wiring between those modules could be the cause. If I unplug the two modules that house the termination resistors one at a time and I see the resistance at the DLC go to zero, I know that was the good module and the open is in the other module or wiring going to it. If, let's say, the PCM houses the termination resistor and I have 120 ohms at the DLC between 6 and 14 and I unplugged the PCM and substitute a 120-ohm resistance across the CAN bus wires in the PCM connector. If my termination resistance is now 60 ohms, I know the issue is internal to the PCM.

Perhaps in my initial termination resistance I see something other than 60 or 120 — I may be looking for a bus that has physically shorted to power or to ground. There are some caveats and limitations to termination resistance testing, but I look at it as another tool in my diagnostic arsenal. It is a fairly simple test and if nothing else, it forces one to consult a wiring diagram and get an idea of the physical layout of the network.



**Scan tool testing**

There have been lots of gains on the OE scan tool side in regards to network diagnostics. Most OEs have some sort of network diagnostic tool or software that works in conjunction with their scan tool. In the case of Ford it is the Live Network Monitor Test software via Ford PTS subscription that works in conjunction with IDS and the VCM interfaces. It is applicable on vehicles from 2006 and up.

Each of the modules or nodes on vehicle's Module Communications Network are repeatedly "pinged" during the Network Monitor Test to confirm that the module(s) can communicate. The test indicator will show green if a module is online and responded to the tool's "ping." Conversely, if a module fails to respond, the test result will be a red icon for the affected module and an audible alert. This can be helpful if the communication faults are intermittent with U codes in history or U1000 State of Health (SOH) codes rather than a current fault. If wiring harness issues are suspected, the tech could perform the "wiggle test" of the suspected harness while observing and/or listening to the tool for changes in module state.

The FCA/Dodge/Jeep scan tool, wiTECH lays out the topology of the network on the home page. The tech can easily see every module that is on the network(s). Moreover, the tech can see which modules are communicating or not and which have codes. When wiTECH is operated online, the VIN is read and compared to the information on the factory server and populates the modules that are supposed to be on the bus via the sales codes assigned to the vehicle's VIN. This "greys out" the modules that are optionally for the vehicle's platform that it is not equipped with. This is a very helpful feature that eliminates that "I wonder if the vehicle is equipped with that module..." thinking that sometimes leads a tech down the wrong path consulting a network wiring diagram that shows all the possible modules on the bus.

The different buses are laid out and identified and color coded. Each separate bus shows the modules that are supposed to be on it and their respective statuses. The modules that are displayed in blue are on the bus and do not have any codes present. The modules that are displayed in yellow



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are on the bus, but have codes stored in them. A module that is displayed in red (Figure 2) is supposed to be on the bus, but it is not present. The radio in this vehicle had been replaced with an aftermarket unit. Note the modules in grey; they are optional equipment that the vehicle was not built with. The lightning bolt signifies that a calibration update is available for that particular module. All DTCs are listed on that same screen. This simple and intuitive layout quickly lets the tech know how the bus is physically laid out, which modules are on the bus, which ones might be missing and which modules have DTCs and what the DTCs are — all on one screen! A solid plan of attack can be made quickly based on these results. One important thing to notice on this network layout is that there is no circuit continuity from the DLC and to the modules on the bus(es) other than the TIPM and the DLC on the Diagnostic CAN C Bus. This can present a challenge for using the standard CAN Bus 60 ohm termination resistance test on the whole CAN network between DLC pins 6 and 14 with the battery disconnected. The TIPM in this vehicle is the gateway in which all communication protocols and networks run through. It also can present issues if the gateway is down and not functioning. However, by referencing a network diagram and employing some creativity and solid dual channel scope techniques, one can quickly determine network bus integrity and continuity from one point to another.

### Some scope techniques

The scope technique I am referring to uses a dual-trace scope to help verify network integrity between two points on a network or between two modules. Let's say we have multiple modules that have U codes for no communication with the ABS module. My POA might be to first verify power and ground at

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### Ford Eco-boost diagnostic tips

Ford Eco-boost diagnostic time can be reduced dramatically with Ron Bilyeu's analytical approach, as well as with the use of his many diagnostic tips and tricks. Eco-boost technology and the scan techniques used and PIDs

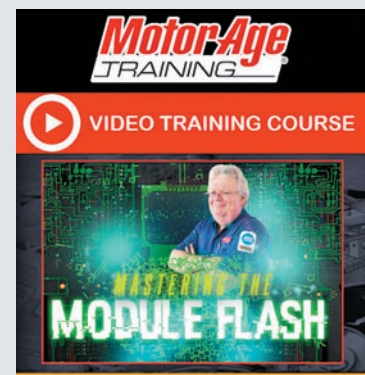
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### The best module flashing practices

Module flashing can be tricky, but instructor Dave Hobbs offers the precise procedures to deal with it. This 75-minute video features hands-on training addressing the necessity for a vehicle flash, the ways to flash, the follow-up on a successful flash and re-flashing issues. Covering the different kinds of module flashes, electronic control module protocol is emphasized



to diagnose the Eco-boost system are key to the discussion on turbo charging and Variable CAM Timing (Twin-Independent VCT). An added benefit is how fuel trims affect the system. Moreover, among the other topics covered in this course are turbo charging, gas direct injection,

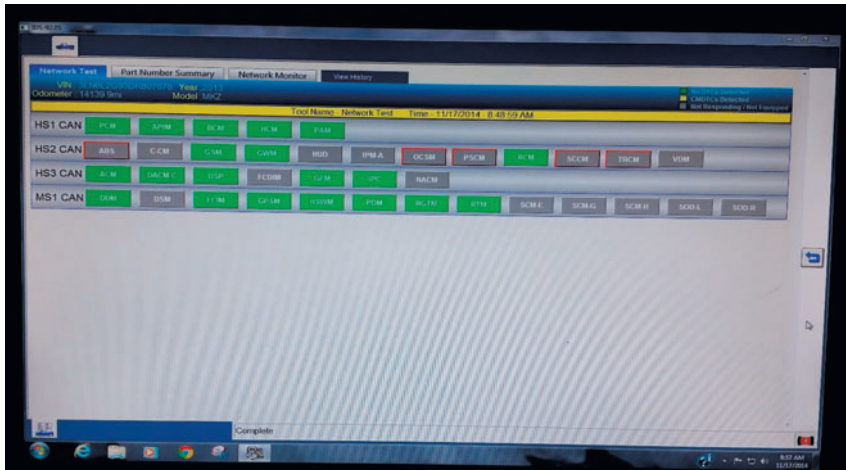


along with using the proper scan tools. Specific topics of interest are the J2534 module flashing standard, module reprogramming, calibration updates and base line tables, GM re-flashes and Delphi iFlash software. Visit [MotorAge.com/moduleflash](http://MotorAge.com/moduleflash).

the module. So say we have both. My next concern is does the ABS communicate on the bus and does the bus have physical integrity or continuity between the ABS module and the module that reported the U code for loss of communication with the ABS module? One channel of the scope is hooked up on the data bus circuit at the ABS module and

another scope channel at the module reporting the U code. Communication is attempted when the ABS module is "pinged" with the scan tool (if possible) and the scope images are compared. If they are "time-stamp aligned" or are mirror images of one another, the wire or physical layer for data communication must be good.

So in the ISO bus circuit shown (Figure 3), I wanted to verify I had continuity between the DLC pin 7 and the ISO communication circuit C310 pin 11 at the RCM. I hooked one channel of the scope to pin 7 of my AESwave's LineSpi DLC breakout box and the other I back-pinned C310 pin 11 at the RCM and attempted RCM communication with the scan tool. What can I say about the bus between those two points? Note how both channels (Figure 4) are aligned and are mirror images of one another. This waveform demonstrates that we have to have continuity between those two points and that there are no other factors influencing the circuit at either point. This particular vehicle had no communication with the RCM, which had been erroneously replaced for the communication fault. Dual-trace scoping the bus quickly eliminated any suspicion of the ISO network between the DLC and RCM communication line. The module had a voltage drop issue on the power side. The feeds and grounds were tested with an LED-style test light and appeared to have both power and ground



**FORD NETWORK TOOL 2**

present, and the module was condemned too quickly. This also illustrates the need to employ good test techniques like properly loading the circuit and using a loaded voltage drop test when verifying feeds and grounds to a module.

In summary, safety and consumer demand for comfort and convenience features are driving engineers and OEMs to build modern vehicles that are becoming increasingly complex, requiring multiple protocols to interconnect all the modules. Network diagnostics and U codes can seem intimidating at first and diagnosing them a daunting task. I believe having a solid POA will serve you well. Remember the basic things like start simple with a scan tool and see which modules you have the ability to communicate with and if any U codes are present. Getting a lay of the land is crucial, so take a couple of minutes to educate yourself about the system you are working on. Note the bus configurations and protocols involved with the bus/module(s) you are trying to diagnose. With the advent of systems like V2V, the connected car and autonomous vehicles soon to be on the horizon, a multitude of modules and multiple protocol networks are certain not to be going away anytime soon. The trick, as I see it, is to do what we as techs have always had to do — educate ourselves and adapt! Never forget that the most powerful tool in your diagnostic arsenal doesn't rest on your toolbox — it rests on your shoulders! We most definitely live in interesting times. The difference is that it can be a great motivator and make for a challenging and rewarding career to those who embrace it; it doesn't have to be a curse. May you live in interesting times indeed! *TZ*

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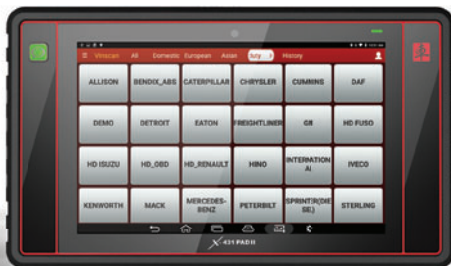
**ERIC ZIEGLER** is an ASE Certified Master Tech who specializes in module programming, drivability, electrical and network systems diagnostics. He owns and operates EZ Diagnostic Solutions Inc. and is a trainer for Automotive Seminars and The Driveability Guys. [eric@diagnosticsolutions.com](mailto:eric@diagnosticsolutions.com)



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1

# A LOGICAL APPROACH TO NETWORK DIAGNOSTICS

**BEING ABLE TO DIAGNOSE NETWORK COMMUNICATION ISSUES IS CRITICAL, AS ALMOST EVERY SYSTEM ON MODERN VEHICLES RELIES ON IT.**

**SCOTT SHOTTON** // Contributing Editor

**S**eemingly simple issues such as power windows that do not work, a no crank no-start condition or even erratic operation of multiple systems can be due to a network fault. In addition, a network issue is often a surprise to the technician due to the fact that the customer's complaint may seem to have no correlation to the actual fault. Given these statements, let us explore network diagnosis.

Networks can fail in multiple ways. The diagnostic approach we choose depends on the type of communication failure we are presented with. Some examples of failures include one module does not communicate, some modules do not communicate, all modules do not

communicate or modules set "U" codes for network communication. Of course, there are additional failures, but these are the most common. Each of these failures may require a different approach. However, there is a four-step plan of attack that can point us in the correct diagnostic direction almost every time.

## **Step 1: Who is talking and who is not?**

The first step in any network diagnosis is to connect a scan tool and attempt to communicate with every module on the vehicle. Some scan tools, or manufacturers, allow us to poll or ping all of the vehicle's modules to see who is communicating on the network(s). Factory, or enhanced, scan tools will be required here because a generic code reader is

not going to cut the mustard since they will most likely only communicate with powertrain-related modules. We will need to attempt communication with all of the modules on the vehicle. If an OE or enhanced scan tool is not available, the diagnosis can still be performed but will take more time and most likely require the use of a scope. The value of scope usage will be illustrated later in this article. During this first step, it is important to keep notes on all of the modules that respond to the scan tool, because this list will have to be compared to the modules that the vehicle is equipped with.

## **Step 2: Get the lay of the land**

The second step is to use the information gathered from Step 1 and compare

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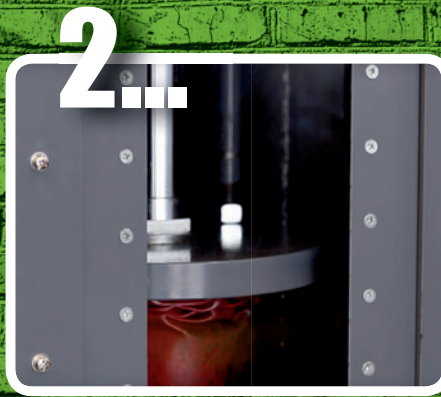
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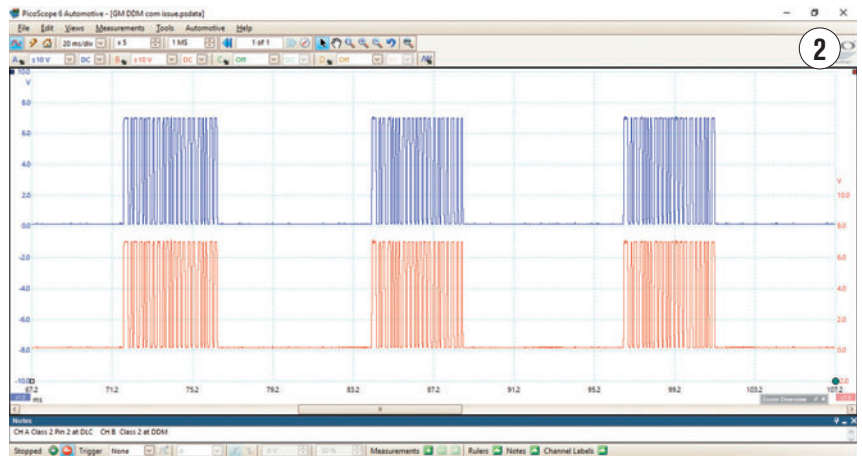
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the acquired list of responding modules to the network topology. Printing the wiring diagram and color coding them with highlighters aids in easy visual identification of what is actually happening on the network. For example, highlight every module that communicates in green, highlight every module that the vehicle is equipped with but does not communicate on a network in pink and cross off any module that the vehicle is not equipped with. This technique makes it easy to step back and get a good feel of what type of network problem the vehicle has. Often, the information provided in this step gives the technician a pretty good idea of where the problem may lie even before any additional testing is performed. Technicians using Chrysler wiTech know what I am referring to because this task is performed for us, with a slightly different color scheme, as soon as the vehicle is connected to the tool.

### Step 3: Know what “good” is

At this point we will most likely be connecting a scope to the communication line somewhere in the circuit. Knowing what a good signal voltage should be is crucial. For example, GM Class 2 should rest around 0 volts and pulses to about 7 volts while communicating. What is being said by the individual modules we may never know nor do we need to know. Our concern is if something can actually be said, not what is being said. The voltages of communication protocols vary. Another example of network voltages is CAN. Most high-speed Controller Area Networks, but not all, have two wires and similar voltages. One of the CAN wires — CAN high — rests at 2.5 volts and pulls high to 3.5 volts to communicate. At the same time the other wire — CAN low — mirrors CAN High with a resting voltage of 2.5 volts but pulls low to 1.5 volts during communication. Regardless of which communication



protocol we are dealing with, we need to know what good network voltages are so we can observe them on a scope. In addition to appropriate voltage values, we should be able to observe clean transitions between the resting voltages and the communicating voltages.

### Step 4: Choose your path

Based on the type of failure the vehicle has, we will need to choose a diagnostic path. Regardless of the path we need to tread, an oscilloscope will most likely be used to monitor network communication. It should be noted, no matter which type of network issue is being diagnosed, that every module needs three things to function on a network: good power, good ground and the ability to communicate.

To illustrate this diagnostic plan of attack we will use two vehicles. The first vehicle has a communication issue with a single module. The second vehicle has an instrument cluster issue as the result of an entire network being down. In both cases, we will follow the four-step process and perform any additional testing required to diagnose the issues at hand.

### Vehicle No. 1: Power window problems

Vehicle No. 1 is a 2004 Chevrolet Silverado with a complaint of “the driver’s

window works from the driver’s switch, but the passenger’s window does not.” However, the passenger can operate the passenger’s window from the passenger switch. This may sound like a simple power window issue, however a quick look at the wiring diagram for this vehicle reveals a driver’s door module (DDM) and a passenger’s door module (PDM) are involved and communicate with each other over a Class 2 serial data network. This situation is a perfect example of why a scan tool should be connected no matter what the actual fault happens to be, especially since the subject system involves network communication.

Keeping in line with our four-step process, the first action is to connect a scan tool and attempt communication. All of the modules are polled to see if they communicate and DTCs are retrieved while we are connected. There are some “U” codes present, but more importantly, the DDM does not communicate with the Tech2.

The next step, getting the lay of the land, shows us that all the modules on the wiring diagram communicate except for one — the DDM. Given this information, our process has provided us with a diagnostic direction: One module, the DDM, does not communicate. Also, it happens to be a module involved in our customer’s complaint.

Basically, we have narrowed the issue down to a single module, and we will be required to check our three basics: power, ground and communication.

Step 3 of the process, knowing what good communication is, tells us that a General Motors Class 2 network should

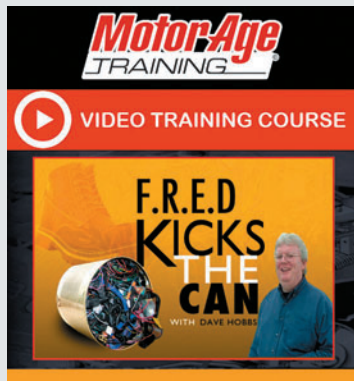
have a resting voltage of near 0 volts and pull high to approximately 7 volts when communicating. Now we can move on to the final step — choose our path. Time to check all three possibilities at the DDM. Some technicians may argue that checking power and ground

to the module does not need to be performed in this case because the driver's window works. Since the power and ground for the window motor come through the DDM, the module must have good power and ground. This observation would be a good one, but

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### Diagnosing vehicle communications networks



Diagnosing vehicle communications networks is the essence of this AVI course (LBT-237 FRED Kicks the CAN with Dave Hobbs). Hobbs diagnoses F.R.E.D.s (Frustrating Ridiculous Electronic Devices) and smart sensors that are connected to communications networks by using a volt meter, ohm meter, lab scope and scan tool. His real-world training procedure will help get you to a quick diagnostic decision when diagnosing the latest CAN buses and the earlier networks on Ford, GM, Toyota and Chrysler vehicles. Both "U-code" serial bus problems and "no communications" scan tool signals are addressed.

[MotorAge.com/networks](http://MotorAge.com/networks)

### Advanced diagnostic help for Mode \$06

With advanced diagnostic help for Mode \$06 being scarce, this AVI course (LBT-192 Advantages of Mode \$06 with Jim Wilson), applicable to all 1996 and newer OBDII vehicles helps fill the void. Understanding Mode \$06 starts with the preliminaries of running



the test to determine pass or fail, as well as being able to determine the differences between continuous and non-continuous monitors. Wilson covers monitor test results and monitor-run confirmation, affirming the data is correct. He provides the OEM websites on where to find Mode \$06 information and uses demonstrations of GM and Honda websites.

This course covers what is different with CAN coolant vehicles relative to Mode \$06 and scanner procedure; verification with Mode \$06 relative to flashing and reprogramming; and how DTCs and failure rates help with Mode \$06.

[MotorAge.com/mode\\$06](http://MotorAge.com/mode$06)

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ignition tests that can't be done with a scanner.

Additionally, he covers other problem areas that can be detected with a DSO, including rich/lean fuel conditions, poor coil performance, erratic triggering problems and secondary insulation breakdown.

When it comes to weak cylinder diagnostics, Fulton offers tests using a DSO to pinpoint misfire causes. Ultimately, this course eliminates confusion by providing scope settings for testing/voltage, time, slopes and trigger source. Also covered are setups using Snap-On MODIS.

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in order to be sure that our diagnosis is correct, we will check them anyway.

There are multiple ways to check powers and grounds to a module. Some of these techniques, if performed incorrectly, can yield false results and misdiagnosis. Voltmeters and test lights are common tools to perform this task, but often result in misdiagnosis if the chosen connections, and subsequent results, are not understood. My preferred method is to load the circuit with a headlamp, which many technicians do, but while performing this test, I measure the voltage drop across the headlamp (Figure 1). This provides an additional piece of valuable information. The headlamp I use draws about 4 amps of current, which should be enough to make the circuit work without melting a wire. To elaborate, if the headlamp lights, we are loading the circuit and

know that sufficient current should be able to flow. If we measure the voltage drop across the headlamp and compare it to system voltage, we can calculate the voltage drop in the circuit. In this case, while checking the power to the DDM, the headlamp illuminates brightly and the voltage drop across the bulb is measured to be 12.43 volts. The system voltage on this vehicle is 12.60 volts. Therefore, the voltage drop in the circuit is 0.17 (system voltage – bulb’s voltage drop), which is acceptable. The same procedure was repeated on all the powers and grounds to the DDM with acceptable results.

Next order of business is to check for the ability to communicate. The technique I prefer to use requires at least a two-channel scope. One channel is connected to the DLC network pin, in this case pin 2, using a DLC break-out

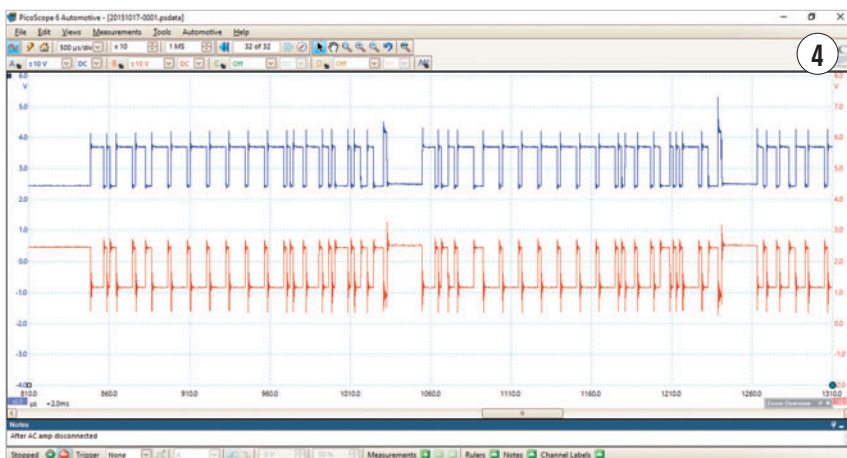
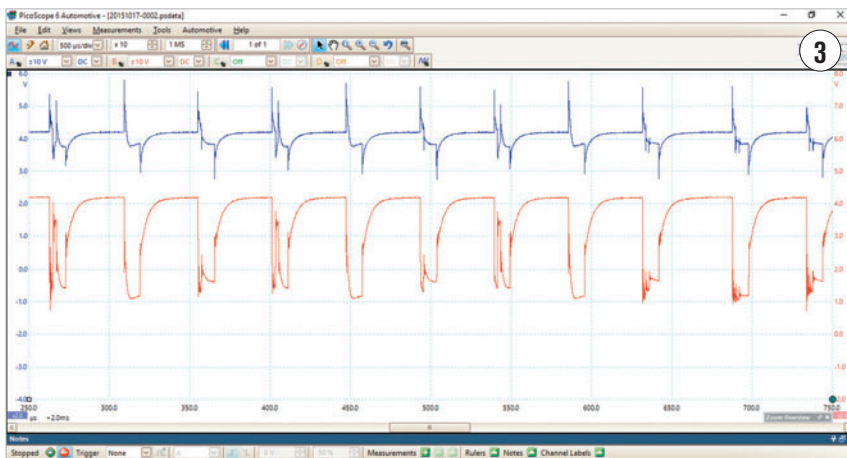
box (Figure A). The second channel is connected to the communication wire at the DDM. If the network wiring is intact, both traces on the scope should have an identical appearance (Figure 2). If channel A were to appear as we expect, and the communication signal on channel B looks different or is missing, then we know that we have a wiring problem. On this vehicle, both traces mirror each other and have the correct network voltages of approximately 0 to 7 volts.

Since we have obtained known good test results during all three of these basic checks, we can conclude the driver’s door module has everything it needs to function on the network, yet it chooses not to. The DDM was replaced; communication was restored with the scan tool. The DDM was then programmed, which is required, to make it work in the vehicle. Power window functionality was restored. The DDM replacement solved all of the issues on the vehicle.

**Vehicle No. 2: Erratic instrument cluster operation**

Our second vehicle is a 2012 Toyota Corolla. The customer’s complaint is erratic instrument cluster operation. Specifically, warning lamps illuminate for no apparent reason. The gauges also perform erratically. For example, the tachometer bounces around even though the engine is idling smooth. The vehicle does run and drive okay.

Step 1 is to attempt to communicate with the instrument cluster to see which other modules are communicating on the network. In this case, the Toyota Techstream scan tool is used, and it reports that none of the modules on the CAN network are responding. The second step — get the lay of the land — confirms that all of the modules shown in the topology diagram are in fact absent. The next step is to know what good is. In this case, CAN high



voltages rest at 2.5 volts and pull high to 3.5 volts while communicating. In addition, CAN low rests at 2.5 volts and pulls low to 1.5 volts while communicating. CAN high and CAN low should mirror each other.

Time to pick our path. Since the entire network seems to have an issue, CAN high and CAN low will be scoped at the DLC using a DLC break-out box. CAN high and CAN low can be found on pins 6 and 14, respectively. The scope pattern (Figure 3) was obtained, and it is safe to say that communication voltages are definitely not what we expected to see.

If we use the data that we have already gathered, we can apply the process of elimination to cross a few faults off of our suspect list. Given the scope capture, we can conclude that neither of the CAN communication wires are shorted to ground. If they were, one (or both) of the traces would be very close to zero volts. The same can be said about a short to power, one (or both) of the communication wires would be resting near system voltage. In addition, an open communication wire would disrupt communication with some, or all, of the modules depending on where the open is. However, an open wire would not corrupt the communication signals in the manner we are seeing. If the network wires were to short together, the two traces would be incorrect, but they would mirror each other. I think it is safe to cross shorted wires off our list as well.

Time to choose our path. Given the observations outlined in the last paragraph, we can eliminate almost everything other than a single module that is failing and corrupting the communication on the entire network. There are multiple ways to isolate individual modules on vehicles. One method would be finding a splice pack or common connection where the network can be broken into individual pieces. In some vehicles, such as many GM



**TERMINATION RESISTANCE** was tested on the Corolla and no faults were indicated.

products, a splice pack may be easily accessible. Some Chrysler products have a diagnostic junction port (DJP) that allows us to isolate individual modules. In the case of our Corolla, there appears to be a central junction point on the wiring diagram, but it is buried in the dashboard and access will be time-consuming. Our option in this case will be to disconnect one module at a time while watching our scope, or scan tool, to determine when communication returns.

For the sake of diagnostic time, the location of all of the questionable modules is identified using service information. The list of modules is then prioritized based on ease of access. For the Corolla, we can put the modules in the following order: A/C Amplifier assembly, Center Air Bag

Sensor, ABS module, ECM, Combination Meter Assembly, Power Steering ECU, Steering Sensor, Yaw Rate Sensor and Main Body ECU. Of course, this order could be different based on the technician's preference.

The A/C Amplifier Assembly was chosen first due to the fact that its connector is visible under the dashboard just ahead of the center console and no disassembly is required to perform the disconnection. Everyone gets lucky sometimes. The scope capture (Figure 4) returned to normal once the amplifier was disconnected. In addition, all of the other modules came back online and the instrument cluster operation returned to normal.

If the A/C Amplifier disconnection did not solve the problem, we would have continued down the list of modules until the desired result was achieved. In this case, replacing the A/C Amplifier Assembly resolved all of the vehicle's issues.

In conclusion, following the four-step plan outlined here will direct a technician through an efficient and effective diagnostic process. In both case studies presented here, a single module caused both faults even though the presentation of these faults was very different. The same process was used to gather data and guide us to successful diagnoses.

To summarize, following the previously outlined four-step process often solves network issues. If not, the process can provide usable diagnostic direction while tackling the odd ball issues that don't fit the norm. **TL**



**SCOTT SHOTTON** As owner of The Driveability Guys, Scott performs mobile diagnostics, reprogramming, as well as industry training and has been a college instructor for the past 14 years. With a degree in Automotive Service Technology, Scott holds more than 21 ASE certifications. [scott@driveabilityguys.com](mailto:scott@driveabilityguys.com)



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**R Ranger**

# FORD DIESEL DIAGNOSTICS

**A 2001 F-250** powered with the 7.3 powerstroke engine. This vehicle is using an automatic transmission, and there are 156,000 miles on the odometer.

## WHEN A FORD DIESEL PICKUP WITH DRIVABILITY PROBLEMS ROLLS INTO YOUR SHOP, DO YOU HAVE RESERVATIONS ABOUT TACKLING THE JOB?

**ALBIN MOORE //** Contributing Editor

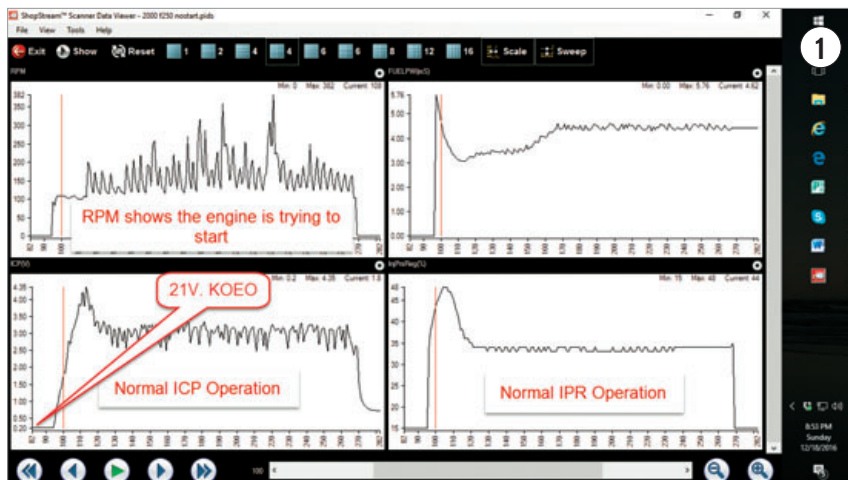
**L**ight trucks have been using diesel power for quite some time. Back in the early 80s when diesel power started becoming popular, the engines were noisy, produced a lot of smoke and were lacking for power for the most part. The mid 90s saw electronic fuel injection systems coming in popularity and along with the electronic fuel injection systems, turbochargers were also the name of the game. The light-duty diesel engines were now operating without much smoke, were becoming quieter and would produce loads of power.

This was all well and good until the clean, powerful diesel didn't run quite right or didn't produce the power that it should. The days of hooking up a fuel pressure gauge or cracking an injection line or two to find that weak cylinder were gone. Now in the electronic age, we cannot see, feel or hear what is con-

trolling the fuel injection system.

Before we get too far into this discussion, I would like to mention one very important thing about a diesel engine, or any engine for that matter. Making an engine run and the engine making power is essentially based on four things: the need for air being pumped

through the cylinder, proper compression, the proper amount of heat in the combustion chamber and the proper amount of fuel being injected at the proper time. In my diagnostic world, any engine power complaint, no start or misfire always comes back to these four things.



**SCAN DATA FROM THE CRANK/NO START.** This scan data gives me a direction to my next test. I know the hydraulic side of the fuel injectors is working properly; the engine will fire but will not start.

PHOTOS: ALBIN MOORE

Ford came out with their first 7.3 powerstroke in late 1994; this run of engines lasted until early 2003. In late 2003, the 6.0 was the engine of choice. The 6.0 lasted until late 2007. It was then replaced by the 6.4, which lasted a few years, and then was replaced by the 6.7. In my little shop, I still see many 7.3 and a lot of 6.0 engines. I will limit the discussions in this article to these two engines. Both of these engines use the hydraulic electronic unit injection (HEUI) fuel injection system. One of the nice things about this fuel injection system is the ease of using a scan tool to analyze fuel injection problems. By using a scan tool to test the injection system, you have the best fuel injector test bench known to man. The fuel injectors can be tested dynamically under real-world working conditions, which cannot be done in a fuel injection shop.

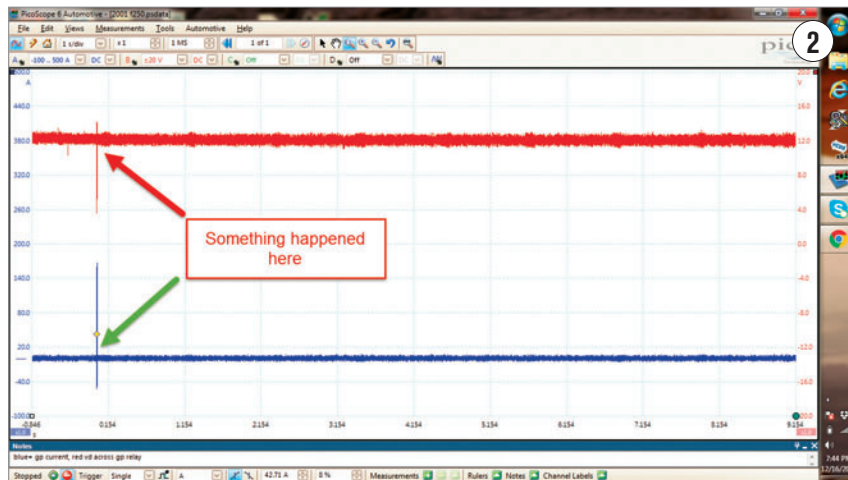
**Proper combustion chamber heat needed for starting**

To get a diesel to start, there are three basic needs: proper amount of fuel injected at the proper time, the proper amount of heat in the combustion chamber and the ability of the cylinder to pump air. To meet these needs, glow plugs are used in the combustion chamber to achieve the needed heat. The glow plug alone will not produce enough heat; a proper cranking speed and proper compression are also needed to get the combustion chambers hot enough to get the engine to start.

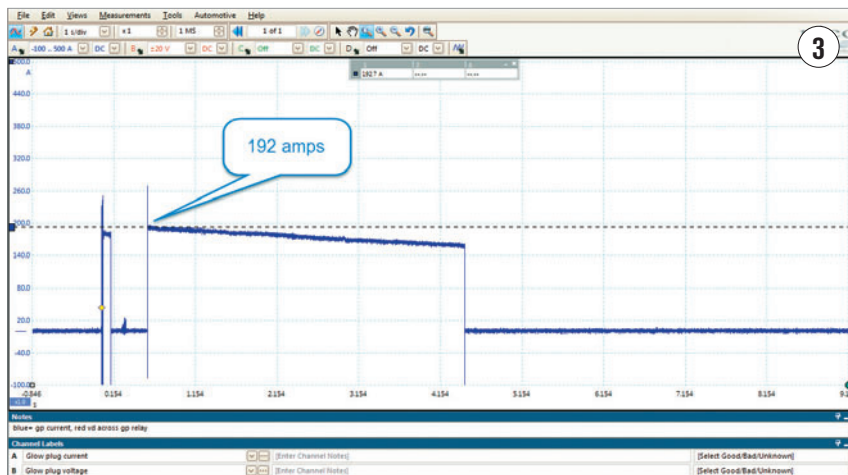
Most times, a cranking speed of 160 rpm is ideal. To get this speed, the batteries need to be up to the task, along with the starter motor. If either of these are not correct, you will have starting problems.

**Proper fuel pressure**

In the HEUI engine, fuel is delivered to the injectors by either a mechanical or an electric fuel pump. This pump is referred to as a transfer pump, or horizontal fuel conditioning module. The pump will ei-



**SCOPE CAPTURE OF THE GLOW PLUG CIRCUIT.** Red trace is a volt drop across the glow plug relay terminals. Blue trace is the glow plug current. The waveform tells me there is power to the relay; the relay has tried to work, but will not carry the needed current to the glow plugs.



**SCOPE CAPTURE OF THE GLOW PLUG CURRENT.** The glow plugs on a 7.3 powerstroke engine should draw 192 amps when first turned on. As the glow plugs warm up, the current flow drops. This waveform proves that the circuits are supplying power to the glow plugs, and the glow plugs are working correctly.

ther be mounted in the engine valley, in the case of the early version 7.3 (1994 - 1997), or mounted to the left frame rail directly under the driver's feet. The fuel pressure should be around 60 psi, or a little higher on the 6.0 if the updated fuel pressure regulator kit has been installed. Without proper fuel pressure and volume, the engine will lack power.

**ICP and the HEUI engine**

Injector control pressure (ICP) is a very important thing to understand when analyzing starting and running problems on these engines. The ICP sensor is screwed

into the high-pressure oil rail and is a feedback signal to the powertrain control module (PCM). The high-pressure oil system operates in a closed loop system, where the PCM commands the injector pressure regulator (IPR), which controls the high pressure oil, which operates the hydraulic fuel injectors. Without proper feedback from the ICP sensor, it is possible to get a no start, a rough-running engine or a poor power complaint. Here again, keep in mind the three basic needs of the diesel engine: fuel, compression and air. These three things need to be in the correct order and quantity.

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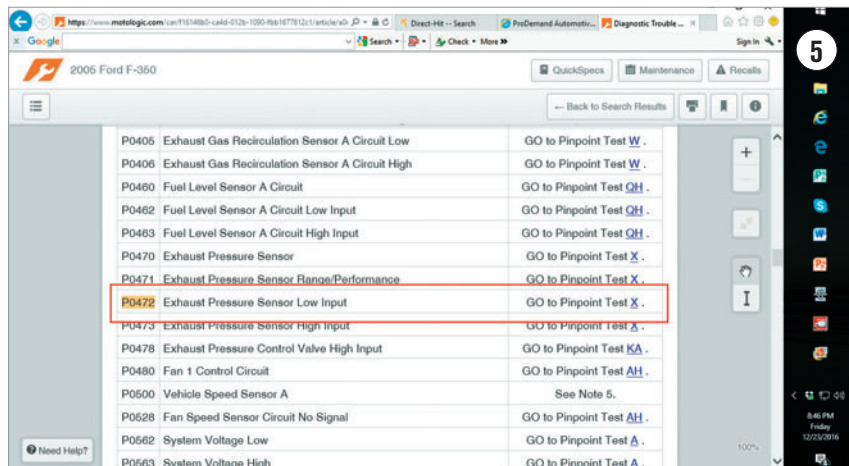
## IPR, the PCM command of high-pressure oil

The last thing on the list is the IPR. This pressure regulator is a pulse-width modulated device, which is operated by the PCM. This regulator is screwed into the high-pressure oil pump and controls the pressure in the fuel injector high-pressure oil rail. This oil pressure is monitored by the ICP sensor, which sends the pressure feedback to the PCM. If the ICP sensor reports the wrong pressure, the symptoms can be a no start, poor power or a rough-running engine. This system works in closed loop (PCM commands the IPR, which is monitored by the ICP). This IPR regulator is normally open, so if there is no command from the PCM, or there is no power to the regulator, the engine will not start.

### 2001 F-250 cranks/no start

The vehicle is a 2001 F-250 powered with the 7.4 direct injected powerstroke diesel engine. The odometer shows 156,000 miles and uses an automatic transmission. This vehicle is at a shop that has installed a set of new glow plugs and valve cover gaskets in an attempt to fix the problem of no start when the engine is cold. The engine will start fine if the electric engine heater is plugged in for an hour or so.

Knowing this information narrows the starting problem down to only a few things. When I arrived at the vehicle, it was sitting outside in the snow. The temperature was about 15°F, and



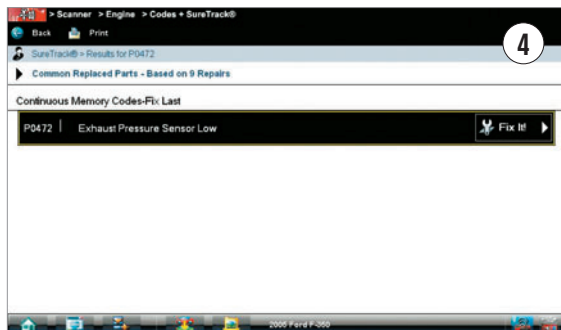
**SERVICE INFORMATION IS ALWAYS A GOOD THING** to check when wanting to know the correct information on a DTC. In this case, the information also includes a hyperlink to the next step in the diagnostic process, the pinpoint testing.

it had been sitting for about four hours. On any problem like this on HEUI engines, I start with a scan tool and do the key on engine off (KOEO) injector electrical buzz test. This test is testing the upper portion of the fuel injector, the electric solenoid that sits on top of the fuel injector and the wiring between the injector control module. There are two parts to this test: the electrical part and the audio part. If there are any problems with the electrical circuits to the injectors, the scan tool will display a DTC. If there is anything stuck in the mechanical hydraulic control, you will be able to hear it as the scan tool activates each fuel injector. In the case of this vehicle, there were no DTCs stored, and I was able to hear each of the fuel injectors buzz with the same sound.

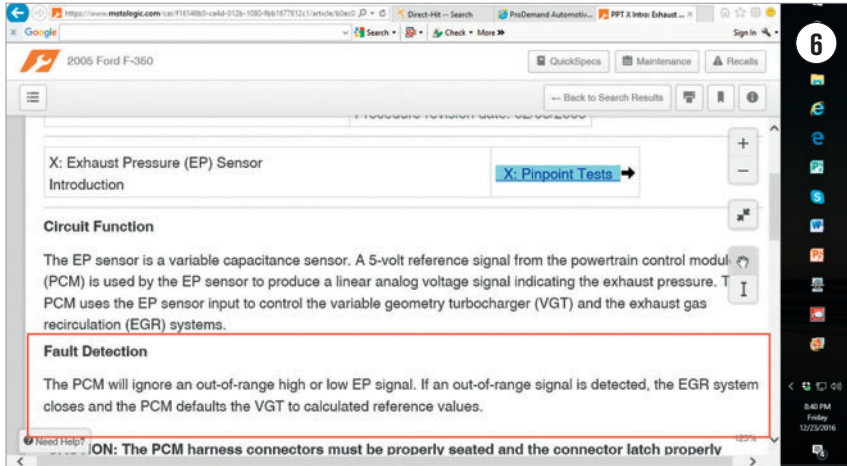
With an electrical or hydraulic problem ruled out, I will use the scan tool to record four data PIDs from the PCM. These PIDs are: RPM, fuel injector pulse, ICP voltage and IPR control. The reason I use ICP voltage instead of ICP pressure is that the ICP voltage is always correct. The ICP pressure is an inferred value, and during a crank/

no-start problem, many times the PCM will substitute a value, something like 2250 psi and this can easily lead you down a rabbit hole. The PCM will not pulse the fuel injectors until the ICP voltage reaches .8 volts. In the case of an ICP sensor that does not report correctly, this can easily cause a no start if the ICP voltage does not get above .8 volts. The PCM will only react to the voltage sent by this sensor. Always be sure to take a look at the ICP voltage before you start cranking the engine. The KOEO voltage should be .2-.25 volts. If this KOEO voltage is higher or lower than these values, then it is time to replace the sensor. In the meantime, unplug the sensor and give the engine a crank.

This is one of the few times you will hear me say to unplug something. When the ICP sensor is unplugged, the PCM will default to an ICP pressure of 700 psi, and it will pulse the injectors. Figure 1 shows the scan data captured on the first attempt to start the engine. With this scan data, I can verify proper cranking speed, proper ICP pressure and proper IPR command. If the PCM did not see a proper cranking speed (caused by either low cranking speed or no input from the CMP (camshaft position sensor), there would be no fuel



**DTC P0472 GIVES** a good direction on where to start on this poor power complaint.



**THE PINPOINT TESTING STARTS OUT** with the description of the circuit and the theory designed into the system. What more information do you need? Knowing how the system works is half the battle in finding out what is wrong.

injector pulse displayed. The scan data shows proper fuel injector commands and by watching the graph of RPM, it is easy to see the engine trying to start.

With this information and the history of the vehicle, I am assured there is some fuel supply to the fuel injectors, at least enough to get the engine to start. I can now narrow the problem down to either low compression, stuck fuel injector poppet valves, or no glow plug operation. Since the easiest test is the glow plugs, I will go there first, but wait — this engine has a new set of glow plugs and valve cover gaskets. That leaves only a glow plug relay not working or the PCM is not grounding the glow plug relay.

The next test is to use a labscope and current probe to test for proper glow plug operation. I will use channel A (blue trace) to test the current draw from the glow plugs, and channel B (red trace) to volt drop across the glow plug relay terminals. Figure 2 shows the results of the test. The labscope trace shows something happened when the ignition switch was turned to the on position. There was some current flow and some volt drop across the relay terminals; what happened is not proper glow plug operation.

By using a wiring diagram of the glow plug circuit, we find the glow plug

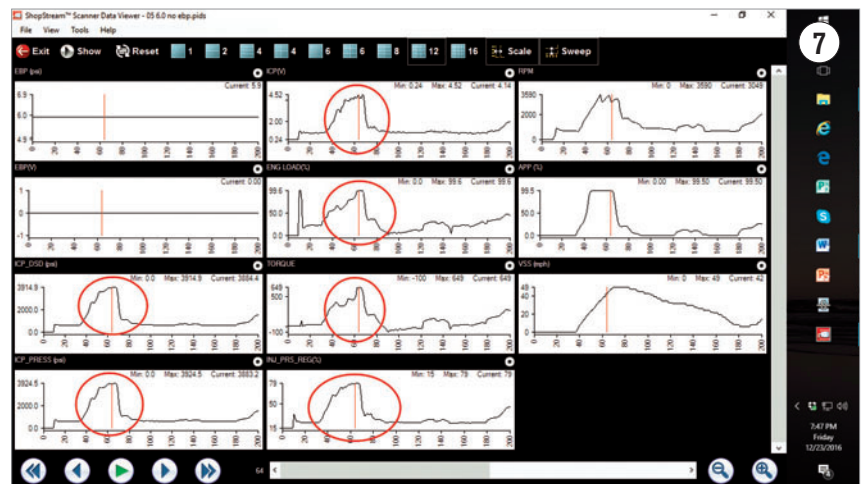
relay is powered directly from the battery; the relay coil is also powered directly from the battery and is grounded by the PCM at terminal 101. Knowing this should make the pinpoint testing of the relay pretty easy. The pinpoint test found system voltage at both positive terminals of the glow plug relay. The negative terminal of the relay coil showed system voltage, and when the key was turned to the on position, the voltage was pulled to zero volts (the relay coil should be grounded at this point) but the relay contacts were never closed. This test has proved the PCM is capable of grounding the relay coil and

the relay is defective. To test for proper glow plug circuit operation, Figure 3 shows where I have used a screwdriver to short the two relay terminals across to test for proper glow plug current. The waveform shows an initial current of 192 amps. This value is correct, so I know there is nothing wrong with either the glow plugs or the wiring. It is time to install a new glow plug relay.

### 2005 F-350 poor power complaint

The next vehicle is a 2005 F-350 powered by the 6.0 direct injected diesel engine. The vehicle is using the Ford Torqueshift transmission, and the odometer shows the vehicle has traveled 297,500 miles. The complaint is the engine lacks power especially when starting a heavy load. Once the engine gets up to speed, it seems to have good power, although the transmission will downshift when climbing even small hills. There is also no check engine light on with the engine running.

The first step in the diagnostic process is to hook up a scan tool and see if there is any diagnostic information stored in any module. The scan tool found one DTC hiding in the PCM. Figure 4 shows a DTC P0472 with a scan tool description of “exhaust pressure sensor low.” My question is low what?

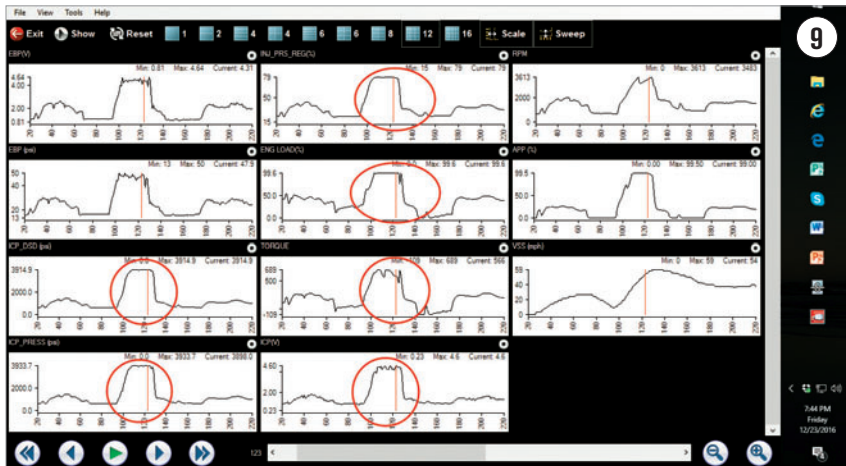


**SCAN DATA FROM THE ENGINE** when the exhaust back pressure (EBP) sensor was not reporting properly. Notice in the PIDs circled in red how the data is pointing to the poor power problem. Please compare this data with the known good data captured in Figure 9.

Is it low voltage or low pressure? Well, since any sensor like these only inputs a voltage to the PCM, then the problem is low voltage. Since this is an electrical circuit DTC, we must treat it as such.

The next step in the diagnostic process is to stroll over to our service information system and see what the manufacturer has to say about this DTC. Service information (Figure 5) gives a code description of “exhaust pressure sensor low input.” Over to the right side of the DTC description is a little blue “X”; by clicking on that X, you jump to the pinpoint test (Figure 6). There is a lot of information about the DTC; I have highlighted the important part in red. The 6.0 engine uses this exhaust back pressure (EBP) input for several things, and when the PCM doesn’t like the voltage sent from the EBP sensor, it locks down the EGR valve and does some funny stuff with the variable geometry turbocharger (VGT).

Please keep in mind that for any engine to produce power it needs to have fuel and air to make that power. In this case, the PCM will limit the turbocharger operation, which will also limit the amount of fuel the PCM can inject into the combustion chamber. This all results in low power output from the engine. Before embarking on any electrical testing I like to take a look



**SCAN DATA OF THE FIXED VEHICLE.** By comparing this data with Figure 7, it is easy to see how the misreporting EBP sensor has caused the lack of power in the engine.

at scan data to determine the next step.

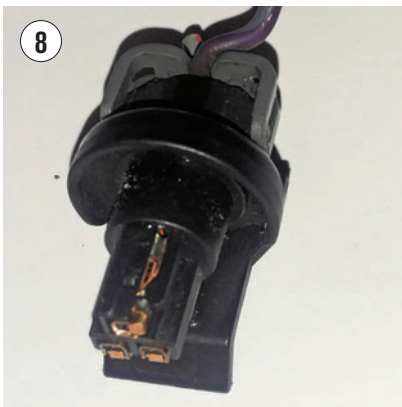
The scan data shown in Figure 7 was taken during a test drive. Notice in the upper left corner the two EBP PIDs, EBP voltage and pressure. The EBP voltage is showing zero volts. This information is telling me there is an open circuit in the EBP sensor circuit. I took the vehicle on a wide open throttle (WOT) test drive to see how the ICP, IPR and engine load PIDs looked. I have circled the important PID informant in red. To me, this data doesn’t look right. The data shows the engine is lacking power. Now if you are not familiar with this data, be patient and I will put up the data captured after the engine is fixed. By comparing the two sets of data, it will be easy to see the difference.

Since the EBP voltage shows zero volts, we need to go to the sensor and take a look to see if the plug is fastened in the sensor properly (do a visual) or see if the wiring has not been installed properly in its correct place. These engines have a lot of electrical harnesses lying on the top of the engine, and if they are not put back in their correct places, bad things happen. In the case of this vehicle, everything looked good. The harness was nice and clean, installed in its proper place and the plug was installed in the sensor properly.

Since the scan tool displays the

sensor voltage, there are two things we can do to use the system to test itself. One would be to gently wiggle the plug while watching the scan data, and the other would be to unplug the scan tool and use a small jumper wire to jump the reference voltage to the signal line and see if the scan tool voltage responded. In this case, all I had to do was to gently press on the EBP plug and the scan tool voltage changed. Now I am on to something — the problem is in the EBP plug. With the plug removed, it was easy to see the problem; the plug is broken and does not make good contact when plugged in (Figure 8).

With a new plug installed on the EBP harness, the vehicle was taken on a test drive while capturing data (Figure 9). The scan data showed the engine running as it should. This problem was quite simple — just an EBP sensor that was not reporting correctly. By using the power of the scan tool and the power of service information, the problem was easily found, easily fixed and it was fixed right the first time. *ZZ*



**THIS IS A PHOTO TAKEN OF THE EBP PLUG.** The problem with the vehicle is the plug is broken and will not properly contact with the terminals in the sensor.



**ALBIN MOORE** spent 21 years in logging before opening in 1992 a shop that specializes in drivability problem analysis.

He is an ASE CMAT L1 technician with 40 years of analyzing and fixing mechanical and electrical issues.

[bwrench@yahoo.com](mailto:bwrench@yahoo.com)



# BEATING FLAT RATE — AT WHAT COST?

TO MAKE MONEY ON COMMISSION-BASED PLANS, TECHS FEEL PRESSURE TO CUT CORNERS

**PETE MEIER** // Technical Editor

**O**ver the Christmas holidays, I happened on a documentary that told the story of American Airlines flight #191 — to date, the single worst air crash in our country's history. The story covered the aftermath of that accident and the resulting FAA investigation into the causes. It was the conclusions of that investigation that really raised my interest, and as you'll see as I share what I learned, this tragic occurrence has lessons to share with all of us in our roles as professional technicians.

On May 25, 1979, 271 passengers boarded AA 191 at Chicago's O'Hare airport. Shortly after the big jet rotated on takeoff, the left engine separated from the wing and literally fell off of the aircraft. It also ripped through vital hydraulic and electrical lines, including the "shaker" that warns the pilots of an impending stall by vibrating the primary controls.

The pilots knew they had lost an engine's power, but didn't realize they had lost the engine structurally. They followed emergency procedure for a loss of power as the plane continued to climb, attempting to gain enough altitude for a safe return back to the airport. When the last of the hydraulic fluid leaked out, the front wing slats on the left wing closed, reducing the

amount of lift on that side of the DC-10-model aircraft, causing the plane to dip over into a hard left turn until the wings were nearly vertical to the horizon and stalled. With the wings no longer producing lift, the plane crashed shortly after, killing everyone on board.

## Why?

The aircraft had just been in for maintenance eight weeks earlier. Part of the maintenance was an inspection of the engines and their mounts. On the DC-10, the engines are attached to the wing through a highly engineered part called the pylon. This mount supports the weight of the engine and is attached at two points, fore and aft. Accessing the areas of the mount for inspection is supposed to be performed after the engine has been removed from the pylon, but the procedure to remove the engine was involved and time-consuming.

And here is where the story really caught my attention.

Rather than remove the engine first, someone decided it would be so much easier if the engine and pylon were removed as an assembly. An engine stand was mounted on a forklift and the lift was used to support the weight of the two during removal. Once the work was completed, the lift was used to raise the assembly into place while the pylon was reattached to the wing. And here is where the problem occurs. During the

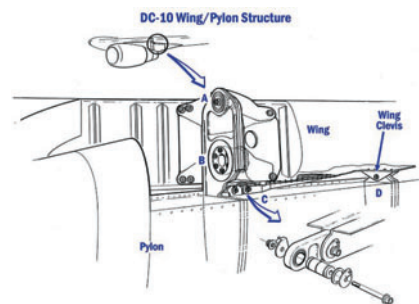


IMAGE: FAA

**THE AFT MOUNT OF THE PYLON** is the single "wing clevis" shown in the diagram. The mass of the assembly was enough to crack this mount during the reinstallation. This short cut cost more than 270 people their lives.

reinstallation, proper positioning of the pylon mounts is critical to protecting them from damage. That kind of precision placement is kind of hard to do with a forklift positioned perpendicular to the mount. During the job, the pylon aft mounting plate was cracked, ever so slightly, and the damage went unnoticed by the maintenance team. That's easy enough to understand, since they just inspected that component and found it to be serviceable.

During the next eight weeks of takeoffs and landings, additional stresses caused the crack to grow until the aft mount finally failed. It failed on the takeoff roll of AA #191, causing the full weight of the engine to pivot down on the front mount until it too sheared, allowing the engine to complete its rotation over the front edge of the wing and finally coming to rest on the runway.

## Sound familiar?

There isn't a commissioned technician I know of that hasn't come up with ways to make a job go faster or easier. I'll never forget an instance back in the early days of the Dodge Neon. When first introduced, they were notorious for leaking oil from the original head gasket design, and we repaired dozens of them under factory warranty (I worked for the local dealer at the time) using the new MLS-style gasket. Some of the techs where I worked loved the jobs and could complete them in just a few hours. How, you ask? By cutting some major corners, that's how.

Rather than remove the head and clean the gasket surfaces, these "techs" would remove the head bolts, leaving the cam and timing belt intact, and

simply lift the head just enough to slide the old gasket out and the new one in. They weren't concerned if the gasket failed, or if some other problem arose, arguing that they would just fix it again "under warranty."

And how many of us love to tackle A/C evaporator cores by peeling the dash back and laying it on the seat, rather than removing it completely from the car? I loved the Chrysler minivans when the book time was still something like 12 hours or so. Heck, I could have one done in four hours, and that included sucking out the refrigerant and charging it back up!

The difference between these two examples is significant though. In one, there was no regard for the consequences of the shortcuts taken while

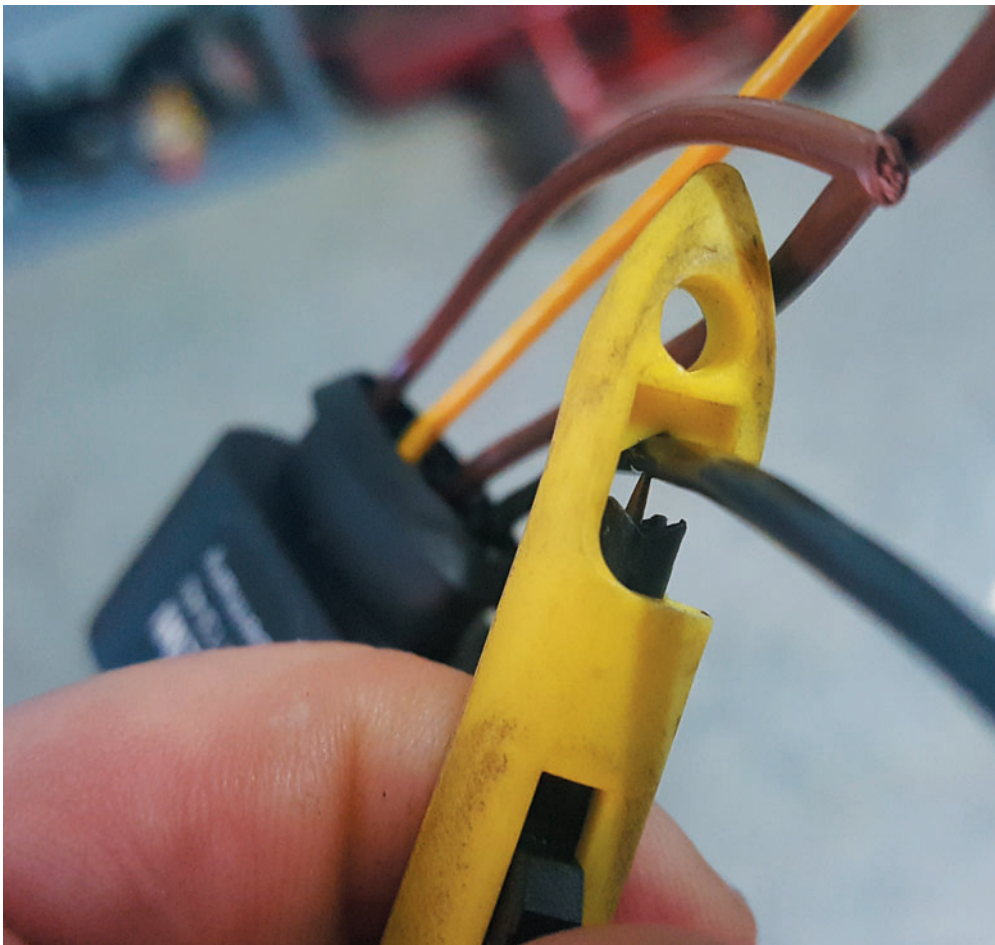
the other was a generally acceptable way of approaching the repair (so much so that now flat-rate times have been adjusted accordingly). The yardstick, for me anyway, has always been based on industry acceptable "best practices" — in other words, "First, do no harm."

That can be a major no-no, like the gasket replacement example I just shared. The surfaces of the head and engine block were never cleaned, the timing belt tension and alignment were never verified and the head bolts were installed with air tools rather than a torque wrench. How much potential for harm is there in that scenario? I guess it's a good thing that we don't have to sign our names to the maintenance logs for each car we service, isn't it? But if it was required, would you be willing to sign yours?

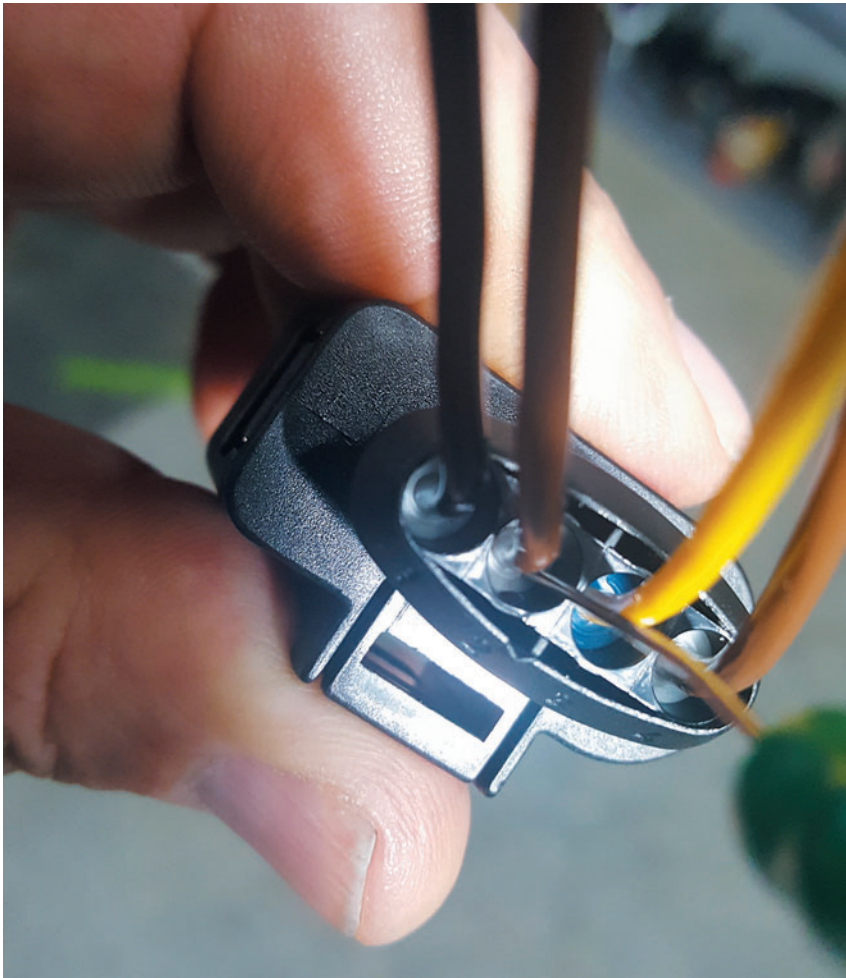
## Avoid harm when performing electrical checks

On a related note, let's talk about "doing no harm" when performing electrical tests on your customer's car. The most effective tests are performed with the system operating and that means we have to access the circuit wiring while it remains intact. There are two ways we commonly do that: backprobe the connector or pierce the insulation of the target wire. Both can be effective and efficient — both can create future problems if done improperly.

Backprobing promises the opportunity to avoid damaging the wiring, but only if done carefully. It is imperative that your backprobe be designed for that purpose. Many techs use



**PIERCING CAN BE AN ACCEPTABLE WAY** of accessing an electrical circuit if you follow the "best practices."



**FOLLOW THE WIRE INTO THE CONNECTOR** and position the probe in the space between the weather seal and wire — not through the seal as you see here.

the “T” pins you can find at any store that sells sewing supplies, but it is also possible to short two of these pins together during testing, and that may be just enough to let all the smoke out of the ECU you’re connected to! It is also not uncommon to place your probe in one cavity, yet come out on the other side on one of its neighbors, again resulting in a potential component-damaging short. Last but not least, if the probe passes anywhere other than the space between the weather seal and the wire’s insulation, damage to the weather seal may be enough to allow moisture in with the resulting corrosion that accompanies it.

Piercing will certainly cause a hole

in the wire’s insulation, so be sure to seal that hole when you are done with some liquid electrical tape. When clamping down on the wire with your piercing probe, use only enough tension to make contact with the wire strands inside to avoid damaging too many of them in the process.

See you next month! 



**PETE MEIER** is an ASE certified Master Technician and sponsoring member of iATN. He has over 35 years practical experience as a technician and

educator, covering a wide variety of makes and models. His primary goal is to bring working techs the information they need.

[pete.meier@ubm.com](mailto:pete.meier@ubm.com)

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# CLOAKED ISSUE

SOMETIMES ONE PROBLEM WILL HIDE ANOTHER

**RICHARD MCCUISTIAN** // Contributing Editor

**T**hose of us who have attended manufacturer schools know full well how important the progression of a repair goes. First, the concern must be verified (if possible). The freeze frame data helps in that regard with drivability problems, because that snapshot provides what Chrysler used to call a “similar conditions window.” But then there are those problems a scan tool can’t detect — but our ears and eyeballs can. Spraying or dripping fluid leaks; engine noises from inside and outside; whining alternators and power steering pumps; rattling or rumbling A/C compressors. Those are easy to verify, but some of them can be difficult to pinpoint.

Back in 1977 I was working at a

small independent shop for a guy named Ed Davis. That shop had a concrete floor, but no lifts; it looked like a big barn, but it was in a good location. One day a '70 model Ford pickup came driving in the door, and it sounded for all the world like something major in the engine was about to come undone. I stood there thinking we had a major overhaul on our hands, but Ed had the owner switch the engine off, and then he took his pocketknife and cut both belts off. I noticed that one of the belts was gapped and had chunks missing, but so what? That noise was nasty — surely there was metal on metal hammering somewhere! But when the owner restarted the truck without the belts, it sounded so smooth and quiet that I absolutely couldn't believe my

ears. A new set of belts fixed that one. Since then, I've been smacked around a few times by one problem either imitating another or cloaking one.

## The Titan

The subject of today's article — a 2005 Nissan Titan with 157,647 miles — hadn't been driven for a while because the owner was certain that the engine was destroyed, and she wanted us to listen to it. She said her husband had driven it until the oil light came on and kept driving. That sounded serious, but we figured we'd evaluate it anyway. She left the truck one night after we were closed and gone, and we looked at it the next morning. We initially noticed two things. First, before we even started the engine, we found that the oil wasn't touching



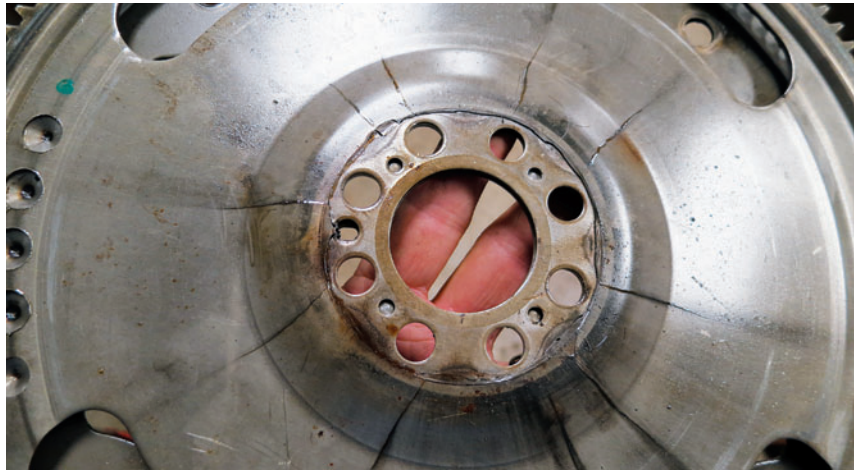
**THIS IS A DOGGONE NICE TRUCK** — well worth the cost of an engine.

PHOTOS: RICHARD MCCUISTIAN

the stick, but it only took three quarts to put it on full, so it wasn't low enough for engine damage, and she didn't mention having added any oil.

When we started the engine, it was rattling to beat the band in the bell housing area and leaking oil from the rear main so fast that it made a puddle nearly two feet in diameter within three minutes. Seldom do we see a pressure-driven leak that bad this side of a double-gasketed oil filter.

The noise sounded suspiciously like a cracked flywheel, but we didn't hear anything else. That being said, how long do you want to let an engine run when it's bleeding to death, and who could hear anything over that nasty rattling in the bell housing anyway? It was telegraphing all over the place. I called and suggested that she let us jerk the transmission out for some exploratory surgery, and she agreed. What we found was a very seriously cracked flywheel. Not only was it cracked around the bolt circle, but it had cracks radiating toward the ring gear. This was a big noisemaker. A new flywheel from Nissan is only a little more than a hundred bucks, and we got her to agree to the flywheel and a rear main seal. We had also drained the transmission oil (which was kind of black), and she'd get the new red stuff, too. This transmission has a metal screen that can be cleaned and reinstalled. We steam-



**I HAVE SEEN A LOT OF CRACKED FLYWHEELS**, but this one took the cake for having been driven many a mile until it began radiating cracks from the bolt circle.

cleaned the muddy transmission and the other parts in preparation for the reassembly, but the flywheel wouldn't be in for a couple of days.

### Altima engine swap

About that time, we drew an engine swap job on a 2005 Altima that came in rattling like a diamondback, and the owner was savvy enough to have a replacement engine dropped off right after the car rolled in. Externally, the replacement mill was rusty on the steel and chalky on the aluminum. It looked like it had been sitting somewhere damp, but it turned easily with the breaker bar, and there was no sludge we could see in the oil splash area through the filler cap hole, so we didn't even yank the valve cover. It did get a rear main seal

just for grins. I considered transferring the catalyst heat shield from the original engine, but those little bolts will usually snap when you try to remove them, so I left it be.

With everything disconnected and the powertrain sitting on the OTC lift, we decided to take the Autel scope camera and the MaxiSys we got from AE tools to have a look in the upstream O<sub>2</sub> sensor hole at the brick, where we found at least part of the reason for the engine failure, and it's a fairly common occurrence on these little rascals. That potential source of damage tends to be cloaked if you don't look here. The catalyst on the bad motor looked like Bryce Canyon Utah on a moonlit night when we took our snapshot, and some of that brick dust must have made it through



**YEAH, WE SHOULD HAVE CHECKED THIS FIRST.** It was a bad call, and all mine, to go after that flywheel noise and that geyser of an oil leak. We never stop learning, it seems.



**WITH THESE TWO GROUNDS SWINGING**, the Nissan would just sit there and spin, which isn't particularly surprising. What's worse is when the guilty ground is buried somewhere out of sight.

the remaining comb, into the EGR system, and back into the chambers. The early Ford SHO Taurus engines tended to have that problem, too. Fortunately, the replacement engine's cat had a nice, healthy looking light-off honeycomb.

And every Altima veteran knows it's a good idea to shove new cam and crank sensors in the used replacement engine, but we didn't (why, I still don't know). And this time we got lucky, but at first we didn't think so. The replacement engine spun without fire and even showed moderate activity at the COP coils with the PICO wand, but then we found two small ground wires on the upper part of the timing cover he had

left swinging, and when we got those in place we had fire in the holes. After a few test drives, we found that it would sometimes default to idle and throw TP sensor codes; it would need a throttle body. We had used the car's original one when we sewed it up, because the one that came with the replacement engine had fallen prey to the elements, and risking that one would be a bad bet. Even with a customer-supplied engine, that job wasn't cheap at the end of the day, but today it's back on the road.

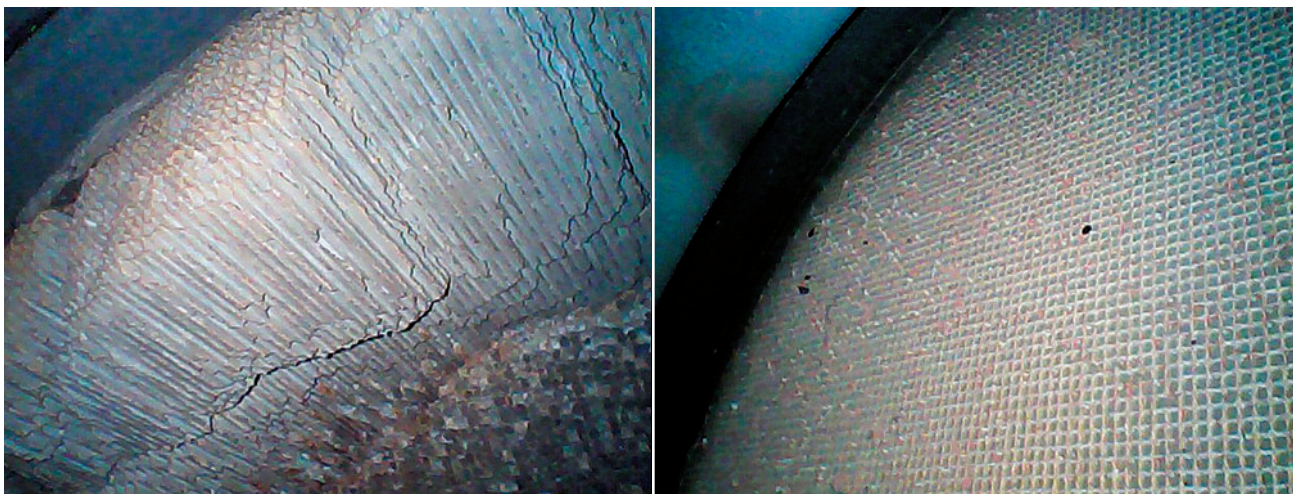
### The frozen Focus

The 2010 Focus belongs to a colleague, and her complaint was that she'd

lose her air conditioning after driving awhile. One of the first things we noticed was that the suction line would become coated with ice. This was a freezer, and we needed to know why. The evaporator thermistor likes to die and prevent A/C engagement on these Fusions, but could it possibly fail the other way? We had popped one in there last year, and she didn't seem to have much trouble after that, but this past autumn the problem returned, and we broke out the IDS to see what we could see on the PID list. Measured with a thermometer, the register temperature would drop into the low 20s with the evaporator temperature read-



**THIS WAS ACTUALLY KIND OF FUNNY** — a guy down the hill who primarily does diesel nuts-and-bolts work made this connection and couldn't figure out why it wouldn't charge; the alternator was checked and found to be fine.



**THE CATALYST ON THE ALTIMA WAS A NASTY MESS**, and this isn't uncommon on those vehicles. Fortunately, the replacement engine's cat looked healthy, but a bolt-on replacement runs about \$350 or so if needed.

ing hovering just below 50 degrees. What the heck was this all about?

Let me go on record by saying that I absolutely love Identifix and wouldn't be without it, but in this case, the I-fixers weren't much help. A/C problems abound on Ford Fusions, and it's easy to get bogged down wading through all the posts. I put in a hotline request and the guy suggested installing a resistor in series with that NTC thermistor — higher resistance translates to a lower measured temperature. A very competent Ford tech I know suggested the same thing. Had it been done successfully before? I had no idea.

With everything sitting fallow and the control box out of the loop, the thermistor measured the right resistance for ambient temps. And while I could see the hotline guy's logic, I couldn't figure out why it'd be necessary to add a component like that to a system that wasn't built with it. Of course, there have been times in my career when I did stuff like that for troubleshooting purposes, and so that's what I did this time, but nothing seemed to change. In the meantime, we also noticed that the blower was come and go, and we had to replace the controller and its connector to take care of

that problem — that's another common malady on more than a few vehicles we saw last summer.

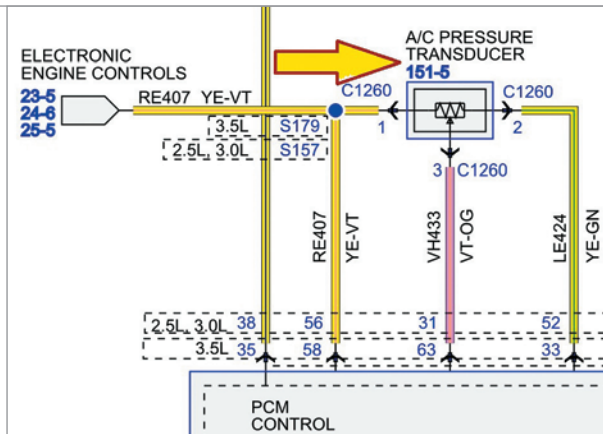
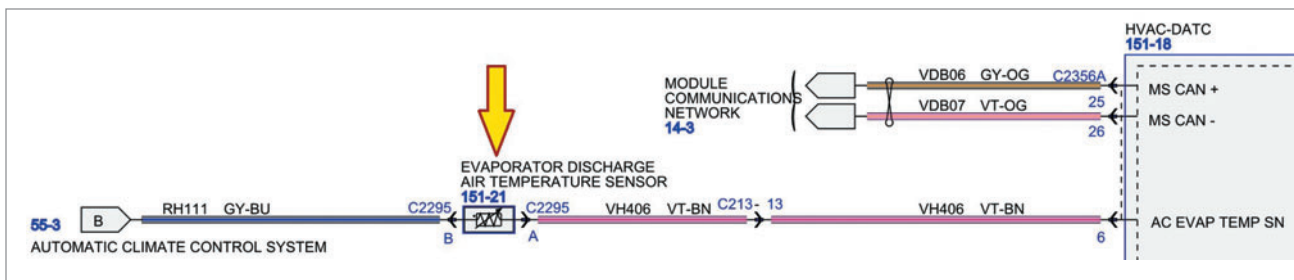
While we were fighting the Focus, a 2006 Pontiac G6 came in with a charging system that wouldn't work. Well, as it turned out, somebody had worked on that one in the starter area and had connected the fuse-linked alternator charge wire to the solenoid post that

fed the starter motor where nothing is supposed to be. The charge current from the alternator was never making it to the battery; it was apparently just slowly spinning the starter motor as the car was driven. That one was easy to find because there was no B+ measured at the big alternator terminal. It looked like somebody had put the charge wire on the terminal that was easiest to get to. Rookies do that sometimes.

My breakthrough on the Focus freezer came when Jimmie, one of my superstars at a nearby Ford dealer, ran into the same problem on a Fusion he was working on. After replacing that \$20 thermistor and his Fusion was still freezing up, he decided that the A/C pressure transducer was at fault (I had never seen this), and while he was ordering one for the car he was working on, I had him snag one for me. And since we changed out that \$125 transducer, our Fusion has had normal A/C. The part is easy to change. This cloak came from the fact that the actual temperature of the evaporator case plenum was skewed because the evaporator was freezing up and blocking airflow — rather than measuring the actual evaporator temperature



**THE FREEZING EVAPORATOR** was apparently blocking the airflow across the thermistor on this Fusion. It's not in the heat exchanger like they used to be, and that created the confusion.



**THE DISCHARGE SENSOR** was what we found ourselves focusing on, but actually the easy-to-change pressure transducer was at fault — it stopped the freezing problem for good.

the old fashioned way, the thermistor is measuring that open area, and for some reason it doesn't read the temperature of the air that's exiting the registers. Thus, this problem was cloaked by design, albeit not purposely. The IDS PID in this case wasn't particularly friendly or helpful. One way or another, this one snowed us for a while.

### Clash of the Titan

The flywheel came in for the Titan, and with the oil leak fixed and the transmission re-stabbed, it was the end of a long day. We started the engine, and it didn't leak oil and ran quietly, but we didn't warm it up or test drive it that day. That would happen the next day, and when I spoke to the lady on the phone, I told her that the jury was still out, but I'd know more tomorrow. And I did.

The bullet wasn't dodged. When we started the engine the next day to test

drive it, we heard a tattletale knock as soon as we dropped it in gear — and it wasn't a good sound. Apparently, it had gone lower on oil than we had presumed, to the severe detriment of some bearings. At that point we pulled the sump pan to find two things. We found a partially clogged oil screen and slivers of engine life forces swimming in the sump. It wasn't a good feeling, but the lady who owned the truck was surprisingly understanding — the flywheel had indeed needed replacing, but a replacement engine very probably would come with one anyway, and that 2010 truck is worth an engine. I even found her one for a good price, but she decided to put off the repair until she could feather out financially. They drove the truck away with the knock, and from what she told me, we'll see her again when she gets an engine. It was a heck of a lot quieter and there were no oil leaks, but it still felt like we had dropped the ball — and I guess we did.

one serious problem cloaks another one to the point that the first fix isn't the final one, and some customers are more understanding than others. And I don't like this any more than the customer does. With 20/20 hindsight, I realized that we should have pulled the sump pan before we went after that flywheel, because it would have been easy to do, and the bad call was all mine. I suppose the vibrations from the flywheel coupled with that hard rear main seal must have been the perfect formula for making a pint-a-mile oil leak, especially with the bearing(s) hammered out. Well, at least we got that oil leak fixed. *ZZ*



**THIS IS THE PART NUMBER** for the transducer on a 2010 Fusion, in case you run into one of these.

### Conclusions

I was lamenting the experience with that Titan to my advisory committee, and several of them said they had experienced the same kind of pitfall —



**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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# Upgrading your scan tool

**W**ith the right automotive diagnostic scan tool, you can pinpoint vehicle issues faster, helping you fix more cars and make more money. The wrong tool can send you down a rabbit hole, throwing parts at a car because of misleading information and a wrong diagnosis.

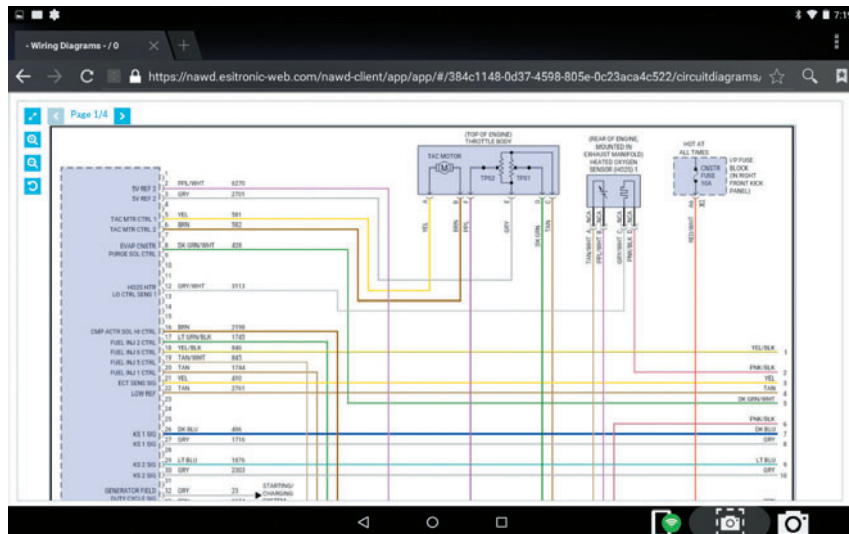
If you're looking to upgrade your current scan tool, it's important to consider the features and capabilities you need in your shop. Will a code reader do the job, or should you invest in a true diagnostic tool with bidirectional controls, special tests and repair info? If you don't have a scan tool and are looking to get your first, what do you need to get started?

As you consider which scan tool is best for you, here are some things to consider:

**Operating System:** Android or Windows? With both systems available on various scan tools, an Android operating system is more universal and typically offers faster speeds, giving technicians better ability to multitask and faster access to data.

**Diagnostic Capabilities:** What type of capabilities do you need in diagnosing vehicles? The OTC Encore and Evolve offer more than 30 million fixes right on the tool with millions more available through direct linking to Identifix and other repair networks. OTC automatically transfers vehicle data, including YMME and DTC's to help expedite your search.

**Accessing Diagrams:** Do you frequently go from your tool to a computer to pull up wiring diagrams? The OTC Evolve is



OTC's Evolve includes access to full color full-system wiring diagrams for vehicles 1986 and newer right on the tool

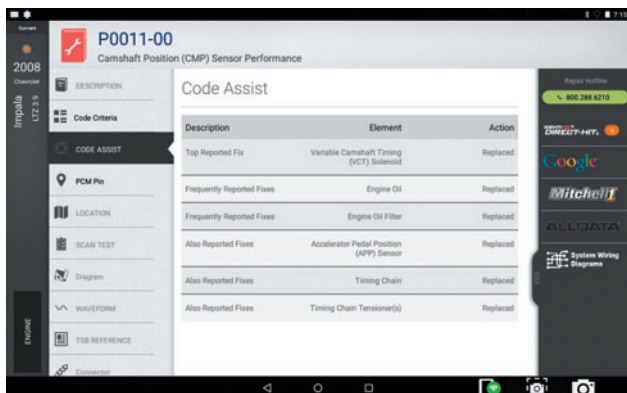
the only scan tool that offers full color, full system wiring diagrams for vehicles 1986 and newer, right on the screen, available directly from the tool. The Evolve's exclusive on-tool wiring diagrams cover nearly 50 passenger vehicle systems and some medium-duty truck systems.

**Software updates and subscriptions:** How often is the tool updated with new coverage, tests and bidirectional controls? Do each of those updates cost money, or are they sold as an annual subscription? Does the tool continue to work if you don't update or renew your software?

**Cost:** Whether you're making weekly payments or buying a tool outright, cost is a major factor. Scan tools can range from \$1,000 to \$10,000 or more. How long will it take you to earn that money back at \$50 or \$80 for a diagnostic read?

**Additional Features:** Some scan tools offer options such as Bluetooth and WiFi to allow connections to printers and wireless networks.

Figure out what you need and where your current tool falls short, then start comparing tools to find what best fits your needs. You can compare the Encore to the Evolve and our competition at [OTCTools.com/fix/more-cars](http://OTCTools.com/fix/more-cars).



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OE-style MLS head gaskets don't address the challenges you face in the service bay. But Fel-Pro® PermaTorque® MLS head gaskets do.

## What's different? Almost everything.

Virtually every element of a Fel-Pro PermaTorque MLS head gasket has been precisely tailored both to the engine's true operating environment and the harsh realities often facing repair professionals. In your job, you're encountering head and block castings that have been exposed to thousands of thermal cycles – some of them severe. Sophisticated, potentially corrosive coolant chemistries have impacted surface conditions. And your ability to restore deck finishes to the ultra-precise specs required for many OE-style MLS gaskets can be difficult at best. In addition, many OE-style gaskets are available only in original bore sizes and thicknesses, ignoring the fact that overboring and deck refinishing are commonplace in the repair environment.

Each of these realities is addressed in a Fel-Pro PermaTorque MLS gasket.

Fel-Pro engineers design these gaskets with larger combustion openings and



Fel-Pro PermaTorque MLS head gaskets feature a proprietary coating engineered to provide unparalleled fluid sealability for head and block surfaces as rough as 80 Ra.

slightly greater overall compressed thicknesses to accommodate machining. Plus, these gaskets feature a proprietary coating engineered to provide unparalleled fluid sealability for head and block surfaces as rough as 80 Ra. By comparison, many OE-style MLS gaskets call for a 30 Ra micro-finish, which can be very difficult to achieve in a typical repair environment

It's also true that many engines experience significant "head lift" that taxes not only the spring-like capabilities of MLS technology, but also the OE gasket's combustion seal. Many Fel-Pro PermaTorque MLS head gaskets feature the brand's LaserWeld® technology, an enhanced combustion seal first developed for – and widely used in – professional racing engines. This technology ensures the far more robust seal needed in cases where increased combustion pressure and reduced clamping forces can lead to significant head lift.

## Results matter.

Fel-Pro gasket engineers analyze, model and validate applications in the real world rather than assume OE-style design and technology will work in the repair environment. Engineers apply stringent test



The Fel-Pro brand's LaserWeld technology ensures a far more robust combustion seal – a vital benefit in an age of rising combustion pressures and increased head lift.

standards and validation processes to every product that carries the Fel-Pro name. In fact, the Fel-Pro Field Test Garage conducted well over 1 million miles of on-vehicle gasket analyses and validation in 2016 alone.

"Repair professionals turn to Fel-Pro because they are confident in the sealing repair that our gaskets allow them to provide to their customers. For nearly 100 years, we've focused on the needs of the professionals who install our parts. We not only analyze the data, but we also model the application and then engineer a product that is validated to the conditions repair professionals will experience with installation," says John Gurnig, chief technician in the Fel-Pro Field Test Garage in Skokie, Ill.

Which approach helps you feel more confident about the repair? A gasket that simply mimics the OE design, ignoring the realities you're facing each day? Or a Fel-Pro PermaTorque MLS gasket, application tested and real-world validated?

Visit [www.FelPro.com/blog/repair-environment](http://www.FelPro.com/blog/repair-environment) for more information.

**FEL-PRO**  
THE GASKETS PROFESSIONALS TRUST™

**“There’s just no other gasket brand.”**



Michael Haskett | Owner and ASE Certified Technician | Fel-Pro Only since 1992

FelPro.com     #PartsMatter

**“ ONLY FEL-PRO<sup>®</sup>**  
**has the coverage I need to service the vehicles**  
**I work on, whether it’s European, Asian or domestic. ”**

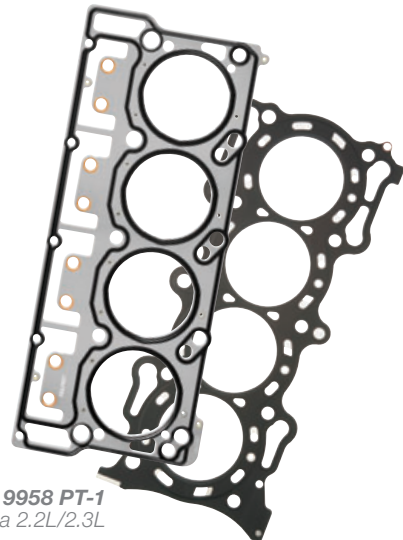
Trust Fel-Pro<sup>®</sup> for industry-leading coverage and assurance  
of a complete sealing solution for every repair.

 **FEL-PRO<sup>®</sup>**  
**THE GASKETS PROFESSIONALS TRUST™**

Visit **FelPro.com** to learn more about  
our problem-solving Power Stroke<sup>®</sup> head gasket!

**26374 PT**  
Power Stroke 6.0L

**9958 PT-1**  
Honda 2.2L/2.3L



# #8150 4.5" Diamond Grinding Wheel

**D**iamond abrasive products are more expensive to manufacture than standard abrasive disks; however, they last longer and perform better while maintaining their size and shape throughout their cutting life. The 4.5" Diamond Grinding Wheel (#8150) from Innovative Products of America® saves time and cost, while offering unparalleled versatility and performance.

Typically, bead grinding and prepping metal is slow work, filled with hot sparks and unhealthy, odorous soot. With IPA's 4.5" Diamond Grinding Wheel, there's barely any sparks or smell, and it maintains its shape and size throughout its extremely long life! The wheel lasts a minimum of 20X longer than traditional grinding wheels due to its industrial, diamond-abrasive coating, which is brazed onto the type 29, depressed-center machined wheel.

The #8150's innovative, three-dimensional contour allows for fast cutting, gully grinding, bead finishing, and even



back cutting without having to grind upside down, or stop and flip the work over to clean an edge. The wheel provides consistent reach and performance when dressing welds, accessing corners and more. It has a 7/8" arbor with 5/8" adapter and can be used on all ferrous metals, concrete, and ceramic, as well as

aluminum with proper lubrication.

IPA's 4.5" Diamond Grinding Wheel (#8150) delivers unmatched capability with its highly durable, diamond-abrasive coating and maintains its diameter and shape throughout the life of the wheel — a professional solution for professional metal workers.



**IPA**<sup>®</sup>  
**FUTURE NOW**<sup>®</sup>







Grinder not included

#8150

## 4.5" DIAMOND GRINDING WHEEL

*Lasts a Minimum of 20X Longer Than Traditional Grinding Wheels*

- Innovative, three-dimensional contour allows fast cutting, back cutting, gully cutting and bead finishing
- Maintains diameter and shape throughout life of wheel
- Significantly less sparks, odor and debris
- 7/8" arbor with 5/8" adapter - 14,000 rpm max



#9008-DL

## SUPER MUTT® TRAILER TESTER

**PRO EDITION** 7 Round Pin

*One Man Diagnostic Testing for Lights, Air Brakes and ABS*

- Remote controlled from over 200 ft. away
- Current, ground and circuit fault detection
- Diagnostic Pulsar Mode®, air brakes, leak down and servo testing



## MOBILE UNIVERSAL TRAILER TESTERS

*Other models available:*

Part Number	Pin Type	Access ABS Blink Codes	Cable Testing	Electric Brake Testing	Air Brake Testing	Remote	Diagnostic	Battery Type (not included)
IPA9101 Light Ranger MUTT®	7 Flat Pin (RV & Utility Type)			✓		No	Short Circuit Protection	Group 14
IPA9102 Heavy Ranger MUTT®	7 Round Pin (Semi Trailer Type)					No	Short Circuit Protection	Group 14
IPA9004A Smart MUTT®	7 Flat Pin (RV & Utility Type)			✓		3-Button Remote	Short Circuit Protection, Cross and Open Circuit Sensing	Group 14
IPA9004M Smart MUTT® Pro Edition	7 Flat Pin (RV & Utility Type)			✓		3-Button Remote	*	Group 31
IPA9007A Smart MUTT®	7 Round Pin (Semi Trailer Type)	✓	✓			3-Button Remote	*	Group 14
IPA9007M Smart MUTT® Pro Edition	7 Round Pin (Semi Trailer Type)	✓	✓			12-Button Remote	*	Group 31
IPA9005A Super MUTT® Head	7 Round Pin (Semi Trailer Type)	✓	✓		✓	2x 3-Button and 12-Button Remote	*	Group 14
IPA9008-DL Super MUTT® Pro Edition	7 Round Pin (Semi Trailer Type)	✓	✓		✓	2x 3-Button and 12-Button Remote	*	Group 31
IPA9008-SE Super MUTT® Base Model	7 Round Pin (Semi Trailer Type)	✓	✓		✓	3-Button Remote	*	Group 31
IPAM2000 NATO MUTT®	7 Round Pin (Semi Trailer Type) and NATO Plug	✓	✓		✓	2x 3-Button and 12-Button Remote	*	Group 31

\* Short Circuit Protection, Cross and Open Circuit Sensing

#8044

## MASTER TRAILER CLEANER SET

*Clean and Restore Male and Female Connectors on Any Trailer in North America*

- Maintains continuity and helps prevent circuit failure
- Cleans and resizes trailer pins



#8001D

## 36-PIECE PROFESSIONAL BORE BRUSH SET

*Clean Bushings, Ports, Tubes, Channels, Sockets, Brake Guides, etc.*

- Twisted wires for increased cleaning action
- For automotive, agricultural, industrial and MRO industries
- 36 Brushes (12 Steel, 12 Brass, 12 Nylon) and 1/4" Locking Bit Head Driver



# Crash Avoidance Systems require maintenance

**Y**our customer's vehicle and its Crash Avoidance Systems capability may be at risk unless you help them make good ride control (maintenance) choices. That's correct: Shocks, struts, steering, suspension, brakes & tires are the most critical components of a vehicle's Computerized Crash Avoidance System!

TV commercials and new vehicle salespeople would have you and the motorist believing that just because a vehicle has all the latest high-tech, fancy name features that it's nearly Crash-Proof. What they don't tell you is that it only works well (if) you maintain the designed performance of its ride control components. That's when a parts professional can really help the motorist... Stay in Control.

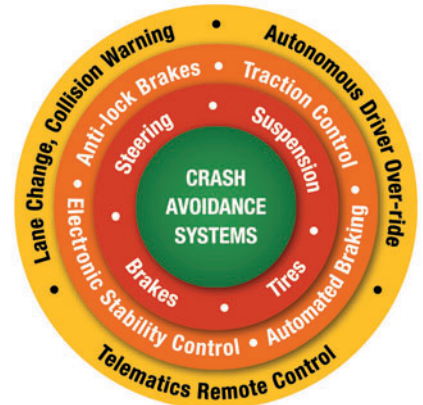
A computer system like Electronic Stability or Traction Control can't actually stop a vehicle, it can't change lanes quickly and it can't help grip the road. Only the tires, brakes, shocks & struts and ride control components



can! Computerized controls can only observe how a vehicle is behaving and make decisions about how to correct a bad driving situation. Electronics and computer software can't actually correct the problem nor avoid an accident by itself. The parts you recommend are what make the difference between it working well, or not.

So, are shocks & struts important to Crash Avoidance? Of course they are because they control the vehicle's springs, which in turn controls body movements like pitch, roll & yaw. When too much spring movement occurs due to shock & strut wear the steering becomes unresponsive which causes under & over-steer problems as well as reduced tire to road contact. As a vehicle begins to lose control, Crash Avoidance kicks in and tries to keep the vehicle in control by applying brakes, slowing engine speed and in some models it changes transmission, cruise control & steering functions.

You may be surprised to learn that National Highway Traffic Safety statistics show that most vehicle accidents occur to vehicles that are 4 to 8 years old. Virtually all vehicles in that age range are equipped with Crash Avoidance Systems, but they're still involved in the most collisions. That's where you,



the parts professional, can help your customers: by helping them understand the importance of ride control maintenance parts like shocks & struts that help keep Crash Avoidance working at its best.

KYB is one of the world's largest suppliers of shocks & struts to new vehicle manufacturers and are original equipment on many of the world's top selling vehicles. The importance of Crash Avoidance is why all KYB shock & struts have original equipment quality and are specifically calibrated to help restore a vehicle's designed performance.

Helping the motorist stay in control is an auto care industry shared responsibility. The more you know and share with the customer, the safer we all drive!

# KYB®

**World Class Shocks & Struts**



**Original Equipment  
for the Aftermarket®**

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**KYB**<sup>®</sup>  
World Class Shocks & Struts



Original  
Equipment  
for the Aftermarket<sup>®</sup>

## KYB SHOCKS & STRUTS

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



**Don't take a chance:**  
*Crash avoidance technologies help driving safety.*  
*...KYB Shocks & Struts help them work properly.*

**Your Customers Can RECEIVE up to \$80.00**  
on a VISA Prepaid Card with a  
**PURCHASE of KYB Shocks or Struts**

[www.kyb.com/save](http://www.kyb.com/save)



**MARCH 1 - APRIL 30**



# Purolator launches spring mail-in rebate promotion

**P**urolator has launched a spring mail-in rebate program across the United States and Canada to help its customers drive additional sales in the engine air and cabin air filter categories. The promotion will run from March 27th through June 30th, and customers at participating repair shops will qualify for a \$5 mail-in rebate on the installation of any Purolator air or cabin air filter.

Cabin air filters are the fastest grow-

ing segment in the filtration category. More than 80 percent of vehicles on the road today are equipped with a cabin air filter. While there continues to be excellent natural growth within the category, cabin air filter replacement is still one of the most under-performed maintenance items on the vehicle.

In addition to the savings opportunity, Purolator is providing participating repair shops with complete point-of-sale kits to further draw atten-

tion to the promotion. The kits include an informative cover letter explaining the program, counter-easel mounted rebate pads, and eye catching in-shop point of sales materials including posters and window clings.

Products must be installed by June 30th to qualify for the savings, but customers have until July 31st to redeem the rebate. For more information, visit [pureoil.com/rebates](http://pureoil.com/rebates) or contact your Purolator sales representative.

**A REAL DIRT MAGNET.**  
(AND WE DON'T MEAN THE DOG.)

**SAVE \$5**

ON ANY  
**PUROLATOR AIR OR  
CABIN AIR FILTER**  
WHEN INSTALLED AT THIS LOCATION.

Offer valid from 3/27/2017 - 6/30/2017  
after mail-in rebate.

Installer Kit  
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PUROLATOR | [www.purolator.com](http://www.purolator.com)



**When you've got the right equipment,  
nothing gets by you.**

Like Bruiser here, Purolator filters stand their ground against damaging dirt and debris. With advanced filtration technology, our full line of automotive filters fiercely defends your engine against damage – so nothing will get by you.



**NOTHING GETS BY US.™**  
[pureoil.com](http://pureoil.com)



# Can your oil filter go the distance?

Only a decade or so ago, it was recommended that the majority of passenger cars and light trucks in operation should have their motor oil changed every 3,000 miles. Today, original equipment manufacturers are recommending oil changes at 7,500 mile intervals and some at 10,000 miles. These extended intervals are being adhered to by vehicle owners because of extended warranty coverage, as well as automated service reminders, complimentary maintenance with a new vehicle purchase, and consumer concerns about the environmental impact of oil disposal.

It's interesting that the question most often asked, when discussing extended drain intervals, is not about the quality of the oil filter, but about the type of motor oil. For OEMs to establish extended drain intervals of 7,500 miles and greater, synthetic motor oils are required. Why is this? Because synthetic motor oils provide high oxidation stability and excellent lubricity, which results in longer lubricant life, but...



## What about the quality of the oil filter?

They are definitely not all manufactured to the same specification and performance level. With as many brands of oil filters as there are available in the USA, it's more important than ever to understand the quality of the filter being installed. The filter you install must have the media capacity to last the length of the recommended OEM oil change interval. Installing a lower quality oil filter that doesn't have the media capacity to continue to filter oil through the drain interval doesn't necessarily mean that oil will stop being circulated through the engine. It does mean that the pressure relief (bypass) valve has opened in the oil filter to prevent oil flow restriction. This occurs because the media has become clogged or saturated with contaminants and oil is no longer being filtered before it is circulated through the engine. Long-term use of unfiltered oil could result in expensive repairs or total engine failure. From this we can conclude that capacity is directly related to the quality of the media used in the oil filter. The media must have the capacity to continue to filter harmful particles without becoming clogged during the extended oil change interval.

## Meet MIGHTY MAX™!

To address these new extended OEM oil change drain interval requirements,

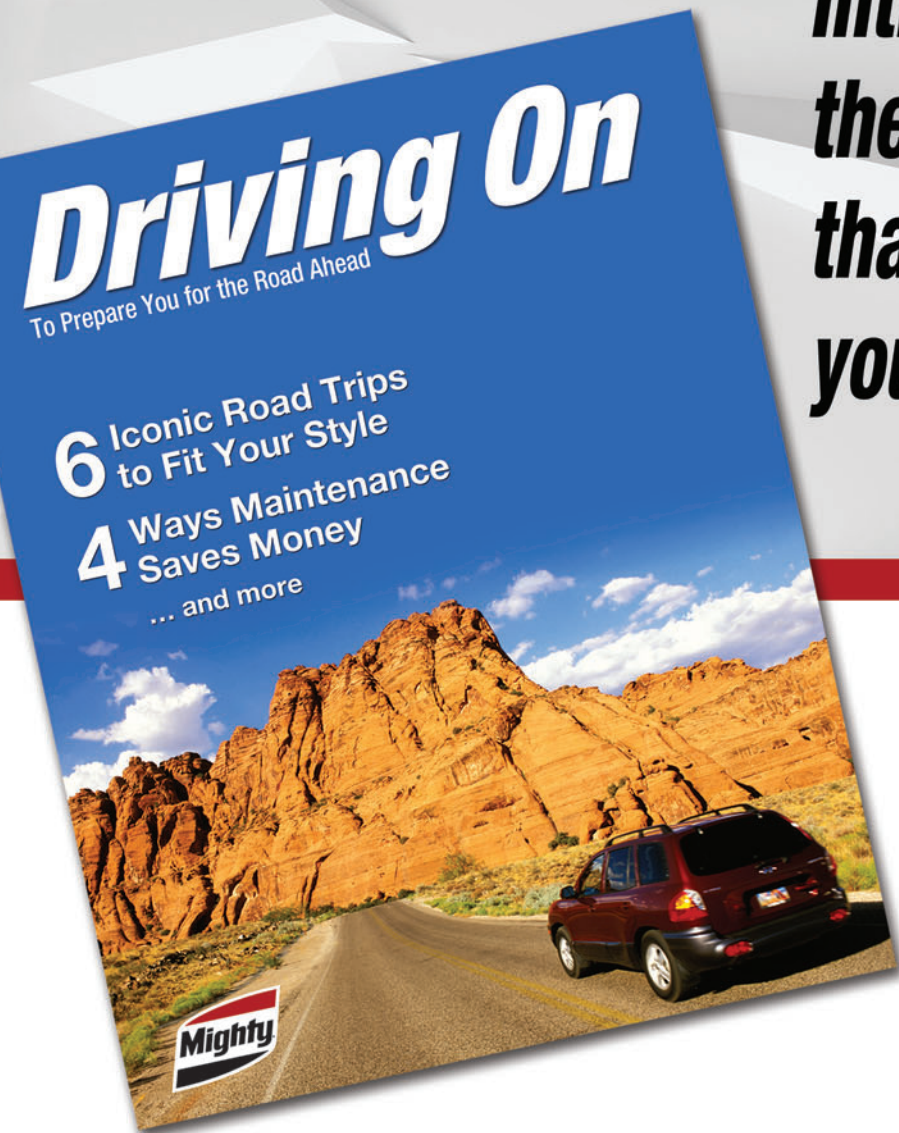
Mighty offers the Engine Guard MAX™ Synthetic extended life oil filter. The Mighty MAX™ is manufactured in the USA and provides comprehensive application coverage currently with a total of 14 spin-on and 21 cartridge oil filters. The spin-on filters are constructed exactly like Mighty's existing Engine Guard II filter, except for the media. Mighty MAX™ is manufactured with a cellulose and synthetic blended media. This spe-



cial type of media, which is also used by two original equipment manufacturers, will provide the capacity needed to meet OEM recommended oil change drain intervals.

For additional information on the Mighty MAX™ extended life oil filter program, please contact your local Mighty representative at [www.mightyautoparts.com](http://www.mightyautoparts.com).





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the new magazine  
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**Mighty**  
AUTO PARTS

**POWERING YOUR PERFORMANCE®**

# Mitchell 1 professional tech community continues to evolve

If you've ever hit the wall when diagnosing a vehicle, you know the value of having a community of professional auto repair technicians close at hand to help get you on the correct path to a solution.

In an online community, you can type your question and with a click of your mouse instantly send it to an entire community of experienced technicians. Be prepared to receive answers and ideas within a few minutes that will help get you over the hump and back to fixing the vehicle.

For about 10 years, Mitchell 1 has offered an active community of professional techs as part of its repair information system. The community has evolved over the years and is now integrated inside the ProDemand<sup>®</sup> repair and diagnostic information software, giving techs streamlined access to collaborate on diagnostic and auto repair issues with their peers.

## Community of professional techs

The Community is located in the SureTrack<sup>®</sup> diagnostic module in ProDemand. SureTrack combines diagnostic insights with repair timesavers, Real Fixes, common repair procedures for the selected vehicle, probable components to test and a waveform library. This information is available right alongside ProDemand's comprehensive OEM information, so technicians don't have to search multiple databases with multiple logins and subscriptions to find the data they need to complete the repair.

"Our SureTrack Community has helped technicians with diagnostics

since it was introduced in 2012. Since then, we've seen it grow to over 20,000 active members, contributing answers and helping their peers with tricky vehicle issues," said Gary Hixson, market manager for Mitchell 1 ProDemand. "The latest enhancement integrates the SureTrack community more tightly with our core product, ProDemand, giving technicians access to insights from community members along with the OEM and SureTrack information delivered in a single lookup."



The new SureTrack community integration also offers an enhanced user profile that allows technicians to participate in the community as individual members, even if they access ProDemand through the auto repair shop where they

work. The updated profile manager will not only provide additional security for the account, but also allows technicians to control all aspects of their personal information within the community.

## Community highlights

**Ask the Expert** — Techs with specialized professional skills, knowledge and experience can register as an "expert" and share their knowledge with other community members. Experts receive an alert when a question is posted related to their area of expertise so they can provide insights and answers. Members who ask questions validate the experts' responses by rating their answers as "Best," or "Good." All members can indicate whether a "Best Answer" helped solved a similar problem they have faced in their shop. If it did, the answer is recorded as a "Fixed It."

**Leaderboard** — The top community members are displayed in the leaderboard. Members are awarded points for answering questions as well as for how many "Best Answers" and "Good Answers" they have contributed. Those who gain the most points for the current time period are recognized at the top of the leaderboard.

Read more about SureTrack and the Community in the Mitchell 1 Shop Connection Blogs: <http://mitchell1.com/shopconnection>.

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*In your shop, at your side*

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# “I’VE GOT A TOOL FOR EVERYTHING. MITCHELL 1 IS MY TOOL FOR GETTING IT RIGHT.”

From your first look under the hood, ProDemand® from Mitchell 1 guides you to an accurate diagnosis and repair. Quickly find the solution and related repair procedures in our vast database of OEM service information and Real Fixes from professional techs.

Put Mitchell 1 to work for you, with the industry’s most complete line of software tools and services for your professional shop.

- ▶ **Repair Information:** Complete OEM and real-world information delivered in a single lookup
- ▶ **Shop Management:** Industry-leading shop productivity tools to streamline operations
- ▶ **Shop Marketing:** Automated marketing, reputation management and customer communications

#### For more information:

Call: 800-896-3126 | Visit: [mitchell1.com](http://mitchell1.com)

Or find your local Mitchell 1 sales representative:

[www.mitchellrep.com](http://www.mitchellrep.com)

[repair information](#) | [shop management](#) | [shop marketing](#)

**Mitchell1**<sup>®</sup>  
*In your shop, at your side*

# What is it like to be the best of the best?

**W**ith the largest network of auto repair centers in the country, it's no surprise that NAPA AutoCare Centers are what comes to mind when motorists' think of quality installed parts and superior repair servicing.

Since the program began in 1984, over 16,000 NAPA AutoCare Members have chosen to partner with us because we continually provide their automotive or heavy-duty repair business with the most integrated and value-driven programs, discounts and tools available.

Members' drive more new and repeat business like ever before with nationally recognized consumer facing, Sales Driver promotions. They also provide more ways to help their customers through an expensive repair with the NAPA EasyPay - consumer financing program.

NAPA AutoCare Centers emanate professionalism and trust while revitalizing their businesses through the NAPA PROimage program. In fact, those who complete a PROimage redesign of their shop exterior typically see an average increase of 27% in their business profits within 6 months.

Hiring the best talent is simple as a NAPA AutoCare member. All members are able to easily post open and available positions directly from the NAPA AutoCare Talent Network. This resource directly collects interested and capable candidates and provides them with exactly what they need to find and apply for your position quickly and easily. There are over 12,000 members who've joined the NAPA AutoCare Talent Network and are finding their careers faster



than they ever thought possible!

Staying at the forefront of technology and innovation, the NAPA AutoCare Member program contains the best mix of digital based service offerings available in the market. These include: the NAPA AutoCare App, Digital Menu Board, Digital Vehicle Inspection, NAPA Service Assistant, and leading shop management tool – NAPA TRACS.

Through these programs, NAPA AutoCare is committed to helping mem-

ber partners lead their competitors in performing diagnostic services, sharing dynamic educational resources, providing convenient communication options and much more!


Being a NAPA AutoCare Center means you're one of the best of the best in your market.

Learn more today and change your business forever.

Visit: <http://www.napaautocare.com/features-benefits.aspx> to get started.



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A crash test dummy named Larry is the central figure. He is wearing a bright blue jumpsuit with a yellow and black hazard stripe across the chest and a name tag that says "LARRY". He has a white helmet with a yellow and black hazard symbol on the forehead and white gloves. He is standing in front of a car with its hood open, with the engine compartment visible. The background is a blurred car shop.

**YOU DON'T  
WANT ANY  
LARRY  
WORKING  
AT YOUR  
SHOP**

**WHEN IT COMES TO HIRING THE BEST TALENT, OUR MEMBERS  
USE THE EXCLUSIVE NAPA AUTOCARE TALENT NETWORK.**



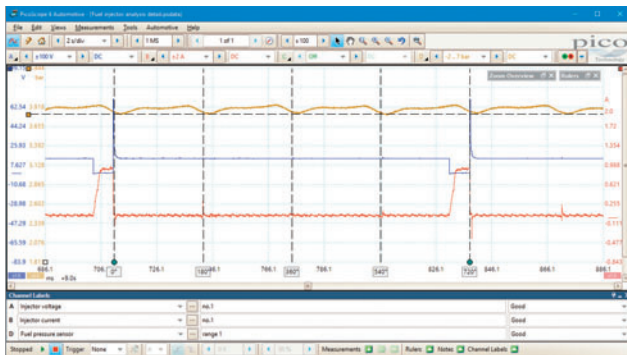
Contact your local NAPA store or visit  
[NAPAAutoCare.com/Benefits](https://www.NAPAAutoCare.com/Benefits) for more information.

# Diagnosing a misfire with PicoScope

The UK based firm **MarkStammersDiagnostics** was recently called out to assist with a 2001 Vauxhall Corsa, engine code Z12XE. The vehicle was suffering from a misfire and was repeating the Diagnostic Trouble Codes (DTCs) P0300 Random misfire detected and P0302 Cylinder 2 Misfire.

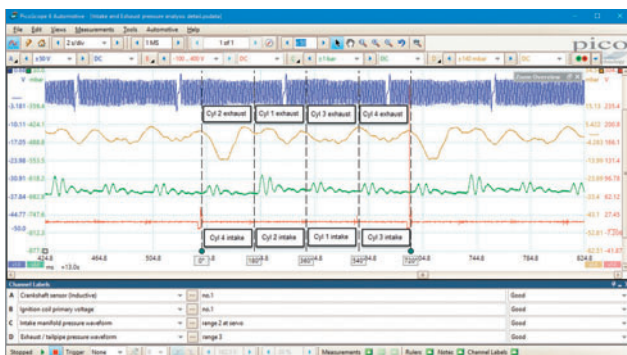
The garage that called on Mark's services had already replaced the spark plugs and the ignition coil and had verified the cylinder compressions. They were concerned that the fuel injector could be the problem, but had not been able to replace it or check it properly.

Mark's first call was to perform a quick fuel pressure and injector delivery test with his PicoScope and the WPS500X pressure transducer. The result proved that he could rule out the fuel injectors, as each injector's performance showed symmetry between them.



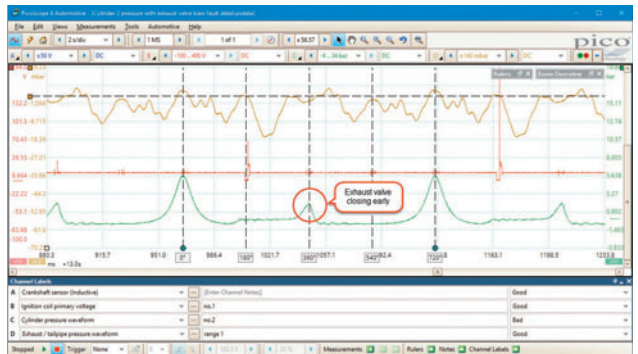
During this test it became apparent that the engine was quite noisy. Mark decided to do a quick capture of the cam and crank synchronisation while already working in that area. Having analysed it, looking for any deviations, it checked out fine.

Mark then looked at finding the answer by inspecting the intake pressure and the exhaust pressure, using his WPS500X. This result showed a clear pattern anomaly in the intake wave-



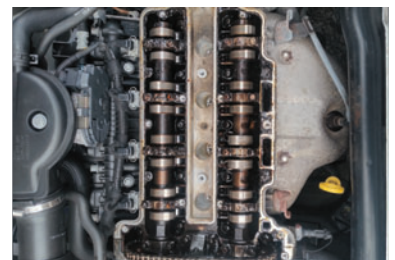
form. There was some disruption in the exhaust, but at this stage it was simply noted. The misfire was not significant and would vary in intensity during the running test, but the intake pressure anomaly seemed constant.

He then started thinking there was a fault with the intake camshaft lobes or the valve train, but could not make a definitive diagnosis. He went on to check all four cylinder pressures, again using the Pico WPS500X. This displayed a clear valve issue with cylinder two:



The pressure waveform illustrates a positive pressure ramp at the end of the exhaust stroke. This meant that the camshaft cover had to come off, so that an inspection of the cams could take place. At this point it was easy to see the problem: the exhaust cam lobes for cylinder two were worn, and the tappets had dislodged.

Initially, Mark had been thinking that the intake was the problem, but a closer look at the waveforms and a comparison with the other cylinders told the story of the fault with the exhaust valve operation.



The exhaust valves on cylinder two were opening early and closing early. The early closing resulted in the positive pressure escaping into the intake when the intake valve opened. This is the positive pressure ramp that could be seen in the intake pressure waveform.

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Technology

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# PicoScope®

#test not guess

pico®  
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## WPS500X Pressure Transducer

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

- Accurately measure up to 500 psi (34 bar)
- Ultra-fast 100  $\mu$ s response time
- Zoom function for enhanced analysis capabilities
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- Auto zeroing
- High noise immunity
- Temperature compensated



from only  
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# Raybestos® Introduces Element3™ Brake Pads

Automotive brake pads are formulated for extended life and exceptional braking



**T**he Raybestos® Element3™ line of premium automotive brake pads was developed to offer full coverage of the finest brake pads in the industry. Selected as the best, Element3 EHT™ Enhanced Hybrid Technology and Element3 PG™ Professional Grade™ formulations deliver a complete array of superior brake pads that are engineered for durability and maximum control.

Element3 EHT Enhanced Hybrid Technology brake pads include the best attributes of ceramic and semi-metallic all in one pad to provide the ultimate in noise damping and excellent pedal feel. Engineered for maximum control in all conditions, including aggressive stopping situations, and formulated for long life, less noise and reduced dust, these pads deliver exceptional braking. Late model coverage is available for domestic and import applications. Superior multi-layer noise-reducing shims promote quiet stopping performance over a variety of temperature ranges and vehicle platforms.

Protecting the environment has been a priority for Raybestos and they have been a forerunner in reducing copper levels in their friction formulations. The Element3 EHT brake pads already meet the 2021 standards set by the Copper-Free Brakes Initiative, and by 2021 Raybestos intends to meet the 2025 standards well in advance of the environmental requirements. Their timely efforts to reduce the levels of copper in their EHT pads puts Raybestos ahead of the competition in helping to protect the environment.

Delivering the best attributes of semi-metallic or ceramic comparable to OE, Element3 PG Professional Grade brake pads were developed for everyday driving conditions. These premium pads round out the coverage for import and domestic applications and extends the premium quality that professional technicians expect from the Element3 brands, to a full range of vehicles. The brake pads include application-specific slots and chamfers to suppress noise and are factory cured for effective braking right out of the box. The pads are also compliant to all environmental copper regulations.

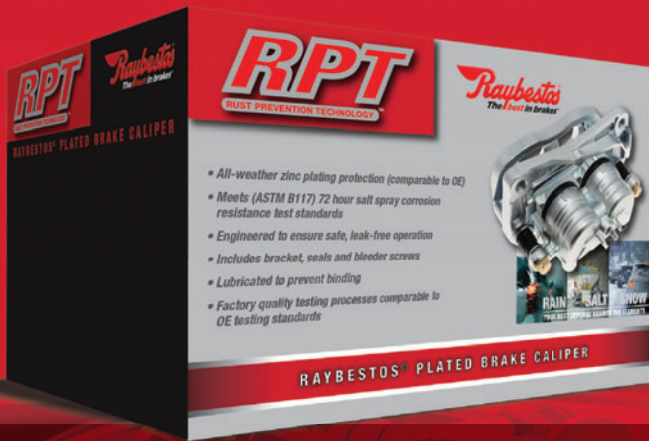
Raybestos has been known as the best in brakes for over 100 years. With a demonstrated commitment to research, development and testing, Raybestos is widely recognized for quality brake components. For more information on the Element3 line of premium automotive brake pads, or the complete family of Raybestos brake products, including disc pads and shoes, drums and rotors, wheel cylinders, calipers, hoses and hardware, visit the new website at [www.raybestos.com](http://www.raybestos.com).

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# Dan-Am Air<sup>®</sup> Advanced Aluminum Air Pipe System

**T**oday's clean air requirements are more critical than ever. Air tools, blow driers, HVLP spray guns, and supplied air respirators may require more air volume and better air quality than needed in the past. Not only does clean air effect equipment performance, but it is also critical for paint coatings performance. Dan-Am Air, along with SATA filtration can solve all of these issues.

Dan-Am Air is lightweight, aircraft grade, powder coated aluminum, which provides clean, dry air up to 232 psi. The reinforced composite Nylon fittings have dual seals, which rest on un-scraped pipe, providing a leak free guarantee. Our Press-to-Connect fittings feature a full bore design for turbulence free air delivery. This quick, instant connection eliminates the need to thread, solder or glue, accounting for far less installation times than traditional copper or black pipe.

We also stock a large array of threaded connectors and adapters, allowing Dan-Am Air to be integrated into existing systems without compromising performance, making DAA perfect for upgrade or expansion projects.

Designed with simplicity in mind, DAA allows you to do-it-yourself. Measure, cut, de-burr, then simply Press-to-Connect, equaling lower installation times and cost. All fittings arrive pre-torqued for immediate assembly and pressurization, as well as being interchangeable, allowing for ease of future addition or expansion. "This "Press-to-Connect" subject tends to be the most misunderstood instructions in the DAA system. We have all been taught since we were young, to loosen a given item,

put it together, then tighten it back up, right? That is wrong with Dan-Am Air. DO NOT loosen fitting caps before installation. It really is as simple as push the fitting onto the pipe until it bottoms out. Done. Stop. Move on. The only reason to loosen a fitting cap, is to remove the fitting from the pipe. Loosening the cap relieves the pressure on the grip ring, allowing you to gently back out the pipe. To reuse any given fitting, simply re-torque the fitting cap to factory specs (line the arrows up, see figure 1), and "Press-to-Connect. As each cap is individual to its fitting, the arrows are either solid, or hollow respectively. Fitting caps are NOT interchangeable.



Figure 1

DAA also allows you to take your investment with you in the case of relocation, as all components are reusable.

Product design and support is readily available from Dan-Am Company. They also have all products on hand and ready to ship, as well as in-house support for quotes and general information.

Dan-Am Co., is the Exclusive Importer of SATA Products for the US and Puerto Rico. Anywhere you can purchase SATA Products, also has access to our Dan-Am lines as well, including Dan-Am Air.

Please visit our Website at [www.dan-amair.com](http://www.dan-amair.com), as well as our Facebook page



[www.facebook.com/danamaluminumair-line](http://www.facebook.com/danamaluminumair-line) for recent install pics, comments etc. Both of these have proven to be valuable resources for customers to understand exactly what can be accomplished with SATA and Dan-Am Air combined.

## DanAmAir<sup>®</sup>



### BRAD GRAVENHOF

has been in the automotive industry for over 30 years and serves as DanAm Company's Sales and Technical DanAm Air Specialist.



# DanAmAir®

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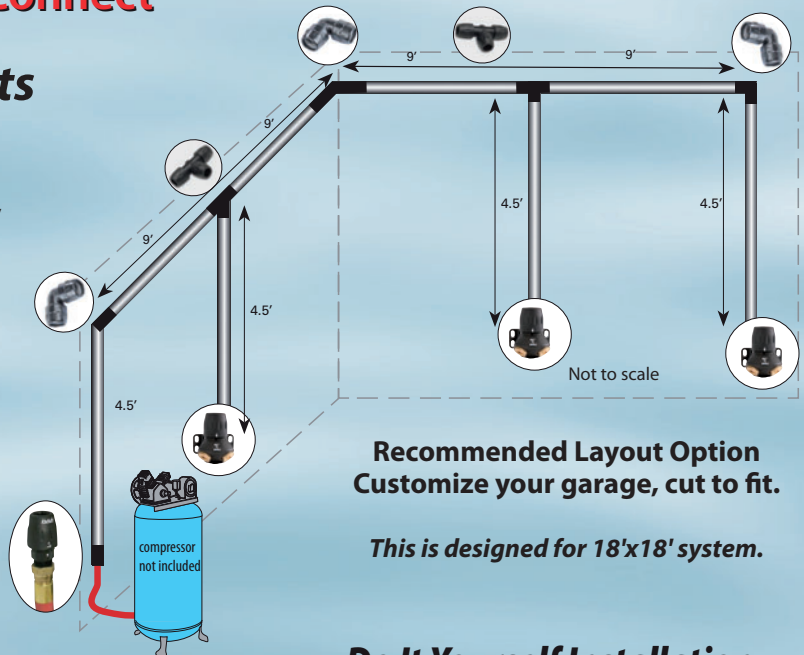
**Easy to install yourself**



**Measure & Cut • Push to Connect**

## DanAm Air's benefits

- Energy efficient
- Lower installation costs
- Push-to-connect technology
- Immediate pressurization
- Removable and reusable
- Modular design
- No corrosion
- Leak-free guarantee
- Full bore design
- 1/2" - 6" pipe sizes



**Recommended Layout Option**  
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*This is designed for 18'x18' system.*

## Do It Yourself Installation

**No threading - No soldering**

APS253 Dan Am Air Kit		25mm / 3 Drop
QTY	Part No	Description
6	1013A 25 0600	25mm x 9' Gray alum pipe
3	6602 25 00	25mm 90° Elbow
2	6604 25 00	25mm Equal tee
1	6605 25 22	25mm x 1/2" Male NPT connection
3	6684 25 22	25mm 2 Port wall bracket
5	6697 25 01	Pipe Clip
1	675805	1/2" x 5' Flex hose w/ends (compressor connect.)



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\*Savings may vary



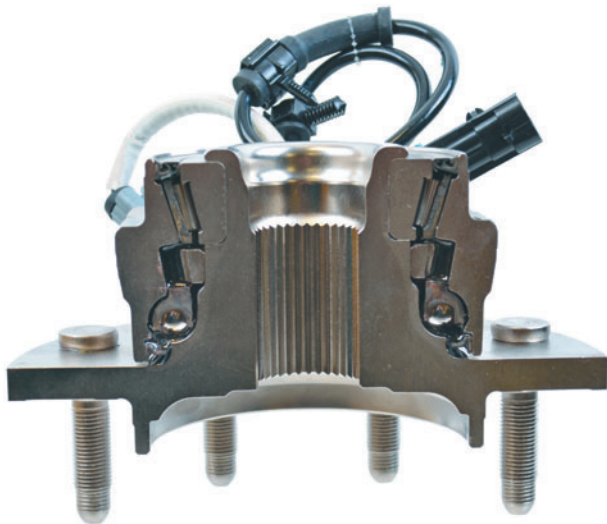
# SKF – A hub of innovation

**W**ith the continued demand to create safer and more reliable vehicles, manufacturers are looking for any edge that can strengthen components and how they perform. SKF continues to build on its history as a pioneer in the development of the first, second, third and fourth generation wheel end hub bearing units.

Today, SKF continues its ongoing partnerships with original equipment manufacturers to develop a new level of performance, reliability, safety and comfort for today's vehicles.

## The next generation of wheel end technology

SKF's X-Tracker hub bearing unit provides precision handling and braking characteristics, ultimately delivering improved handling and comfort. The SKF X-Tracker Hybrid hub bearing unit is designed to provide increased performance to pickup truck and SUV applications. Combining the strengths of the ball and tapered roller hub units, the hybrid hub bearing unit offers less rotor and flange deflection which helps withstand harsh off-road environments.



## SKF hub bearing kits – everything you need in one box

SKF's hub bearing kit is designed to save time by providing everything an automotive technician needs to replace a press-in style hub bearing, including a cartridge-style wheel bearing, C-clip, axle nut, seals and the only premium hub flange in the aftermarket that meets 100 percent OE Specification. SKF's hub bearing kit reduces the chance of customer returns by provid-

ing quality parts designed to fit and work properly together, eliminating the hassle of sourcing separate parts, sometimes from separate suppliers.



## Expanded line of U-joints from SKF

Building on our industry-leading expertise in bearing and seal technology, SKF has updated our U-joint offering with broader coverage, including an expanded range of the high performance Brute Force line. The line offers more part numbers for broader coverage of automotive, truck, agricultural and industrial applications. Additionally, improved cataloging with key specification information creates easier parts identification.

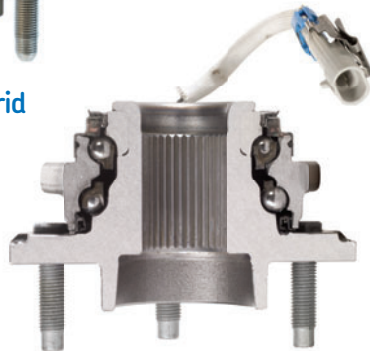


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# Hub of innovation.



SKF's X-Tracker Hybrid hub bearing unit



SKF's X-Tracker hub bearing unit

With increased load capacity during cornering, SKF's X-Tracker hub bearing unit provides high performance vehicles with precision handling and braking characteristics, ultimately delivering improved handling and comfort. SKF's X-Tracker Hybrid hub bearing unit combines the strengths of ball and tapered roller hub units for less rotor and flange deflection, helping pickup trucks and SUVs withstand harsh off-road environments, improving steering accuracy and vehicle dynamic behavior.

Learn more about these hub bearing units and other SKF innovations at [www.vsm.skf.com](http://www.vsm.skf.com)

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# Repair tips for today's diesel engine

## The comeback kid

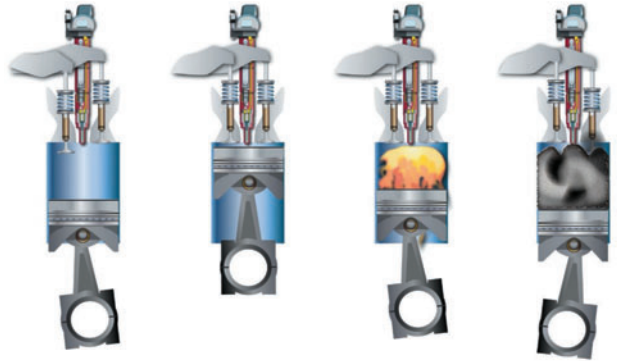
Compared to the mid-90s, diesel vehicles have made a serious comeback. The increase in popularity is largely the result of a steady string of advancements and improvements to the diesel engine. New engine designs, noise- and vibration-damping technologies, and improvements like electronic engine control have spawned a new generation of diesel engines that are more powerful and 30-35% more fuel efficient than similar-size gasoline engines, all while running quieter and smoother than diesel engines of the past. Cold-weather starting has been improved. Noise levels are down. Reliability has been improved. Tail pipe emissions are down. Most importantly, horsepower and torque are up significantly! Many of today's diesel engines that come as an option in the medium-duty trucks are now advertising over 800ft-lbs of torque. Those numbers were unheard of 20 years ago.

## The power of compression

To help understand today's advanced diesel engines, it may help to understand the diesel engine in general. The main difference between a diesel and gasoline engine is the absence of an ignition system to ignite the fuel mixture. Diesel engines are compression-ignition engines as opposed to spark-ignition, so there are no spark plugs, wires, or ignition coil. Instead, heat generated from compression ignites the air/fuel mixture in the cylinders. Diesel engines also have a much higher compression ratio than gasoline engines, which allows them to compress air into a tighter space in the cylinder to create the high temperatures needed to ignite the air/fuel mixture. Let's not forget the fuel, either. The type of fuel used in gasoline and diesel engines contributes to the power produced by the engine. Compression-ignition engines burn fuel evenly, which allows diesel engines to have very good fuel mileage while producing more power than gasoline engines for the amount of fuel used.

## Heavy-duty, not invincible

Due to the combustion and high compression ratio inherent in diesel engines, diesel fuel system components need to be able to withstand high internal pressure. That's why diesel components are made of high-grade metals. But the strongest, heaviest metal can't do much for a diesel component that has clearances down to six-millionths of an inch. These tight



tolerances are the reason why heavy-duty diesel engines are still vulnerable to issues. For example, the smallest amount of dirt can wreak havoc on the engine's internal components and fuel injection system, while water (which has poor lubrication properties) can cause corrosive damage and accelerate wear.

## Premium diesel replacement parts by Standard®



To keep diesel engines running powerfully and smoothly, Standard® Diesel is proud to offer a line of 100% new Diesel Fuel Injectors, which includes new OE-production fuel injectors for 6.0L and 6.4L Ford® Power Stroke® diesel engines. Standard® Diesel offers full 'original equipment' design, engineering, and manufacturing, so every Standard® Diesel new fuel injector is equal in quality. To learn more about our full diesel offering—which includes turbochargers, diesel fuel injection pumps, and much more — visit [StandardDieselParts.com](http://StandardDieselParts.com).

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## THE SECOND HALF OF OBD II

### LOTS OF GAMES ARE WON IN THE SECOND HALF – AND THESE NEXT 5 MODES COULD BE THE TOOLS YOU NEED TO WIN MORE YOURSELF!

PETE MEIER // Technical Editor

Last time on The Trainer, we went over the first five modes of Global OBD II. We learned that there are a total of 10 modes available to any technician who owns even the most inexpensive Global OBD II-capable tool. Each of these modes provides a resource that can help us troubleshoot and repair the Diagnostic Trouble Codes related to emissions — that is, most of the powertrain codes.

We also learned that the first five modes are, for the most part, ones you are used to using every day. Mode \$03 for learning why the Check Engine light is illuminated, Mode \$02 to see the stored Freeze Frame data related to the DTC that caused the light to come on, Mode \$01 to view relative current data and finally, Mode \$04 to turn the light



off and clear the code(s) when we're all done with our repair.

We'll take a look at Modes \$06 through \$0A (that's Mode 10 in computer talk), providing you an overview of what each mode does and its use as a diagnostic aid. You'll learn about TIDs,

CIDs and MIDs, how to make sure your customer didn't install a used ECM without telling you, and show you that some DTCs can't be erased no matter how hard you try.

All of this, and a bit more, in the March edition of The Trainer. **TL**



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