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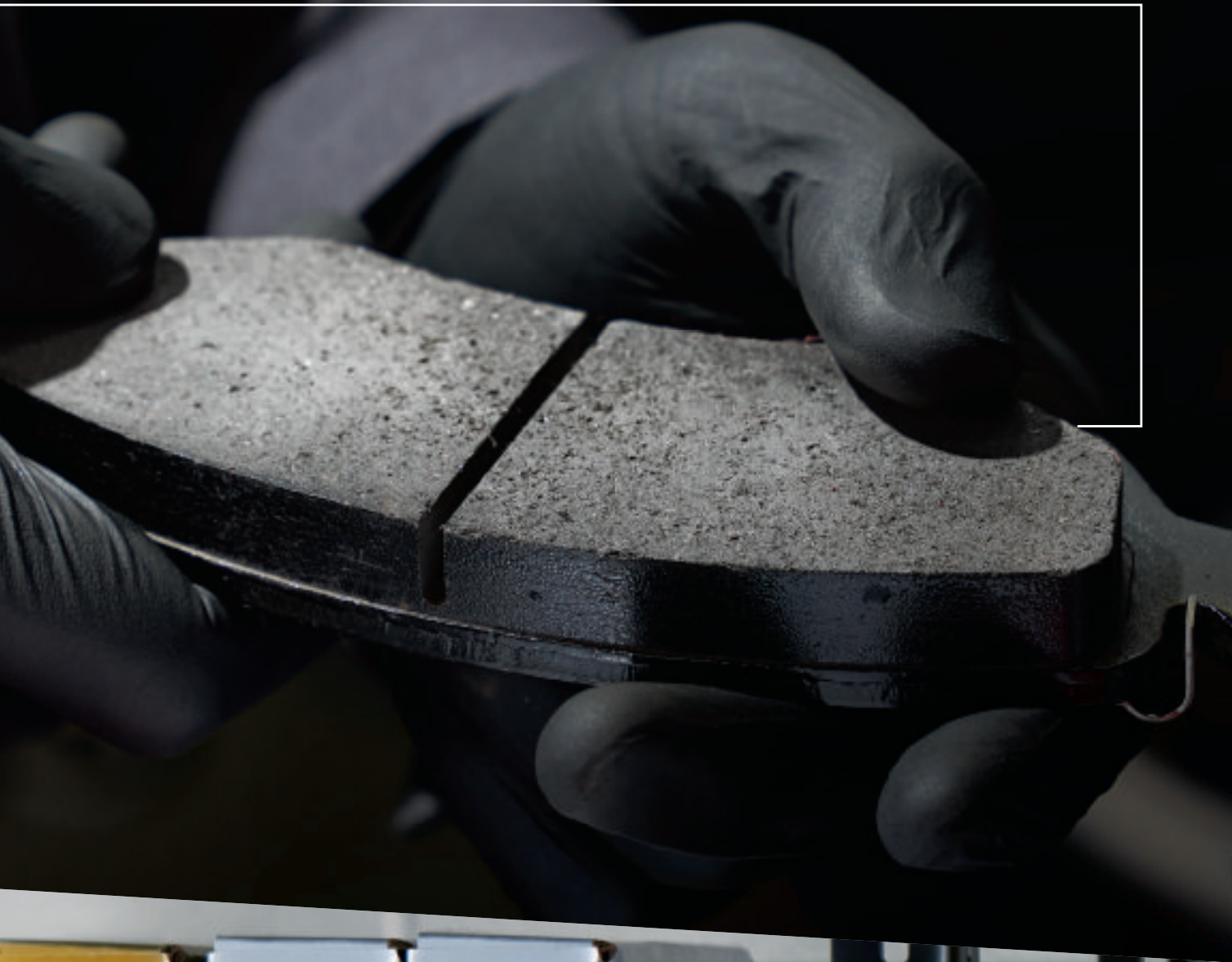
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VIDEOS: SHOPOWNERMAG.COM/CATEGORY/ORIGINAL-VIDEO



FIVE GUIDEPOSTS FOR SUCCESS

Sponsored by Auto Value and Bumper to Bumper

It's never too late to step back, evaluate and make adjustments for your business success. Vic Tarasik shares five things you can do in your

shop right now to put you, your business and your employees on the path to success over the next year.



ON-DEMAND WEBINARS: SHOPOWNERMAG.COM/WEBINARS

CAR KEYS – NEW TECHNOLOGIES UNLOCK OPPORTUNITY

Decades ago, you could replace car keys anywhere. But, over time, the key replacement business shifted from the corner store to the dealership. Nearly every automotive parts category has developed a thriving aftermarket — except keys. Why? Tooling, inventory and training requirements have made it cost-prohibitive for automotive service centers to enter the channel...until now. Breakthroughs in technologies have created one of the biggest opportunities for automotive channels in decades, say experts.



PODCASTS: SHOPOWNERMAG.COM/PODCASTS



UNDERSTANDING WHAT RENTAL CAR INSURANCE REALLY MEANS

Sponsored by ShopLoaner.com

Offering loaner vehicles is key to maximizing your shop's revenue. However, shops often

struggle with managing their fleet and understanding the pitfalls. Laura Tierney, national sales manager for ARS ShopLoaner, explains that insurance has two different, and equally important, connotations. Doug Kaufman, editor of SHOPOWNER hosts this important topic.

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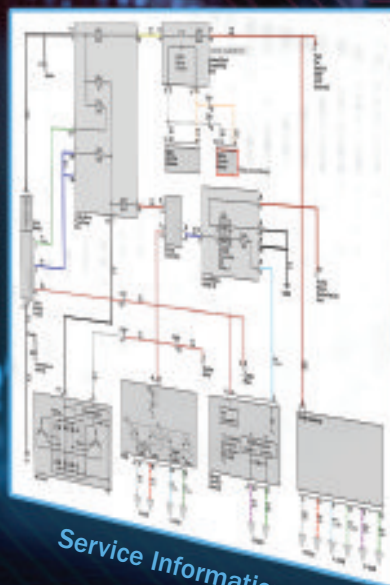
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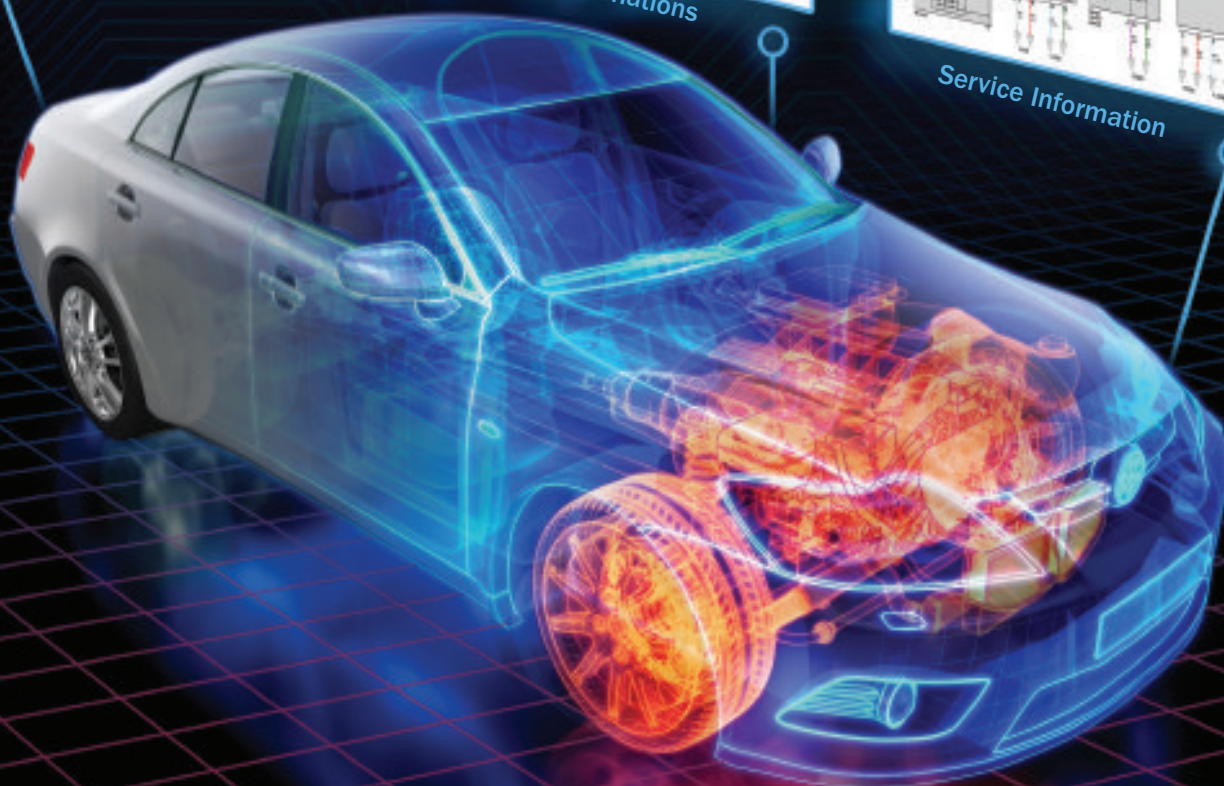
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HOW THE STIMULUS **RUINED MY LIFE** WELL, MAYBE A MONTH...



ANDREW MARKEL
 DIRECTOR OF CONTENT
 AMARKEL@BABCOX.COM
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Last month, more stimulus checks were sent out by the government. These checks put more than \$1,000 in the pockets of consumers, some of which was used at shops to perform vehicle repairs and maintenance. Other consumers went the DIY route and spent their stimulus online or at auto part stores. Either way, the aftermarket received a boost.

I have a policy of always answering the phone when I am in the office. Why? It could be a shop owner or technician looking for information. Some of the best stories come from these calls. This past month, I received a lot of calls from DIYers stuck on their stimulus check projects.

It is not hard to find my phone number online. It is on almost every page of our websites. Many DIYers think we sell auto parts because of the content on our sites. When they are stuck, they give me a call – and some of their questions force me to bite my bottom lip. Here is just a sample from the past month.

One of the best calls I received was from a guy who bought a 1974 Chevy small block with a four-bolt main. He was putting it in his 1999 Chevy truck that had the last Vortec V8, and

he wanted to keep the fuel injection system because he had to pass the New York emissions inspection. The 1974 block will fit the bell housing and motor mounts. But, without a place to put a knock sensor and with an offset crank position sensor, there is no way he would pass emissions. But, it had a four-bolt main!

Another call came from a mid-2000s Toyota Highlander owner looking to fix the power steering. He was wondering why he could find only manual steering racks. I told him to look under the dash at the steering column. After a few minutes, he realized that this is why he could not find a power steering pump or fluid reservoir under the hood. When he saw the price of the electric power steering unit, he realized it was out of his league.

The scariest call came from a windy driveway and a DIYer who decided to install rear calipers. He managed to take the rear nut off the parking brake mechanism, and then the piston fell out of the new caliper. I don't know what he was thinking.

Just about every DIYer who calls would be better off going to a shop instead of doing it on their own. I am not against drivers working on their vehicles, but there has to be a limit. ■

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SOCIAL MEDIA – THE PLUSSES, THE MINUSES AND HOW IT ALL ADDS UP TO SUCCESS

Social media is powerful – it can and will drive public opinion and buying choices; it can even help shift an entire demographic toward social change. With something so mighty at your fingertips, you can't afford to miss the mark.

Proper attention to social media will help you avoid pitfalls and create a highly successful campaign that can set your shop apart from your competitors.

START WITH A PLAN

As with any successful journey, starting with a plan puts you in a position for success. Realize that a quality social media program is a marathon and not a sprint, so expecting immediate results from your posts sets you up to be disappointed and discouraged. Expecting too much too soon can cause frustration, and you may be tempted to discontinue your posts. When you launch your program, be committed for the long haul and you'll find the results are worth the wait.

I spent some time with social media experts Mike DeLaCruz of Broadly and Kim Walker of 5 Stones Media to glean their expertise to share with you.

Is an effective social media strategy important, no matter the size of the shop?

"My belief in social media strategy

is this... why do anything without a plan?" says Kim Walker of 5 Stones Media. "If you're going to do something, DO IT. Go all in. And do it to the best of your ability. A haphazard posting on social media is a waste of time, energy and effort and usually results in the 'I tried social media and it didn't work,' complaint. Just like any marketing tactic, to truly see results and feel like it has been worth it requires forethought, planning and execution. Why do anything partially or halfway? That makes no sense – no matter how big or small your company is."

PROVIDE RELEVANT AND ENGAGING CONTENT

Content is king, but not just any content. You'll want relevant content designed to capture the attention of your target customer. Here's a tip about what makes content relevant: don't overthink it. A lot of shop owners are so close to their shops that they don't see the little things that make their shop stand out from the rest.

Focus on the aspect of your business to which your customers can relate. In almost every circumstance, customers will engage with personal elements of the people in your shop.





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SHOP MANAGEMENT

Mike DelaCruz from Broadly explains, "Content needs to be built to capture your attention. Most people relate to personal things, like a technician who just had a newborn baby, the fact it's your service advisor's birthday or your service manager's work anniversary, or that you're teaming up with the local high school or Boys and Girls Club."

It's about relatability, DelaCruz says. "Whatever it is, show your community involvement! All of these things are relatable and capture interest and attention. Every auto repair shop wants the relationship, so there has to be a personal connection attached to your posts."

You've heard of the 80/20 rule. DelaCruz explains, "You're still in business looking to keep your car count steady, so make sure you post things that are also business-related as well, like upcoming specials. For example, if you are a member of a program group like a NAPA Auto

Care or Parts Plus Car Care Center, you have sales drivers. These should be posted every time a new promo is launched (every two months, for example). The 80/20 rule is 80% personal connection, and 20% business and specials."

POSITIVES AND NEGATIVES

The importance of quickly getting a message out to your customer base was underscored by the unfolding of COVID on our industry at the beginning of 2020. In the midst of the outbreak, there were media reports that businesses were closed and, depending on your area of the country, this might have been accurate. But, in less-affected areas where dire reports were not always on point, shops used social media to deliver a message that was quick and cost-effective.

Additionally, once the government declared the auto repair industry to be an essential business, shops began

using the power of social media to communicate with their communities and customers. Many shops used social platforms to share information about the protocols they had adopted to put the customers at ease and this added comfort level enabled many shops to continue in the first few months of the pandemic with limited disruptions to their day-to-day operation.

Speed, access to your audience and brand building that allows the customer to "meet" you and your team can present your shop as the local expert.

Mike and Kim explain that the cost of a self-directed social media campaign is extremely low, but that's not the only positive.

- **Speed to market;**
- **Ease of access to your customers and potential customers;**
- **Opportunity to present your shop as the "Expert;" and**
- **Brand awareness.**

STILL AMAZING AFTER ALL THESE YEARS



The average age of vehicles on the road today is an impressive nearly 12 years. And in less than 20 years, that age has increased by more than two years!

Vehicle bodies and components are dramatically more durable, keeping cars going further than ever. High mileage vehicles with more than 75,000 miles on them – which make up nearly 2/3 of the vehicles on the road – offer a big opportunity that many shops are failing to capture. When they ARE presented with the chance to upgrade their next oil change to a high-mileage, synthetic blend or full-synthetic motor oil, most customers recognize that they are giving their engine what it really needs – protection for aging components.

According to experts, high mileage cars are more likely to see parts begin to wear down, causing reduced gas mileage, lower horsepower and a shorter engine life. New lubrication technology is formulated specifically to combat issues like friction, deposits and sludge.

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The next time your regular customer rolls up in the same old car with the same old complaints, offer him a chance to refresh the relationship. Remind him that even normal driving habits eventually result in high mileage on the odometer.



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SHOP MANAGEMENT

Unfortunately, low cost can also be negative. Unless you have a social media manager in your shop to consistently push the content out, the likelihood of your program's success will be tempered. It's easy to spend money on postcard mailers or other printed content because the need for content is only on the front-end of the project. However, social media requires a significant time commitment that is ongoing each and every week.

In preparation for this article, I reviewed a significant number of repair shops' Facebook profiles. My research revealed that, on average, 80% of the typical shop's posts were out of date and there had been fewer than 10 posts over the last 12 months.

In the foundational business book, *The E-Myth*, Michael Gerber cited the importance of consistency, explaining the emotions that delivering anything inconsistently can bring. Inconsistency will bring a loss of trust, loyalty and eventually a loss of a customer. If you are inconsistent in your social media posts, what message about your business practices do you think is being conveyed to your current and potential customers?

Of the top shops in the industry, many agree how important it is that the social media message be relevant and timely. But, successfully posting content is a lot of work. Many have applied Dan Sullivan's principle of "Who, Not How," from the best-selling business book of the same name. These shops have discovered that a more effective use of their time and abilities is to use a social media management service. This allows them to manage their shop's operations more effectively by outsourcing this aspect of marketing.

There are other negatives as well:

- **It takes time to build an audience;**
- **It's a time-consuming process;**
- **Keeping content flowing can be difficult;**



- **Knowing what to stay away from: politics, recent events, etc.;**
- **You must stay on top of trends; and**
- **You must know how to properly respond to negative reviews.**

Obviously, doing the job right requires a plan.

- **Regular posts** – at least two per week;
- **Relevant Content**
 - Keep it personal, engaging and interesting;
 - Pictures and videos are a plus;
- **Call to action** – soft pedal your call to action — don't be too aggressive in your pitch; and
- **Be committed** – success isn't achieved overnight.

CONCLUSION

Whether you perform the task in-house or outsource your messaging to a social media management firm, make the commitment to use social media to reach your customers. Engagement with your customers and potential customers is one of the best

reasons to be involved with social media.

Social media is likely the most heavily trafficked road in your community – can you afford not to put **YOUR** billboard on it?

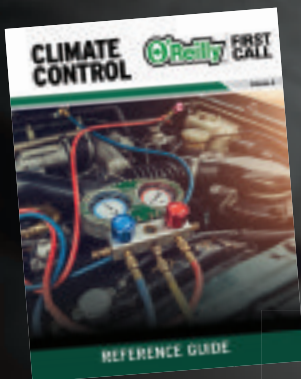
If you're interested in a social media checkup, drop me an email at vic@shopownercoach.com and I'll review your posts and share my recommendations. ■

Vic Tarasik has been an independent auto repair professional for more than three decades and is the former owner of Vic's Precision Automotive in The Woodlands, Texas. He is the founder of Shop Owner Coach, a coaching and training organization that is committed to helping independent repair shop owners achieve their dreams through the intentional application of best business practices. Vic can be reached at vic@ShopOwnerCoach.com or by calling 832.205.8186.

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BUILDING BETTER ESTIMATES

HOW TO DEAL WITH (AND CONVERT!) PRICE SHOPPERS WITHOUT WASTING YOUR SERVICE ADVISORS' TIME AND TALENT

WHAT'S THE VALUE OF A PRICE SHOPPER?

In an ideal world, you take the time to build an estimate, give the customer the price over the phone, it turns out you were the cheapest option, and so they come in and buy from you. A sale, yes – but what's the value of that customer?

They're not loyal. They won't recommend their friends or family. They almost certainly viewed your transaction as a zero-sum game where they beat you. In other words, you'll never see them again.

Which means that my question isn't simply rhetorical, and I'm not just asking the value of a price-shopping customer as a way to make you think. I'm asking if you're aware of the real value of a price-shopping customer?

Because it wasn't simply that your margin was lower on that repair order. It's also that they tied up a tech

and a bay with no-value work. They wasted the service writer's valuable time, who had to build an estimate instead of helping the customers who truly value your time. And, all of that wasted time and effort came for no profit and no hope of a return visit.

In other words, there is no value in playing the price-shopping game. But, what if there was a way to convert that price shopper into a high-quality customer by not playing the game at all?

PRICE - NOT QUITE WHAT SOME SHOPPERS THINK

The truth is, price is the deciding factor only when everything else is equal. If you're buying paper towels or ground beef, then shopping by price is a no-brainer. There's no difference between the Brawny here and the Brawny down the street. Cheaper is cheaper.

But, I don't have to tell you that auto repair isn't a commodity. You work hard to provide excellent service and quality repairs so you can take care of your neighbors. You hire and train quality employees. You pay them well and supply them with cutting-edge tools to diagnose vehicles quickly and accurately.

You're nothing like that shadetree quick lube down the street! Which means that you need to teach that price shopper why that is, too.

What sets you apart? Can your service advisors articulate why you're different from the other places that price shoppers are calling? Is it your warranty? Your experience? What makes your best customers choose to keep coming back to your shop, year after year?

Converting price shoppers, in other words, comes down to being helpful, courteous and kind in helping them

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Jason Eich
Thrifty Car Care Center
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make the best decision for their family vehicle, rather than the cheapest.

Which means that converting price shoppers starts long before they ever pick up the phone to ask for a price. It starts with your marketing.

YOU MAY NOT PREVENT SHOPPERS BUT YOU CAN PREPARE THEM

There's probably no way to prevent price shoppers from calling you, but the marketing messages you send – your website, your advertising pieces, your signage, everything that makes up your shop's image – create a picture in your customers' minds long before they ever pick up the phone to ask for a quote.

Successful marketing is about setting proper expectations and then meeting (and exceeding) them. Do new customers expect to spend money, or are you painting a picture of a discount shop? Do new customers know what makes you better than your competition, or

are you just another cheap place to bring their vehicle?

More and more, I see shops using nearly identical postcards to try to attract new customers. They're all the same size. They all look the same. They have similar coupons, credentials, and pictures and logos. And, when there's no other way to tell you apart from your competition, why not call around to find which of these identical shops can do the job for the cheapest?

If only it stopped there! Shop websites fall into the same trap. If your shop uses the same layout, same stock photos, literally the same text on the page as your competition, then what's really the difference besides price?

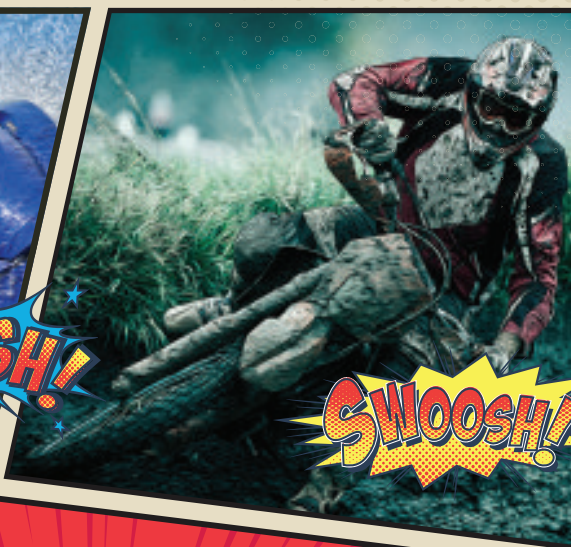
What I'm getting at is that a lot of the price-shopping calls that shops get are a result of marketing that attracts price-shopping customers!

In my shop, we send marketing that builds relationships. It doesn't look like any other marketing done by shops in our area, and that's for a reason. We want to set our shop apart, and so should you.

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BUSINESS SUCCESS

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By the time our new customers bring in their car for the first time, many of them feel like they know us. They trust us before we even pull the car into the bay to inspect it. As long as we follow correct procedures, inspect that vehicle thoroughly and educate that customer on what we found so they can make a good decision for their family, we'll convert them into a loyal, trusting relationship. They'll recommend friends and family, and bring us every car they own.

That's the value of setting your shop apart.

DON'T SELL SHOPPERS, CONVERT THEM

The next time you get a price-shopping customer calling into the shop, try this new approach. Instead of opening the estimate and playing the cheapest price game, teach her why she's asking the wrong question. And, then teach her what the right question should be.



But more than that, take a long, hard look at your marketing and whether you're truly setting yourself apart. If you're doing the same marketing as everybody else, it's no wonder that customers are price-shopping you.

If that's the case, all is not lost. All you need is a marketing company that understands what makes a quality auto repair customer, who can help you set your shop apart like it deserves to be. ■

David Rogers is the President of **Keller Bros Auto Repair** in Littleton, CO, as well as President of **Auto Profit Masters** and **Shop4D®**, a single, fully integrated shop management system designed to help shops become more efficient and overcome the technician shortage, while improving profitability and sales in their operation. Learn more and register for a free webinar at **shop4d.com**. Reach David via email at **contact@shop4d.com** or toll-free at **866-826-7911**.

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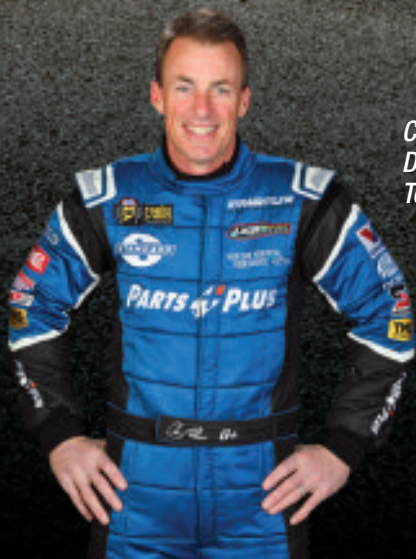
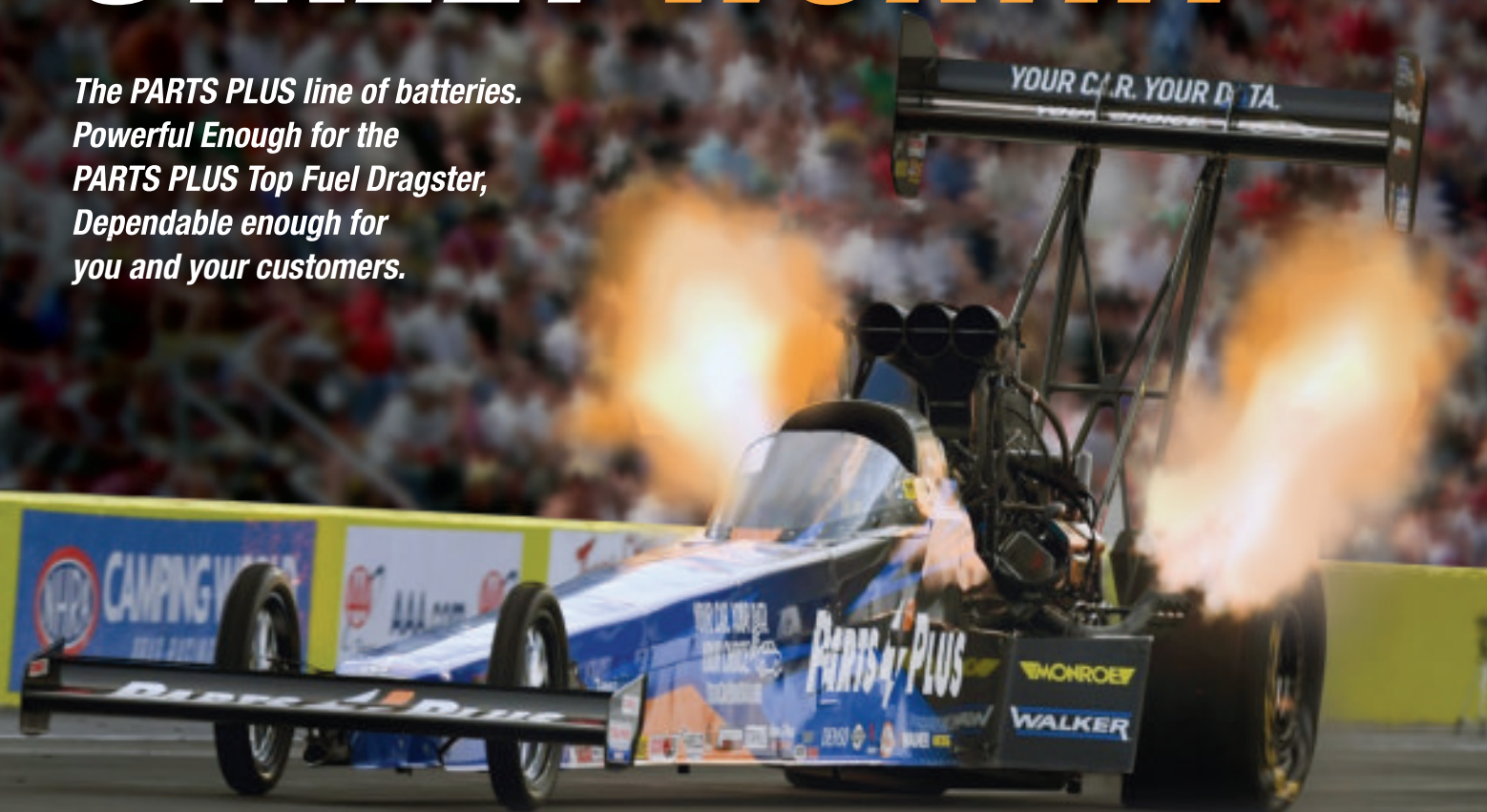
RG Automotive



"WE WANT TO TAKE CARE OF ALL THE MAINTENANCE. WE TRY TO SEE THE CARS AT LEAST TWICE A YEAR, JUST TO MAKE SURE THAT THE SERVICE IS ON TRACK AND THE CAR IS OPERATING AT ITS BEST FOR THE CUSTOMER."

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SHOP PROFILE

by Doug Kaufman, Editor

LIVING THE DREAM

RG Automotive, Halifax, Mass.

When we were kids, we all had dreams of what we wanted to be when we grew up. Whether the dream was to be an astronaut, a firefighter, rock star or professional football player, for most of us life got in the way and we found a job. Sure, it's a good job that has provided for our family but is it the job you imagined as a child?

For Rich Greene, auto repair isn't just his job, it's his life – and he couldn't be more content.

"I've been working on cars since I was probably 14, and I knew early on I wanted to have my own repair shop," says Greene, owner of RG Automotive in Halifax, MA. "So even as I worked for other people, I went to college to take small business management classes because I knew I wanted to have my own business. When I got my first house, I immediately built a two-bay garage in the side yard and started working on cars after work. And then in 1997 I just worked out of that garage solely to build up a client list while I tried to save money to buy my current location."

Greene admits that his single-minded focus has been a double-edged sword. "It was a definite goal for when I was a little kid, which is good and bad. But, that's how I got here, and it's been good."

Greene says it took about five years of working at his home garage to raise the money to build his shop. Though it worked well financially, he felt the stress of never really being able to leave the shop. Thankfully, he says he was able to buy land and build his dream facility in 2005.

His six bay 4,000 sq. foot facility

incorporates several operational attributes that he has admired in other shops he has worked at or visited over the years. The building design includes front and rear roll up doors so that cars can be driven, pushed or towed through. "I didn't necessarily invent the wheel, but maybe I improved on someone else's wheel. At least for my building."

In fact, wanting to improve the experience for his customers is Greene's driving philosophy.

"We want to take care of all the maintenance on the car, under the car and under the hood. We try to see the cars at least twice a year, even if they don't drive a lot, just to make sure that the service is on track and the car is operating at its best for the customer," he says.

"I think my target customer is the typical mom, who's usually in charge of taking care of everything in all her kids' and husband's lives. We can provide her with quick, easy-to-understand estimates and a repair plan, maintenance guide for each car that she has to deal with. She can make fast decisions and just move on to the other things she needs to do."

To ensure the necessary services are performed, Greene has long been an advocate for the digital resources from his suppliers.

"We've been a partner with BOLT ON TECHNOLOGY for about eight years now. Our customers have known that we do digital vehicle inspections on their cars since then, but even to this day, when we send some of the reports on their car they'll comment



RG Automotive

Owner: Rich Greene

Location: Halifax, MA

Hours of Operation: Monday-Friday, 8 am - 5 pm; Saturday, 8 am - 12 pm

Founded: Originally founded in 1997; this location opened in 2005; incorporated in 2019

Number of Employees: 6

Square Footage: 4,000 sq. ft.

Number of Bays: 6

Number of Hoists: 4, with a dedicated front end alignment bay and Massachusetts State Inspection Bay

Average Daily Car Count: 17

Parts Plus Warehouse Partner:

Bagnell Auto Supply, Rockland, MA.

immediately."

To Greene, the photos and videos in a digital inspection supplement the recommendations of a professional service advisor.

"We're trying to help them keep that car on the road, but I think when you ask someone if they want their air filter replaced, they think you're just trying to sell them something. When you send a picture of the problem, you don't have to ask if they want to replace it or even tell them how much it is. They're going to text back and ask you to change it. You don't have to have a conversation about why or how important it is or predict how much more life it has left. They just have to look."

Greene says DVIs often work best with a product many drivers are unaware even exists. "The best one is

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SHOP PROFILE

"I'VE BEEN WORKING ON CARS SINCE I WAS PROBABLY 14, AND I KNEW EARLY ON I WANTED TO HAVE MY OWN REPAIR SHOP."

the cabin air filter – if you take one of those off and there's a mouse nest in there? They're thanking you for changing it."

Greene says the DVI helps takes concerns about needed service out of the equation. "We're always fair with pricing, but we generate the full report on every oil change, then send a second text with estimates that couple with anything that was flagged on the picture report. Usually, we'll just get a text back from the customer telling us to do certain services while the car is in the facility. There's no phone conversation and no downtime for us or the customer. It definitely can increase the bottom line but, more importantly, customers are more confident that they're not being sold something that they may or may not need.

"And I'd rather someone be happy to get service done that they need than to feel insecure that we are taking advantage of them. I don't have time for that. There's too much work to get done."

In addition to the digital vehicle inspections, Greene still does local mailings and traditional community outreach.

"We do a local mailer that's like a magazine. There are multiple coupons for all the local businesses, and people will



"EVERYONE'S GOT TO HAVE A JOB, AND IT'S BETTER TO DO SOMETHING YOU LOVE THAN SOMETHING YOU HATE."

keep that on their coffee table for a week or two. And we'll sponsor local baseball or soccer teams in town, which is another key because all these parents are down at the fields with their kids and they'll all need their vehicle inspections."

Massachusetts has a strict annual inspection requirement. Greene says the \$35 inspection brings in nearly 40 potential customers a month. "They need the sticker, and we're convenient and fast, and that's their opportunity to look around and decide if they want to be part of our clientele list or not."

"If the car fails, we'll give them an estimate, and if they choose to come back for us to do the repair, great. If not, someone else can do the work. The re-inspection is free, and we'll treat them just as happily as if we fixed it. And maybe we're on the list for future repair."

When repairs are needed, Greene says his team of technicians is more than capable of doing the job.

Matt Erwin, lead technician, is a past Five Star Chrysler Tech, and a graduate of Mass Bay College with Associates Degree in Automotive Technologies; Aaron Lucier, service





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SHOP PROFILE



technician, has four ASE Certifications and was a Tech of the Year in 2020; Dan Laflower, general service technician, was Tech of the Year in 2018; and Brandon Towne, is a general service technician in Training and a student at Silver Lake Regional High School Co-op in the Automotive program. They are supported by Tori Guerchon, service writer and assistant manager and Richie Greene, service writer.

Greene has his share of accolades as well, including, 11 ASE Certifications. He still enjoys being able to work on the cars as well as working on his business.

"To me, that's part of being a small business owner. It's nice to know that I can do anything that we're selling. I know systems are in place to keep people on track. But there's always room for improvement!"

Greene says his accessibility to his team is part of the appeal. "I try to offer as much as I can financially – 401k, health insurance, paid time off, company-sponsored training and paid holidays. There's always going to be bigger shops that can offer more, but then you're in that disconnected type of thing where you can't even reach the owner if you have an issue. So, I think that that's the winning model to a small shop rather than a big shop."

That's not to say that Greene doesn't

have plans for growth.

"We'd like to open a second location in the future – to do that we need to grow this location a little bit more and add even more highly-skilled employees. I think we're in a good spot to move forward but finding the location and committing to figuring out how to split yourself between two locations, that's the two hurdles. But it's on the list."

Greene says knowing that he has such strong support from his supplier partners helps ease his concerns about growth.

"Our local Parts Plus supplier is Bagnell Auto Supply in Rockland. The parts they carry are great, the delivery times are outstanding, and if we call for something that's in one of their other stores, the delivery driver just brings it to us instead of making us wait. I've been using them when I worked for other companies probably since the late eighties, so I've had a lot of history with them."

Greene acknowledges the challenges 2020 presented to his and others' businesses but is very optimistic moving forward.

"As we go into this year, we're already ahead of last year's numbers, and we haven't even made it to pandemic time yet to compare to. So, things are going pretty good."

He does have concerns about the effect the telematics-driven data access will have in the future. As a Massachusetts shop, he gets a lot of questions from customers about Right to Repair.

"It's hard for us to answer them all because it's still mixed, but for the most part, I'd like to see the customer be able to disable the automatic communication back to the dealer because, right now, I'm not sure where we're really headed with that yet. But if that continues at this level of access, the independent shops will suffer because most of these younger drivers just push the button on the dash, schedule the appointment with the local dealer, and never make it to an independent," he says.

"I understand the fight, but to explain that to a customer is tough. And to guard against it is even harder. The only true guard I think would be limit the data to just the repair shop of choice and let that service center maintain the vehicle – or not let that information leave the car's computer at all."

Greene's message is simple:

"Everyone's got to have a job, and it's better to do something you love than something you hate," he says. "I'll be honest, I like fixing cars. I like helping people. That's all I know." ■

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GOING BEYOND REPAIR

by Rich DiPaolo

How working with local professional carwashes and detail businesses can elevate your shop's level of service.

As a business owner, your number-one objective should be providing a high level of customer service. The skill of your shop's technicians plays a significant role in reaching that level of customer service. But, ultimately, how customers feel about the value they received after bringing their vehicles in for repairs or upgrades will determine loyalty and word-of-mouth referrals.

These outcomes are often affected by the cosmetic appearance of the vehicle, both the exterior and

the interior. You can guarantee customers will be completely satisfied with your work by giving them a voucher for a free carwash or detail service. Remember, unsatisfied customers will always win the battle, especially now that social media and negative customer reviews are only a click away.

Successful shop owners offer transparency, respect in communications and value. For instance, while handing the customer a bill for over \$1,000 in repairs he or she was not expecting, providing a voucher for a free carwash or detailing service could

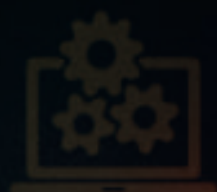
make a huge impact on delivering value.

STARTING A CARWASH OR DETAIL BUSINESS

If you are thinking of adding a carwash or detail service to your current business, or even building an automatic carwash, industry experts would recommend that you reconsider these options.

According to Bud Abraham, a carwashing and detailing consultant with over 50 years of experience in both industries, shop owners who are pondering this decision should not





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take it lightly. “Even though washing and detailing a vehicle might look like an easy addition to your business,” he says, “it’s not. Nothing ticks customers off worse than getting their cars washed or detailed, regardless if it is free or not, and still having dirt on it. Sure, you can shine your customers’ tires with a consumer tire-shine product, but that’s not exactly detailing.”

Instead, Abraham recommends shop owners should stick to what they are good at and not try to attempt to do something they’re not trained nor skilled at, such as carwashing and detailing. Today, both automated and expert hand wash businesses are skilled at getting a vehicle properly cleaned. Attempting to perform carwashing and detailing services with a bucket, wash mitt and a garden hose can even be detrimental to a vehicle’s paint, not to mention what damage could be done to the interior.

Keep in mind, many motorists today are recognizing that they are not able to properly care for their own vehicles and, in most cases, don’t want to do it themselves. Add to this the environmental concerns of wastewater being discharged into



storm drains and the ground, and it is no surprise that more and more of your customers are leaving driveway washing behind and instead opting for professional carwashing and detailing businesses. According to the International Carwash Association, in the U.S., the percentage of drivers who report most frequently washing their vehicles at a professional carwash was approximately 47% in 1994. According to the association’s updated information, released

in 2020, a record-setting 83% of Americans washed their vehicles at a professional carwash within the previous year.

With the emergence and growing number of express exterior carwashes available to customers, today that percentage is certainly higher.

PARTNER UP

Abraham warns, “If you are not fully committed to the business of carwashing and detailing, your efforts

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CUSTOMER SERVICE



will be exposed to business failure from the start. You simply cannot add carwashing and detailing to your existing business model and be successful – there are too many before you who tried and failed.”

Shop owners do have a responsibility to place mat coverings in customers’ vehicles and an opportunity to perform some level of cleaning after service.

“Certainly, buy a shop vac and vacuum out the customers’ car if you want to provide a little bit of service,” recommends Abraham. “But, shop owners are better off partnering with a dependable professional carwash or detail business in their area.”

With automation leading the charge, most carwashes will welcome the added traffic to the site. Today’s modern carwashes offer a multitude of payment processing options — from cash, coin and vouchers to RFID and license plate reader technology.

The good news is that carwash and detailing shop owners are like-minded business partners. “Most carwashes and detailers that I know of are comfortable partnering with local businesses,” confirms Abraham. “Almost all carwashes that I know of offer discounts for fleet accounts. You can purchase a book of 10 or



20 carwashes, and vouchers can be handed out. Customers love it and feel much better going to a professional.”

However, it’s important to partner up wisely, because your customers — who respect and value your business — will expect that you picked a quality business for your team mate. Like it or not, the experience they have at the recommended carwash or detailing business will be a direct reflection on your repair shop, so choose wisely.

Experts recommend that you

consider partnering with several carwash businesses, as there are different wash models and formats within the industry, and customers have preferences for each. At the end of the day, after you’ve fixed and upgraded what customers typically can’t see, going the extra mile to offer a clean, shiny car will help make them see and appreciate the overall value. ■

Rich DiPaolo is Associate Publisher – Editorial for *Professional Carwashing & Detailing*.

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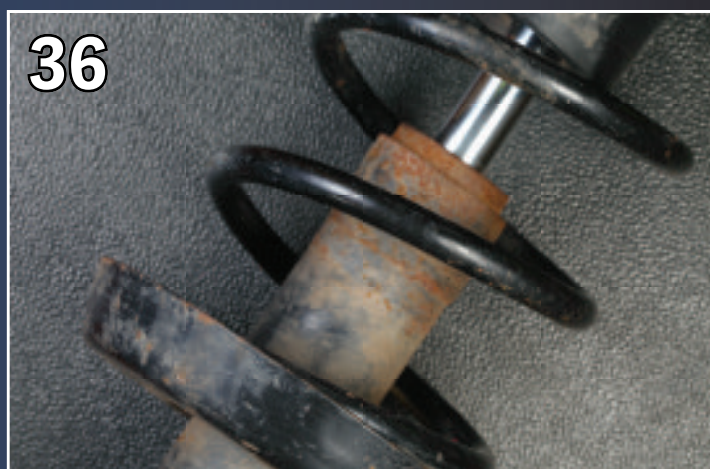
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other problems that aren't quite so obvious. Strut assemblies aren't just for comfort — they're required for safety. Make sure you know how to properly diagnose the real issues they're experiencing.

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HOW TO PREPARE YOUR DIAGNOSTIC PROCESS

Sponsored by OPUS IVS. Diagnosing a vehicle can be a challenging undertaking.



You'll save a lot of time and frustration if you build and follow a methodical diagnostic process. Drew Hernandez and Andrew Markel discuss the three-step process you can integrate into your workflow to make every job more efficient.

34 DIAGNOSING BLIND SPOT SENSORS

Servicing ADAS blind spot complaints doesn't have to be difficult if you're using the right equipment.

36 SUSPENSION CONSULTATION

Customers may not realize their shocks or struts are bad until it's too late. Can you sell the safety factor?

42 CATALYTIC CONVERTER CRISIS

Thefts of catalytic converters have risen during the pandemic due to the value of the precious metals inside.

46 TPMS TIPS

Sometimes, turning off the TPMS light is a complex procedure that requires tools. Other times, it's much simpler.

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DIAGNOSING *Blindspot and Cross Traffic Systems*

Blindspot detection was one of the earliest Automatic Driver Assistant System (ADAS) features offered on vehicles. The system alerts the driver to objects in the blind spot of the vehicle. Servicing these systems is straightforward to diagnose and repair and with the right tools and service information, it is possible to efficiently resolve a customer's complaint.

THEORY AND OPERATION

Blindspot detection systems can use radar or cameras, and some systems use both. The radar sensors emit radiowaves that bounce off objects and are received by the sensor. The sensors are mounted in the rear bumper. Camera systems will have cameras mounted to the side mirrors or A-pillar. The image from the camera is processed by a computer to classify the object. Some systems will use both radar and camera sensors to make a more accurate classification.

The information is processed to ensure the object in the blind spot is a vehicle, guard rail or pedestrian. The more information from the camera and radar, the fewer false alerts.

The blind spot sensors can also be used as a cross-traffic detection system. These systems extend the range of radar sensors to detect vehicles when they are in reverse.

INPUTS

Radar sensors have a range that starts at the rear of the front doors up to 20 feet behind the vehicle. Some sensors used for cross-traffic detection can extend the range of the sensors up to 230 feet. Most radar sensors process the signals internally and communicate with a module.

Cameras have what could be called a fisheye lens and must be able to capture images during the day and night. The images from the system are processed by a camera module, which can then determine if an image is headlights, road spray or snow. The cameras have a shielded cable that carries the signal from the camera to the module.

Vehicle speed is an essential piece of data for radar and camera sensors. For the blind spot detection sensors to work, the vehicle has to be moving. For most vehicles, the speed is around 5 mph. As vehicle speed increases, how the system processes the inputs from the sensor changes.

GM vehicles will also use GPS to control the system's radar components. If a vehicle enters the Radio Astronomy Zone or National Radio Quiet Zone in Maryland, Virginia and West Virginia, the blind spot detection will deactivate. These zones have very little background radio interference, and have both astronomy and military applications.

OUTPUTS

Every system uses warning lights in the sideview mirror glass to alert the driver to objects in blind spots. Some vehicles will give audio alerts. The infotainment systems on most vehicles are used to alert the driver of objects in blind spots. The audio alerts can be sent to different speakers depending on the location of the object. Some vehicles may use a seat shaker to alert the driver, while others will shake the steering wheel.

Early blind spot detection systems had issues with false alerts. Many drivers became annoyed with the systems and turned them off or turned down the sensitivity. More advanced systems use radar sensors, cameras and information from systems like the lane departure. More data and faster computer processors have decreased the number of false alerts.

CALIBRATION

Most radar sensors have a self- or dynamic-calibration procedure. This procedure may require a scan tool to initialize the process and a test drive.

Camera systems may require calibration if the unit is replaced or moved. Some of these calibration procedures require target mats to be placed on the floor next to the vehicle. The process will require a scan tool to initiate the calibration procedure. ■

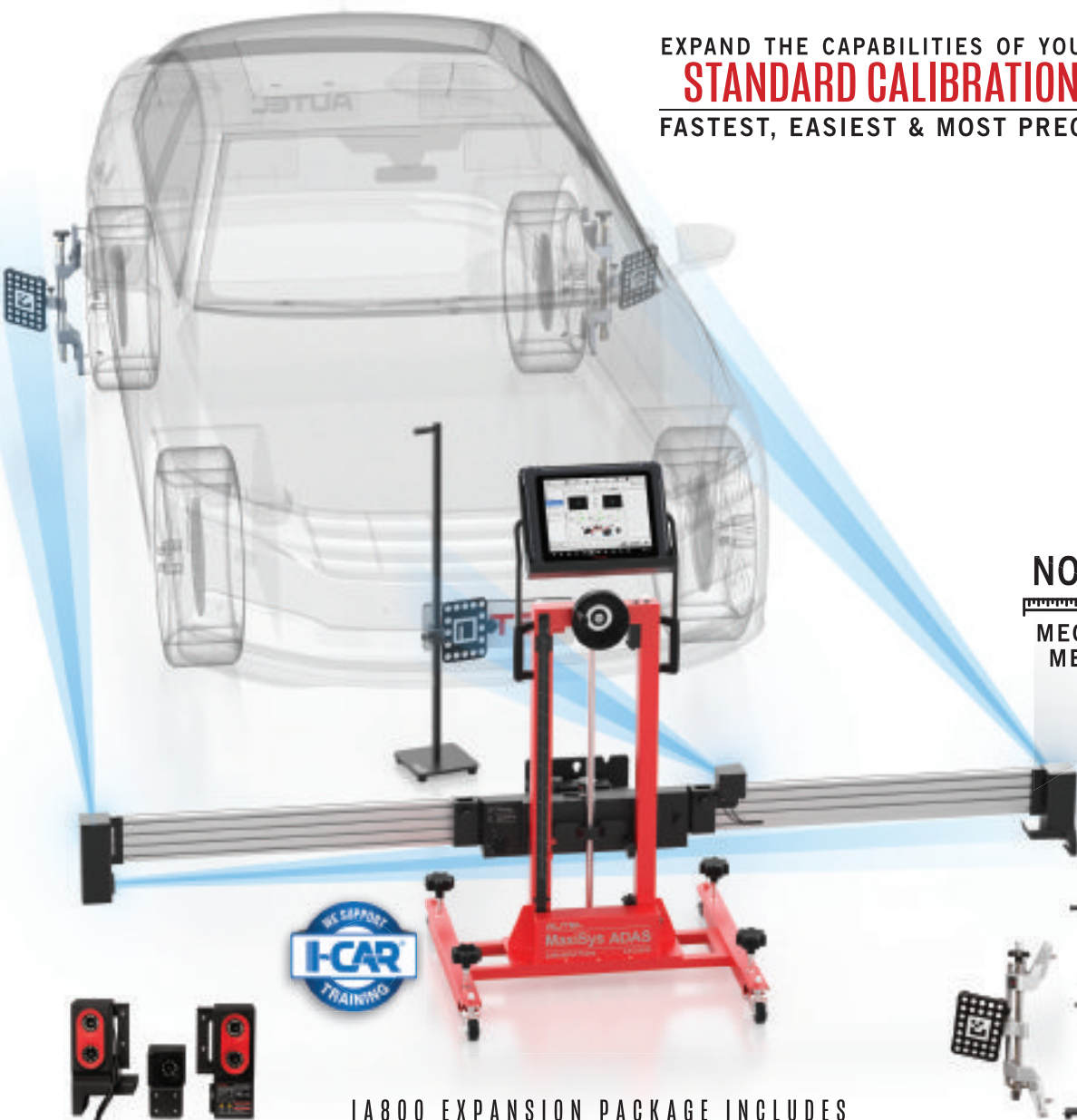
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CAN YOU SELL A SHOCK OR STRUT WITH SAFETY?

Dollar for dollar, replacing worn or damaged ride control components on a vehicle can have the most significant impact on the performance of the safety systems. During a panic stop, these components can reduce ABS stopping distances. During a sudden lane change, the ride control can complement or hinder the stability control system. Beyond that, new ride control can even extend the life of the tires. So, why is it such a tough sell?

It is difficult to calculate the value of the integrity of vehicle systems and components when it comes to safety. No one can put a price on events that may never happen. People always think they can avoid a crash or that it would never happen to them. This is why it can be challenging for the person selling replacement shocks and struts or the customer to rationalize the expense.

Vehicles and drivers are changing. Vehicle lifespan is increasing, and the average age is about 12 years old. This has also impacted how long owners

are holding onto their vehicles. The length of a car loan is also on the rise with the average car loan lasting six to seven years. Even after the first owner is finished paying off the vehicle, it still has a considerable value; they can continue to drive it or trade it in for their next vehicle.

Shocks and struts are one of the few components on a vehicle that slowly degrade over a long time. Yet, the degradation in performance is so gradual that the owner does not notice. Most drivers will not seek out new ride control until something is broken. It could be a snapped spring, rattling upper mount or something

that does not feel right. If you can reach the driver before their ride control fails, you have a chance to get the sale and satisfy the customer by keeping them safe.

IT IS NOT YOUR DECISION

The key to selling ride control is to realize that it is not your vehicle. Many service advisors treat a customer's vehicle as their own in terms of a budget. But, when it comes to vehicle safety, the golden rule does not always apply.

Worn ride control components are either good or bad. These are the findings you need to present to the





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Suspension

customer. If you can show the benefits of new ride control, chances are they will invest in their vehicle. There are no high-pressure sales or scare tactics using this approach.

By the time a vehicle hits 100,000 miles, the shocks or struts have cycled more than 180 million times. The strokes cause wear to the shaft and seal, allowing oil to escape from the body of the shock. The valves inside the shock or strut can fatigue over time and lose the ability to control the fluid flow. The gas charge in the body can also escape, which can lead to foaming of the oil and fade in the unit.

Shocks and struts can also be damaged when the vehicle hits potholes and other





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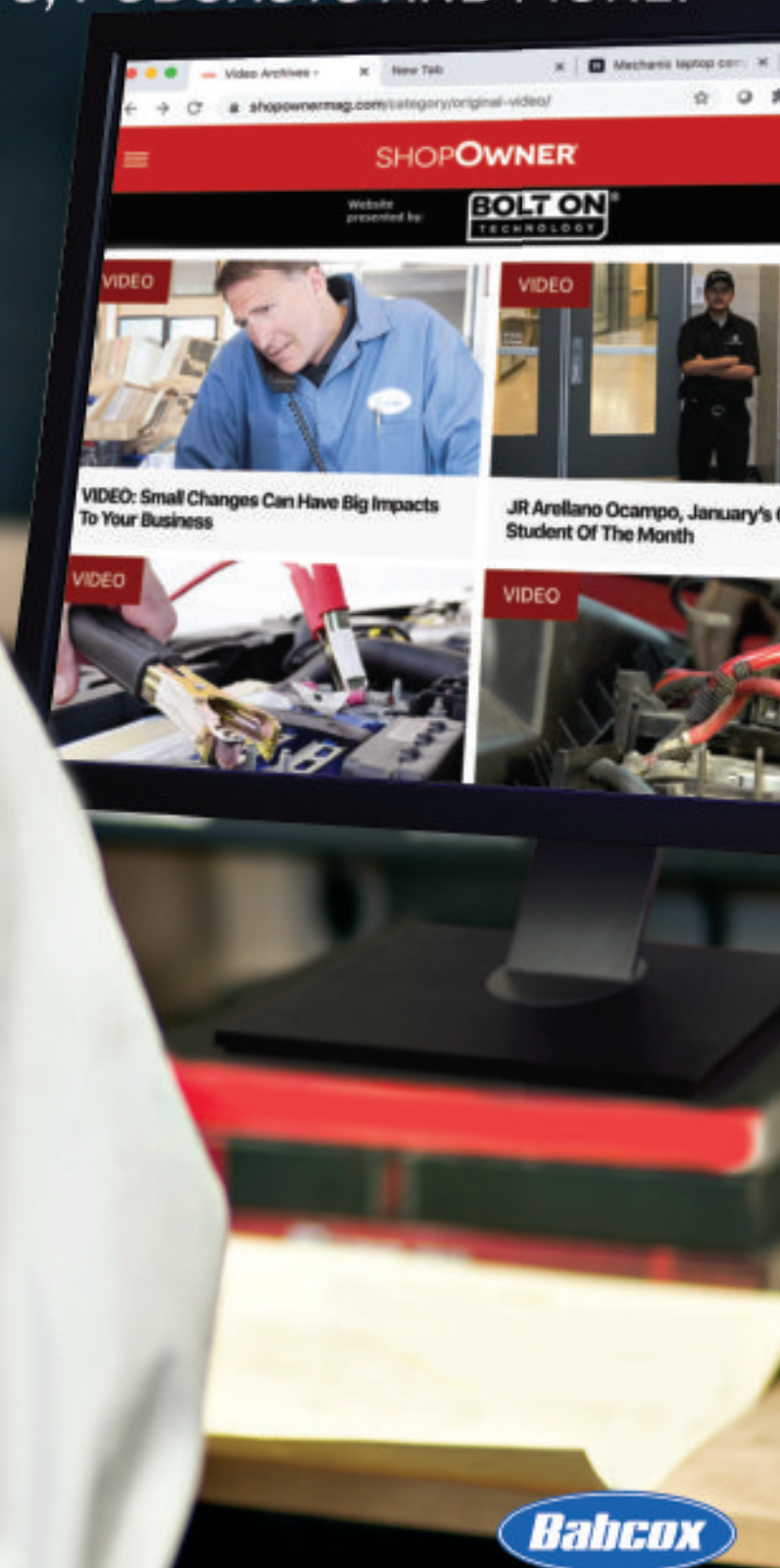
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Suspension

objects in the road. When the suspension bottoms out, the shaft with the valves can hit the bottom of the shock that might also have valves. The bump stop on the shaft is designed to prevent this type of damage if it is still on the shock or strut.

No matter how the wear or damage occurs, the shock or strut loses the ability to dampen the movement of the suspension and body. This can directly affect the braking, handling and acceleration of the vehicle.

VEHICLE STABILITY

During a panic stop, weight transfers to the front tires, loads the front suspension and causes the springs to compress. How much the springs compress is influenced directly by the shocks or struts. When the springs compress, the contact patch of the tires changes due to the weight and geometry of the suspension.

The rear suspension is even more interesting. When the weight loads the front tires, the rear spring expands, making the contact patch of the rear tire smaller. If the shock or

strut is unable to control the rebound of the spring, additional weight is transferred to the front, which nosedives even more.

During a panic stop or emergency lane change, the vehicle becomes unstable if it needs to swerve to avoid something in its path. The front tires have all the traction, while the rear tires have very little. This usually results in an oversteer or understeer condition that leads to a loss of control. Even if the vehicle has stability control, if the dampeners can't control the transfer of weight, the corrections will not be effective.

When a wheel reacts to a bump or body motion, the spring is compressed and releases the energy. During each compression cycle, a little bit of life is taken out of the spring's steel. It's not the amount of travel that matters, but the frequency of the cycles.

Weak springs are also more likely to fail when a new strut or shock is installed. The springs on many late-model vehicles are thinner than older versions to reduce weight and have an outer plastic coating to

protect the metal from corrosion. If this outer coating is cracked or damaged, corrosion can form a hot spot that eats into the spring, weakens it and eventually causes the spring to break. The health of the springs can have a dramatic effect on even seemingly unrelated vehicle components, including visibility, stopping and steering.

The previous information might sound like a bunch of technical mumbo-jumbo to some customers. The relevant point is the shocks, struts and springs wear out. If they are not serviced, it can impact the overall safety of their vehicle.

Where cost comes into play is when there is an accident. Even a simple fender bender that damages a bumper cover can cost between \$800 to \$1,300, depending on the vehicle. Even if the driver is paying only the \$500 or \$1,000 deductible, it always costs more in the form of higher car insurance payments. New shocks or struts can prevent multiple accidents, and the cost of replacing the ride control components is typically less than \$1,500. ■

Pro Tip from **KYB**

Most customers don't know they are already candidates for new shocks and struts. These three categories make identifying replacement opportunities easier.

1. UPGRADING

Is the customer using their truck or SUV to tow or haul heavy loads? Maybe they have larger wheels and tires that have added weight to the vehicle. These vehicles are great candidates for monotube upgrades.

2. MAINTENANCE

What's the vehicle's mileage? Shocks can move up to 1,750 times every mile. By 50,000 miles that is over 87 million cycles. The valves in the shock wear, making it harder to control the weight of the vehicle and harder to maintain designed road traction.

3. FAILURE

Evidence of failures can include excessive

bounce, leaking fluids, tire cupping or visible component damage. In these cases, shocks and struts should be recommended immediately.

The **KYB ROAD TEST APP** is designed to help you start the conversation about shocks and struts. Making any recommendation without evidence doesn't work, but the KYB Road Test App helps give you the evidence you need to make good recommendations. After a short road test, the app allows you to quickly score the performance of the vehicle and sends an easy-to-understand Vehicle Condition Report to your customer. The KYB Road Testing App is available as a free download from the App Store and from Google Play.



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Catalytic Converter **CRISIS** A Product of the Pandemic?

by Andrew Markel, Director of Content

In the past six months, we have seen a dramatic rise in catalytic converter thefts. Criminals are using lithium-ion battery-powered reciprocating saws to cut the catalytic converters out of vehicles. The criminals are not stealing them for replacement value because it is illegal to install a used catalytic converter unless it's tested by the Environmental Protection Agency (EPA). Thieves are stealing the catalytic converters for the precious metals inside.

Some police departments report brazen thieves stealing converters in broad daylight and targeting specific vehicles because of the amount of rhodium, palladium and platinum in the converters. Some thieves have been killed due to jacks collapsing.

Unfortunately, this is not the first time nationwide converter thefts have skyrocketed. In 2011, catalytic converters started to go missing. Precious metal prices increased due to a downturn in the economy and a strike at a mine. This time, price increases are due to increased demand and the pandemic.

The first factor increasing the prices of precious metals is demand. Tightening emissions standards in China, India and other countries are driving demand for these metals, with increased rhodium prices the result of Covid-19. The largest mines for rhodium are in South Africa, with production being limited by lockdowns and new work rules. Also, Covid has hurt transportation of the rare metal. Some are blaming world politics for the price of palladium due to Russia's actions around the world.

WHO IS BUYING THE CONVERTERS?

If no one were buying catalytic converters, there would not be any thefts. States are enacting new legislation to discourage thieves by increasing the



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amount of documentation required to sell a converter to a licensed recycler. West Virginia and Minnesota have proposed new restrictions requiring the seller to be paid with a check and not cash. Texas is proposing new legislation that would require licensed recyclers to obtain a copy of the title of the vehicle to buy the catalytic converter from the seller.

Many recyclers are taking risks purchasing stolen catalytic converters because selling them is very lucrative. But, some thieves are not selling to licensed



HOW IS THIS GOING TO AFFECT YOUR SHOP?

Most catalytic converter thefts are covered under the customer's comprehensive insurance policy. You might have to work with the insurance company to determine if they will cover replacement with an OE or aftermarket catalytic converter.

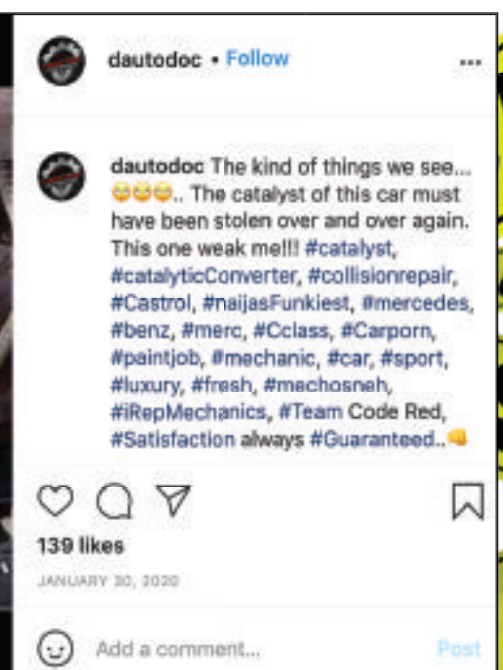
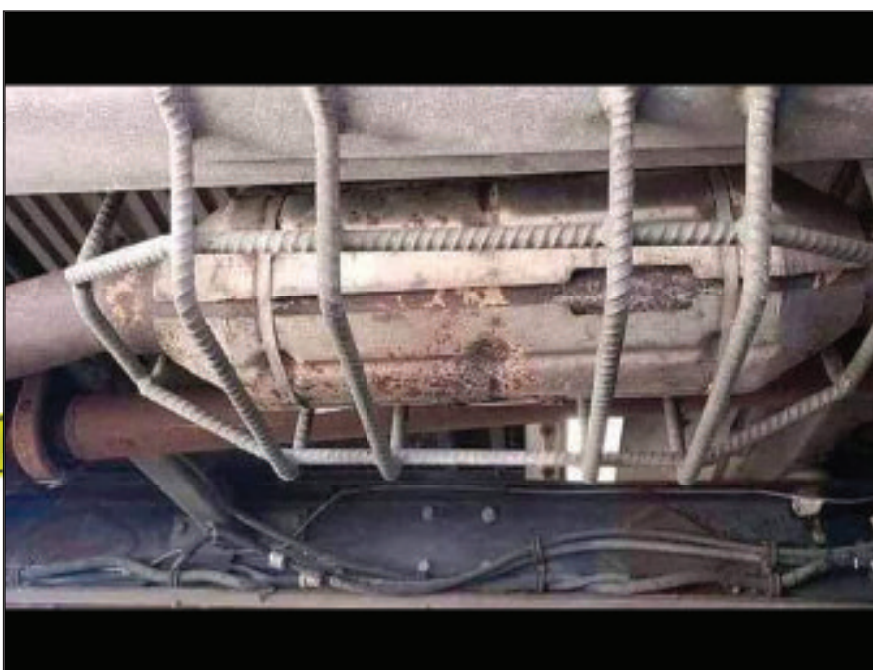
The EPA made selling used catalytic converters illegal in 1990, unless tested and certified by the agency. They also



recyclers. Some thieves and buyers are making a connection on social media.

If you look at Craig's List and Facebook Marketplace and search for a catalytic converter, you will see ads for converters for sale and ads from buyers looking to buy. Most of the photos show converters that have been removed with saws.

There are large recyclers in the U.S., but most police agencies think they are being shipped overseas to extract precious metals.



Emissions

enacted requirements that shops must follow if a catalytic converter is replaced to document the procedure. But, with new state laws, you might need to document who purchased your scrap converter.

Both the customer and installer must sign a statement explaining why the converter was replaced (Manufacturers either provide such a statement with the converter or have an example in their catalogs.). If the replacement is required by a state or local program, the installer must keep a copy of the statement or order from the program representative. Retain copies of the above invoices and statements for six months and the old converters for 15 days (converters must be identified or marked as to which customer's car they came from). The most significant difference between states is the length of time

needed to keep documentation. California and New York require paperwork to be kept for at least four years.

The intent of these rules is to ensure the vehicle meets emissions standards. Violating the EPA rules is a breach of federal law since non-compliance is likely to increase the amount of pollution coming out of the vehicle. Penalties for violations by individuals, service or repair shops, or fleet operators can be up to \$2,500 per violation. Any person who causes a violation could be subject to the same penalty as the technician.

CATALYTIC CONVERTER ADD-ONS

Protecting the converter on vehicles like a Toyota Prius, Ford F-250 or Honda Element has created a cottage industry. These devices

are designed to prevent thieves from accessing the converter or make it difficult to cut the pipes. Some muffler shops that can still weld have been fabricating cages and shields to stop thieves or at least make it more challenging to steal the converter.

Some police departments are also offering services where they will etch the VIN onto a converter's shell. Another strategy has been to spray paint the catalytic converter with red or orange high-temperature paint that might make a thief reluctant to steal the converter.

Will catalytic converters thefts decline? Yes, as prices drop for rhodium, platinum and palladium thefts will go back to normal levels. But, chances are the prices could stabilize at a new normal and subsequently increase the cost of replacement converters. ■

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Flicking The Switch:

Turn Off The TPMS LIGHT

If a vehicle comes into your shop with the TPMS light already on, there are a few key things to always check first for time's sake. Sometimes the solution is much simpler than the time it takes to diagnose the issue itself.

The first step is to turn on the vehicle and look at the TPMS light yourself. Check if the TPMS light turns on instantly and remains solid, or if it blinks before remaining solid. This step alone can be a huge time-saver.

If the light is solid, it is signaling that one or more tires is inflated to at least 25% below the recommended placard pressure. This can likely be fixed by simply filling up the tires to the vehicle's recommendations. Here are some common mistakes that are made when filling up tires that can cause the light to remain on:

- 1.** The tires were filled while warm. Air expands as it warms up, so a tire's air pressure will naturally increase as the tires spin and heat up. It is very common for a vehicle to show a solid TPMS light in the morning after cooling all night, and then for it to shut off as the vehicle is driven. Even if the pressure is reading correct while the tire is warm, keep in mind that the tire pressure can decrease 1-3% once the tire cools; this might be just enough to kick that TPMS light back on.
- 2.** The tires were filled by the pressure displayed on the sidewall of the tire instead of the recommended pressure on the vehicle's door placard. These are often two different recommendations and can be confusing



for the average driver. Always inflate the tire to the door placard pressure.

3. The spare tire was not checked. Some vehicles will also read the spare tire pressure, so it is important to check that the spare tire is also inflated to the proper pressure in order to ensure the TPMS light stays off.

If the TPMS light blinks for 60-90 seconds before remaining solid, then the issue lies with the TPMS system itself. There is likely a dead, damaged or missing sensor in one or more tires. Doing a quick "Test Before Touch" will identify any sensors that are not working. Once you discover which sensor(s) failed, find out why in order to make service recommendations to the customer.

1. First, check for signs of damage. If the stem looks bent or the sensor isn't sitting properly in the rim of the tire, it could signal that the driver hit a curb or a pothole just right, hitting the sensor and causing it to malfunction. You can also check the sensor body for any damage that could have been caused by improper handling during a previous service. If damage is present, the solution is to replace the sensor.

2. If you don't see signs of damage, and if you have the tool functionality, test the sensor battery. TPMS sensor batteries cannot be replaced, so if the sensor battery is dead, the vehicle will need a new sensor. Knowing if it is a battery issue allows you to recommend that the other three (or four) sensors should also be replaced at the same time. If one has died, the rest are sure to follow. Servicing them all at once will save the driver time and money in the end.

3. If you don't find any malfunctioning sensors, then the issue likely lies with the sensors not being properly programmed or that a relearn is needed on the vehicle. A sensor could be completely functional but perhaps was programmed to the wrong make, model and year for example. In this case, the tool might be able to "ping it," but the vehicle's ECU won't be able

to find it, causing the TPMS light to illuminate. In the same sense, if the sensors are programmed correctly, but were never relearned to the vehicle, then the ECU might not be reading the sensor. This creates an unreadable pressure and illuminates the TPMS light. A simple relearn

procedure should solve this issue.

If you try all of these things and are still unable to get the light out, call your sensor manufacturer. They can help walk you through more rare and unique possibilities for a TPMS light remaining on after service. ■



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RULES OF INSPECTION

- Never judge the condition of the brake pads using just one pad. Both pads and their thicknesses need to be inspected and documented.
- Never take rust or corrosion lightly. Corrosion on the caliper and pads is an indication the coating, plating or paint has failed and needs to be addressed. Corrosion can migrate to the area between the friction material and backing plate.
- Some brake pad manufacturers bond the friction material to the backing plate with adhesives. Delamination can occur when the corrosion gets between the adhesive and friction material. At best, it can cause a noise problem;

at worst, the corrosion can cause the friction material to separate and reduce the effective area of the brake pad.

- Never ignore the guide pins, boots or slides. It is rare to find a caliper that has worn out the brake pads without wear or degradation also taking place on the guide pins or slides. As a rule, when the pads are replaced so should the hardware.

- Never estimate life or thickness using percentages. It is impossible to predict the life left in a brake pad with a percentage. While most consumers might be able to understand a percentage, it is misleading and often inaccurate. In order to accurately estimate the

percentage of material worn on a brake pad, you would first have to know how much friction material was present when the pad was new.

Every vehicle has a “minimum wear specification” for the brake pads, a number typically between two and three millimeters.

NORMAL WEAR

No matter the caliper design or vehicle, the desired outcome is to have both brake pads and both calipers on an axle wear at the same rate.

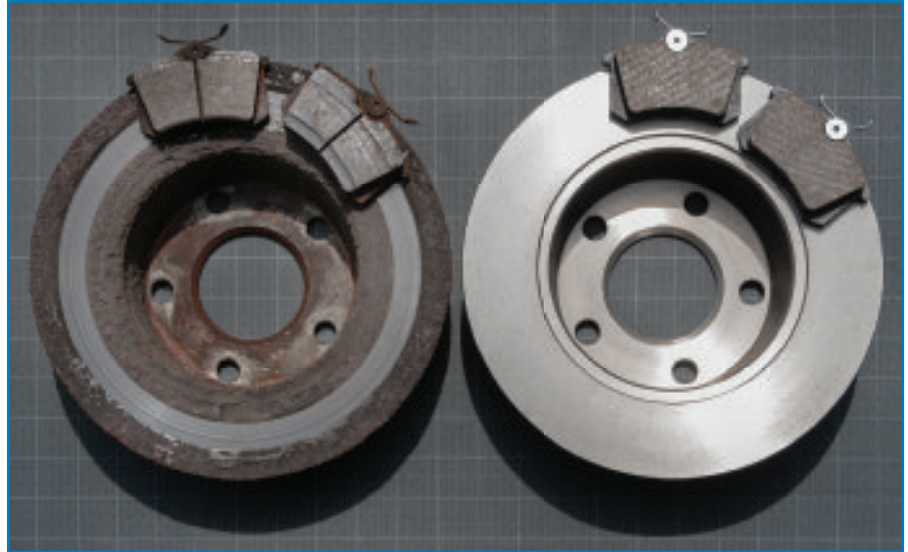
If the pads have worn evenly, it is proof that pads, calipers and hardware have functioned properly. However, it's not a guarantee that



they will operate the same way for the next set of pads. Always renew the hardware and service the guide pins.

OUTER PAD WEAR

Conditions that cause the outer brake pad to wear at a higher rate than the inner pads are rare. This is why wear sensors are rarely put on the outer pad. Increased wear is typically caused by the outer pad continuing to ride on the rotor after the caliper piston retracts. This could be caused by sticky guide pins or slides. If the brake caliper is an opposed piston design, outer brake pad wear is an indication the outer pistons have seized.



INNER PAD WEAR

Inboard brake pad wear is the most common brake pad wear pattern. On a floating caliper brake system, it is normal for the inner to wear faster than the outer – but this difference should only be 2-3 mm.

More rapid inner pad wear can be caused by a seized caliper guide pin or slides. When this occurs, the piston is not floating, and equalizing force between the pads and the inner pad is doing all of the work.

Inner pad wear can also occur when the caliper piston is not returning to the rest position due to a worn seal, damage or corrosion. It can also be caused by a problem with the master cylinder.

To correct this kind of wear, take the same steps as fixing outer pad wear as well as inspect the hydraulic brake system and caliper for residual pressure and guide pin hole or piston boot for damage, respectively. If the pin holes or piston boot are corroded or damaged, they should be replaced.

TAPERED PAD WEAR

If the brake pad is shaped like a wedge or is tapered, it is a sign the caliper might have too much movement or one side of the pad is seized in the bracket. For some calipers and vehicles, tapered wear is normal. In these cases, the manufacturer will have specifications for the tapered wear.

This kind of wear may be caused by improper pad installation, but the more likely culprit is worn guide pin bushings. Also, corrosion under the abutment clip can cause one ear of not move.

The only way to correct for tapered wear is to make sure the hardware and caliper can apply the pads with equal force. Hardware kits are available to replace the bushings.



Diagnostics

CRACKING, GLAZING OR LIFTED EDGES ON THE PADS

There are multiple reasons why brake pads can overheat. The surface may be shiny and even have cracks, but the damage to the friction material goes deeper.

When a brake pad exceeds expected temperature ranges, the resins and raw components can break down. This can change the coefficient of friction or even damage the chemical makeup and cohesion of the brake pad. If the friction material is bonded to the backing plate using only adhesive, the bond can be broken.

It does not take driving down a mountain to overheat the brakes. Often, it is a seized caliper or a stuck parking brake that causes a pad to be toasted. In some cases, it is the fault of a low-quality friction material that was not adequately engineered for



the application.

Mechanical attachment of the friction material can provide an

extra layer of safety. The mechanical attachment goes into the last 2 mm to 4 mm of the friction material. Not only does mechanical attachment improve shear strength, but it also gives a layer of material that remains if the friction material will not separate under extreme conditions.

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DEFECTS

A backing plate can be bent as the result of any of several conditions.

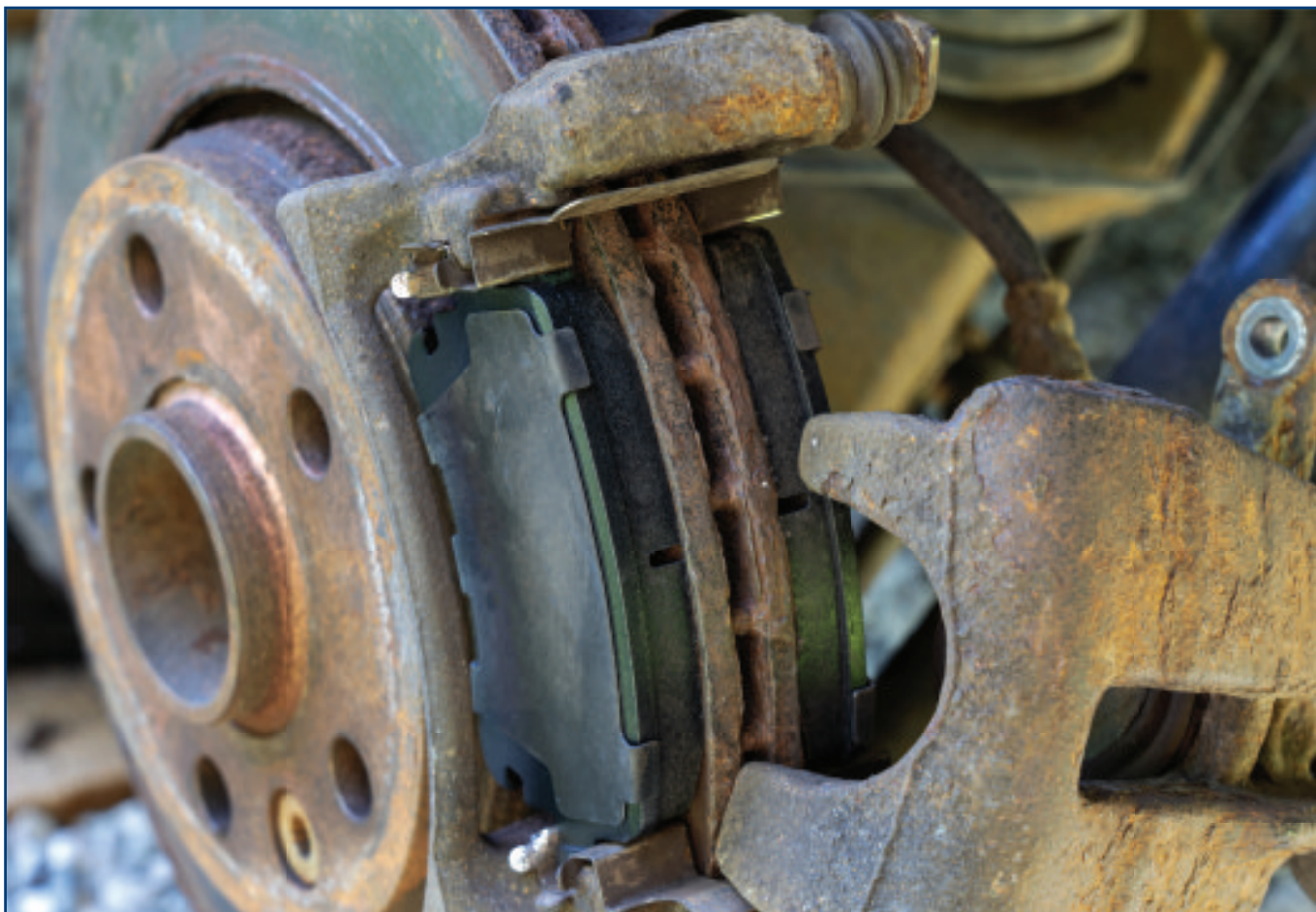
- The brake pad can become seized in the caliper bracket or slides due to corrosion. When the piston presses on the back of the pad, the force is not equal across the metal backing plate.

- The friction material can become separated from the backing plate and change the relationship between the rotor, backing plate and caliper piston. If the caliper is a two-piston floating design, the pad can become bent and eventually cause a hydraulic failure. The main culprit of friction material separation is typically corrosion.

- If a replacement brake pad uses a low-quality backing plate that is thinner than the original, it can bend and cause the friction material to separate from the backing plate.

CORROSION

As stated before, corrosion of



the caliper and pads is not normal. OEMs spend a lot of money on surface treatments to prevent rust. Over the past 20 years, OEMs have started to use plating and coatings to prevent corrosion on calipers, pads and even rotors. Why? Part of the issue is to prevent customers from seeing a rusty caliper and pads through a standard alloy wheel and not a stamped steel wheel. But, the main reason for fighting corrosion is to prevent noise complaints and extend the longevity of the brake components.

If a replacement pad, caliper or even the hardware does not have the same level of corrosion prevention, the replacement interval becomes a lot shorter due to uneven pad wear or even worse.

Some OEMs use a galvanized plating on the backing plate to prevent corrosion. Unlike paint, this plating protects the interface between the backing plate and

friction material.

But, for the two components to stay together, mechanical attachment is required.

Corrosion on the backing plate can cause delamination and even cause the ears to seize in the caliper bracket.

TIPS AND GUIDELINES

When it comes time to order the replacement brake pads, do your research. Since brake pads are the third most replaced item on a vehicle, there are many companies and lines competing for your business. Some applications are focused on the customer's requirements for fleet and performance vehicles. Also, some replacement pads offer "better than OE" features that can reduce corrosion with better coatings and platings.

Additional features like complete hardware kits that utilize high-quality steel and elastomeric coatings can prevent the pads from seizing in the caliper and prevent noise problems

during the entire life of the pad. If you have to replace the pads on your personal vehicle, use it as an opportunity to evaluate a brake pad company for yourself.

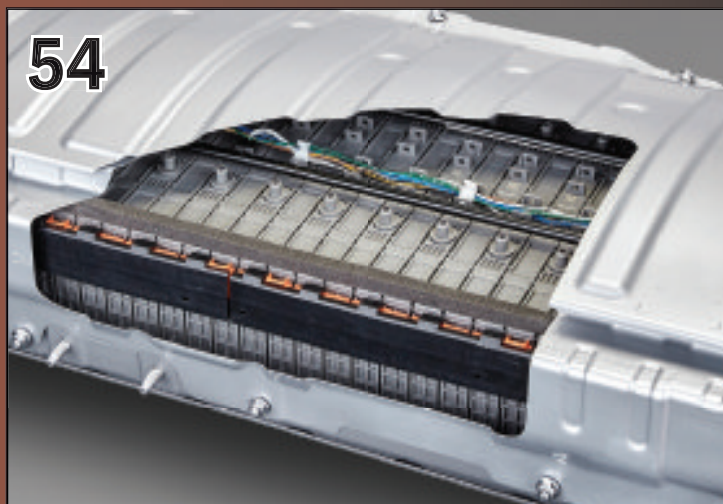
If the pads and rotors have been worn past recommend levels, inspect the caliper's piston boot and the piston. Once the piston has been out so far, it may not retract properly due to corrosion on the exposed piston. Also, the piston seal loses its flexibility as it ages. This will prevent the piston from returning to its rest position, which can cause the brakes to drag and increase pad wear.

Some electronic brake distribution systems may have faster-than-normal rear brake pad wear rates. This is normal in some cases, because the rear brakes are used to control nose dive. If the wear is greater than expected however, check for TSBs. Often, the OEM will issue new software for the hydraulic control module that solves the problem. ■

FEATURED STORY

61 VW AIR RIDE SYSTEMS

The VW Touareg uses a full-featured air ride system with multiple parts. Understanding how they interact is the key to keeping them functioning.



VIDEOS: [IMPORT-CAR.COM/CATEGORY/ORIGINAL-VIDEO](https://import-car.com/category/original-video)



LACK OF OIL ATTENTION CAN KILL VVT SYSTEMS

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Lack of regular maintenance is often the contributing factor in

variable valve timing system failure. It often comes down to the simplest procedure a driver can follow — properly maintaining the vehicle's oil.

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Every day in the shop, regardless of one's job or position, is an opportunity to learn and improve the shop's operations.

Improvement leads to better staff morale, better customer relations and increased shop profitability. But improvement requires a commitment to training.

54 TOYOTA PRIUS BATTERIES

Understanding how batteries are built, how long they last and why they may fail often comes down to deciphering the codes.

56 KIA/HYUNDAI THETA ENGINE

Knowing the basics can serve you well in solving problems with turbo-equipped Hyundais. A good scan tool will help, too.

2 WAYS TO SPEAK WITH A TRANSMISSION EXPERT



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TOYOTA

Prius Battery Diagnostics

Battery pack replacement is becoming more common as hybrid vehicles age. The second-generation Prius started with the 2004 model year and lasted until 2009. They have racked up many miles in the past decade or more, and the nickel-metal hydride battery is probably not providing the same range as before.

Inside a second-generation Prius battery pack are 168 1.2-volt cells that produce 201.6 volts when fully charged. Twenty-eight battery modules are wired in series and configured into 14 blocks. The battery pack has a heat management system to optimize the temperature under hot and cold conditions.

Any battery's life comes down to the chemistry inside of it to store and discharge energy. Like all chemistry experiments, heat plays a part in the reaction inside the battery. Heat can degrade a battery and cause reduced capacity. Charge and discharge cycles can also take their toll on the battery.

The Battery ECU measures the state of charge, internal resistance and current flow to determine the battery's condition.

Most codes that indicate the battery needs replacement will turn on the check engine light, and a message will appear in the information center.

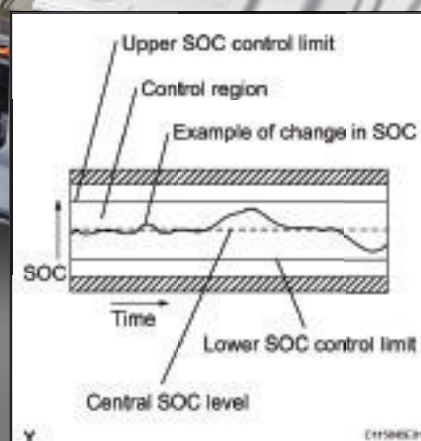
These codes are what bring the customer to your shop.

CODE P0A7F

Code P0A7F has the description of Hybrid Battery Pack Deterioration. The criteria for setting the code are based on profiles determined by Toyota engineers. The first is an increase in the internal resistance of the battery pack for one trip. The second criteria threshold is the state of charge of the battery. If the state of charge falls outside of the expected results for two trips, code P07AF is set. Also, the ECM will use the battery temperature sensor as part of the monitor's enabling conditions. With this code, the only way to resolve it is to replace the battery pack.

CODES P3011-3024

The battery ECU can read the internal resistance and voltages of the battery blocks. All of the blocks should be within 0.3-volts of each other. If the values fall outside the parameters, a code will be set for a weak block. The monitor for these codes is continuous and sets immediately. Typically, the blocks in the center of the battery generate weak block codes.



IDENTIFYING HYBRID BATTERY PACK DETERIORATION

CODE P0A80

The description for DTC P0A80 is Replace Hybrid Battery Pack. This code takes two trips to set and indicates the voltage difference in the blocks exceeds standards. The issue could be with the batteries or in the bus bar connections with the modules.

REPLACEMENT OPTIONS

There are remanufactured battery packs on the market. The remanufacturing process involves removing the modules from the battery pack and analyzing them. Bad cells are discarded, and the good cells from several batteries with similar performance are reused, so the battery is balanced. They will also install new bus bars and check the overall battery performance. ■

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Hyundai Theta Gamma Turbocharged Engines

Hyundai has two four-cylinder engines that use a turbocharger. The Gamma and Theta turbocharged engines were introduced in 2010 for many Hyundai cars and trucks. These engines also have direct injection, which makes them even more efficient.

Knowing the basics of how all turbocharged systems work can serve you well in solving problems with turbo-equipped Hyundais. A good scan tool that can graph boost pressure and a smoke machine can also improve your diagnostic procedures.

OIL QUALITY

The key to keeping the turbo (and, more importantly, the timing chain) healthy is the quality of oil and the frequency of oil changes. Since 2011, the owner's manual has specified an ILSAC GF-4 oil with an API SM rating. But, there have been upgrades. ILACS GF-5 oils are available and API has

issued SN and SN-Plus oils that can extend the life of the turbocharger, timing chain and even the high-pressure fuel pump.

Hyundai recommends changing the oil and filter between 3,000 to 5,000 miles, depending



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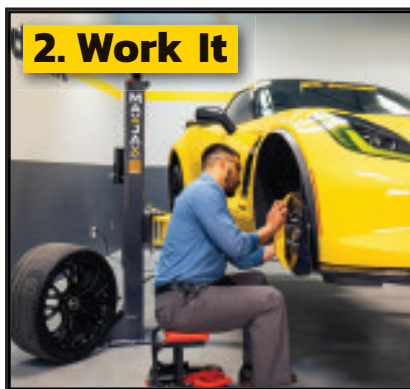
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on how the vehicle is driven. Not changing the oil will cause the oil to form deposits in the turbocharger's housing. These deposits will cause restrictions in the oil passages and the turbocharger to run hotter.

WGT OPERATION

The wastegate manages the flow of exhaust gases over the turbine. If the boost reaches a specific level, the gate opens and exhaust gases bypass the turbine. Depending on the engine, Hyundai can actuate the wastegate with a vacuum pressure pot or stepper motor. Both actuation methods have adjustment procedures.

The first-generation Gamma 1.6 turbocharged engine uses a pressure-actuated wastegate. A diaphragm working against a spring controls the wastegate. Vacuum pressure inside the actuator is controlled by a solenoid that receives a pulse-width modulated signal that is controlled by the ECM.

The Wastegate Solenoid Valve Control Solenoid Valve (WGT) controls the actuator that opens the bypass passage of the turbocharger turbine. In order to drop the turbine internal pressure, the ECM restricts the turbine rotation by opening the bypass passage.

There are alignment marks on the arm of the wastegate and housing. Lengthening and shortening the rod adjusts the wastegate. The actuator rod should move when a vacuum of -9.08 psi is applied to the actuator.

The 2.0 L GDI turbocharged Theta engine uses a stepper motor to open the wastegate. The Electric WGT (EWGAT) is installed on the turbocharger. The actuator consists of a DC motor that actuates the wastegate. Inside the unit is a two-step gear transmission that increases the torque of the motor.

The EWGAT has a position sensor that measures the voltage from the open stop to the closed stop. The voltage from the sensor is used to

measure the position of the vane. The five-volt signal correlates with the amount of wastegate lift. The sensor output on a scan tool is used to adjust the rod. The adaption mode menu for the EWGAT needs to be activated. The target voltage is listed in the service information and can vary, depending on the model and year. Turning the rod end clockwise will increase the voltage; turning it counterclockwise will decrease the voltage.

RECIRCULATION VALVE CONTROL (RVC)

Hyundai calls its blow-off or diverter valve a Recirculation Valve Control (RVC). An electronic solenoid valve that controls engine vacuum operates the RVC. The valve recirculates air back into the intake or air cleaner. The valve can be mounted on the charge pipe or, in the case of the first-generation Veloster, the valve is mounted on the intercooler.

Boost control is accomplished both with the wastegate and recirculation valve. More importantly, they work together so the desired boost pressure is achieved, while keeping the turbines spinning so that lag is minimized.

Codes for the valves and actuators are either electrical or they are generated because a command does not provide the desired result. Electrical codes typically indicate a circuit failure, or high or low voltages that point to an open or high resistance for the solenoid's circuit. Testing the circuit with meters and scopes is part of Hyundai's diagnostic process.

The engine management system looks at several sensors, including the knock, air/fuel ratio and the boost sensors, to regulate the performance of the engine and turbocharger. Other inputs are used to determine if the boost levels are safe. If there is a malfunctioning sensor, the system will reduce boost pressures and go into a fail-safe mode.



TURBO DAMAGE

One of the more vulnerable areas of any turbocharged engine is the exhaust manifold. Leaks around the gaskets and cracks in the manifold can lead to a loss of power and even oxygen sensor readings.

One item to check if you are dealing with lack-of-power complaint is the turbine's compressor wheel. If the fins of the compressor are damaged, it can cause poor acceleration, low boost levels and noise. The damage can occur in two ways. First, the turbo can ingest debris. With the wheel spinning in excess of 100,000 rpm, even the smallest rock or piece of metal is like a bullet. Second, the shaft bearings inside the turbo have enough endplay to cause the turbine to make contact with the housing.



You can expect to see a lot more turbos on Hyundai models. The new Stinger and Genesis models are using a twin-turbo V6 that has more than 300 hp.

WHAT COLOR IS THE DIPSTICK?

The Hyundai Theta engine appeared in 2006 Sonata models and is still going strong in naturally aspirated and turbocharged forms in various Hyundai and Kia applications. The one area of the engine that has been the source of more TSBs and tech tips has been the bottom end of the engine and lubrication system.

Part of the problem can be pinned to owners neglecting oil changes; the other part occurred at the factory. Hyundai and Kia have issued multiple recalls for the Theta engine and issues with the oil passages in the crankshaft causing rapid wear to the connecting rod bearings.

According to the recall documents,

metallic debris was not removed from the engine crankshaft during the deburring process. The debris restricts oil flow to the connecting rods. The symptom of the damage is a metallic, cyclical knocking noise that is caused by wear of the connecting rod bearings. Some engines have seized due to the damage and even caused fires.

Hyundai's procedure to determine if there is an issue with the connecting rods involves using its GDS factory scan tool. The procedure tests the engine at specific engine RPM ranges with a special microphone in the dipstick tube. The test will generate a pass or fail result. At the dealer, the tool records a sound file for the warranty department.

In later recall documents, Hyundai and Kia have increased the oil capacity of the vehicle, from 4.6 quarts to 5.0 quarts, noted by a change in the color of the dipstick. On some vehicles, there are three color codes for the dipsticks.

TODAY'S HIGH-MILEAGE OILS HELP YESTERDAY'S CARS SEE TOMORROW



The highly polished surfaces of engine components like crankshafts or camshafts may look extremely smooth, but don't be misled – they're actually extremely rough. Microscopically, the metal is composed of peaks and valleys – and as engines wear the metal can break off and get even deeper and rougher.

Wear and tear really starts taking its toll on engines at around 75,000 miles. Because the average age of the cars on the road today is nearly 12 years, and 60 percent of them are considered high mileage vehicles, it's all the more critical to begin giving engines special care at 75,000 miles – they're going to need it to help them go another 125,000 miles.

Today's full synthetic high mileage motor oil is designed for anyone who wants to maximize their engine performance while protecting it from the four primary causes of engine failure: heat, friction, deposits and wear. They start with highly refined base oils to provide the best lubrication at all temperatures while minimizing thermal breakdown with a proprietary mix of chemical additives to protect both the oil and the engine. These additives include detergents to minimize deposits, antioxidants



to protect against heat, anti-wear additives to minimize wear throughout the engine and friction modifiers to maximize fuel economy and horsepower.

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Without something to protect them, engine parts will wear down, causing reduced gas mileage, lower horsepower and reduced engine life.

Keep tomorrow's classics rolling for years to come. When you identify the early signs of aging in your customers' cars, the answer may be an oil change with the right product for the right application.

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Engine

A yellow dipstick is the original dipstick and indicates that the engine has not been inspected. If you see one of these dipsticks, check to see if the recall applies to the vehicle.

An orange dipstick indicates the engine has been tested and passed the test. It can also indicate that the oil capacity could be different than your service information.

The red dipstick means that the engine has been replaced under the recall. If the engine is making a knocking noise, it is now the customer's fault.

WHAT DOES THIS MEAN FOR YOUR CUSTOMERS WITH A THETA ENGINE?

Wear of the connecting rod bearing can occur on any vehicle if the oil change interval is passed, or if the wrong oil is used. If you have a

customer who drives a Kia or Hyundai with a Theta engine, the chances are slim that there is an issue with debris in the crankshaft causing wear to the connecting rod bearings. But, neglected maintenance can make the problem occur in Theta engines that don't have the defect.

Another favor you can do for your customer is to reflash the ECM with the latest calibrations. Hyundai has updated the software to protect the engine and prevent catastrophic engine failure. The knock sensor detection system software continuously monitors engine vibrations for unusual dynamic patterns that develop, as an engine connecting rod bearing wears abnormally in a way that could later cause engine seizure.

If vibrations caused by bearing wear start to occur, the malfunction

indicator lamp will blink continuously, an audible chime will sound (in certain models) and the vehicle will be placed in a temporary engine-protection mode with reduced power and acceleration. In this temporary mode, drivers maintain full control of the vehicle as brakes, steering and safety devices, such as airbags, remain operational.

The vehicle can continue to be operated for a limited time in engine-protection mode to enable the customer to safely drive it for inspection and repair. But, acceleration will be slower, with a reduced maximum speed of approximately 60 to 65 mph, and a limited engine speed of around 1,800 to 2,000 rpm.

More details on Hyundai's engine recalls and the knock sensor product improvement campaign can be found at hyundaiengineinfo.com. ■



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AIR RIDE Diagnostics

2003-2010
VW Touareg
Applications

The Volkswagen Touareg was the first VW SUV and the first to get an air ride suspension system. The luxury SUV shares the same platform as the Audi Q7 and Porsche Cayenne. This is a full-feature air ride system, where the driver can control the height, designed to improve comfort, stability and off-road capabilities. Some vehicles with the 4XMotion option will also have a sway bar that can be decoupled to increase wheel travel. The struts have active dampeners that control compression and rebound. The air springs can be serviced separately from the dampeners. When there is a fault with the system, the system will display “Running Gear Fault” in the driver information center.

COMPRESSOR

The compressor is located under the left side of the vehicle next to the frame rail. It is a dry air compressor that will wear out over time. It supplies pressure to two reservoirs. One reservoir is located next to the compressor; the other is located in the rear of the vehicle.

The compressor is equipped with a temperature sensor. If excessive temperature is detected due to extended run times, the control module will deactivate the compressor to prevent damage.

SENSORS

The system has four sensors that

measure ride height. The system also has four accelerometers mounted to the body at the corners. The information from these sensors is used to determine the pressure in the air springs and the dampener settings. The information is also used for the active stabilizer bar and headlights.



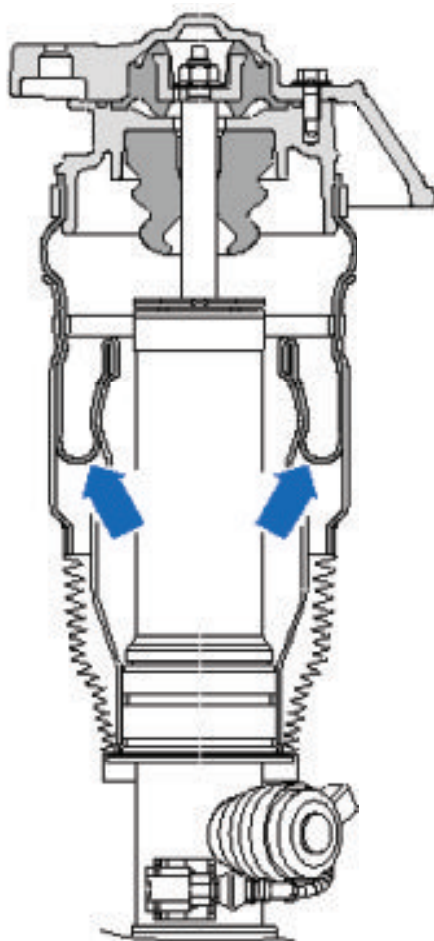
The system has one pressure sensor that monitors the pressure at the valve block. Codes might be related to the time it takes for the compressor to replenish the reservoir or the time it takes to carry out a trim adjustment. If it takes too long, the control module will assume there is a problem and puts the vehicle into a safe mode to preserve the compressor and airbags.

While these observations by the system could be the result of a leak, these faults are more likely the result of a weak compressor or sensor, or a problem with the solenoids controlling the system.

RESIDUAL PRESSURE VALVES

Each air spring has a residual pressure valve at the top of the body. This valve keeps a minimum amount of pressure in the spring when the air spring is resting.

This valve can fail in two ways. First, it can leak and cause the air spring to collapse. Second, it can prevent air from escaping at one



corner. Both conditions will result in a vehicle that looks slanted after it has been parked after a few hours. When restarted, the drive information display will have a warning for "Running Gear Fault." Codes will be set in the air ride control module.

The residual pressure valves can be replaced separately from the air springs and requires a special socket to remove. The valves are prone to corrosion. Take your time removing them as they can snap off.

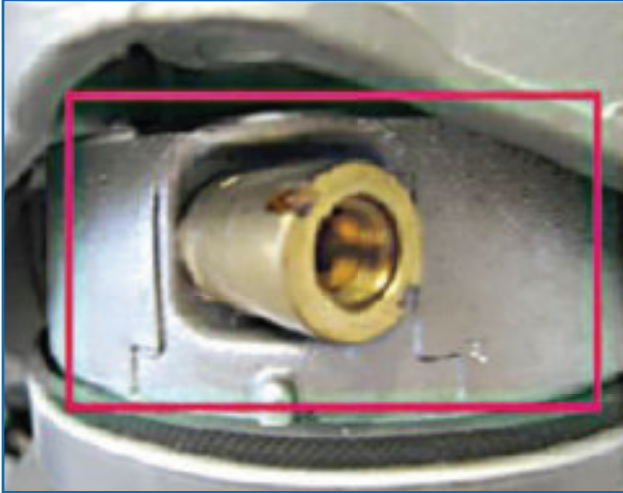
TESTING THE SYSTEM FOR LEAKS

In order to test the air suspension, the following conditions must be met:

- The vehicle must be cold and must not be moved during testing.
- The room temperature should be between 50-85° F, and remain steady.
- The vehicle must be sitting on a level surface.

1. Start the engine.

2. Adjust the suspension to the high level and then the normal level using the front information display.
3. Turn off the engine.
4. Disconnect the connector from the Level Control System Control Module (J197) on the right side of



the rear cargo area to prevent the level control from readjusting.

5. Measure vehicle height on all four wheels from the center of the wheel to the bottom of the wheel arch.
6. After two hours, measure vehicle height again and compare the measurements. If the vehicle is sitting crooked, a leak is present at the suspension with the greatest difference between the first and second measurement.
7. Check the affected air spring shock absorber and the corresponding air line using leak-detection spray in the following order:
 - Air line connections (wiggle the lines to see if the problem leak is present).
 - Residual Pressure Retaining Valve.
 - Air spring.
8. If no deviation is determined after two hours, the measurement must be repeated after 24 hours. After 24 hours, a deviation of up to 4 mm is permissible. ■



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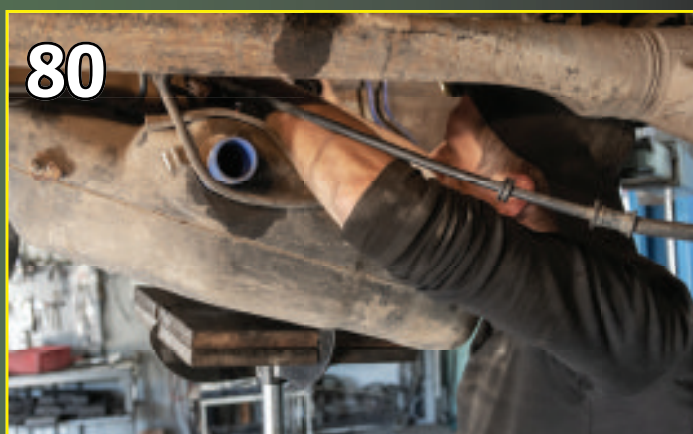
COMPRESSORS

COIL CONVERSION KITS

FEATURED STORY

74 MODERN TURBO SERVICE

The turbo itself is rarely to blame for most engine problems, so determining the real source of performance issues may require additional diagnostic time.



VIDEOS: [UNDERHOODSERVICE.COM/CATEGORY/ORIGINAL-VIDEO](https://underhoodservice.com/category/original-video) //

66 A/C COMPRESSORS

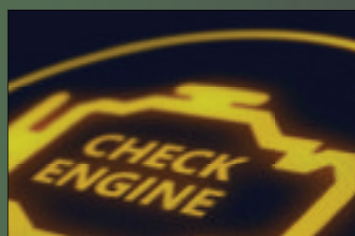
The compressors found in today's electric vehicles may have as much as 400 volts. Do you know how to service them safely?

70 CURING BELT NOISE

Belt noise may be the first symptom that something under the hood isn't operating correctly. Here's how to find it and fix it.

80 FUEL PUMP FUNCTIONS

Fuel pump diagnosis requires communication with modules to see which data PIDs are present and which are missing.



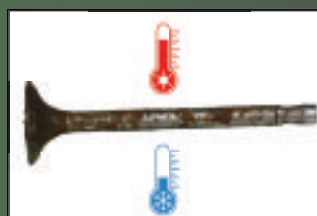
DIAGNOSING A CHECK ENGINE LIGHT

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What's worse, a solid check engine light or one that's flashing? Unfortunately,

customers may not know the difference and, by the time they get around to asking you about it, the damage may be done. There may be multiple reasons an engine may be running poorly and a flashing light indicates that damage could be imminent.

SOLVING THE CARBON DEPOSIT CONUNDRUM



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don't happen overnight, but they can be prevented.



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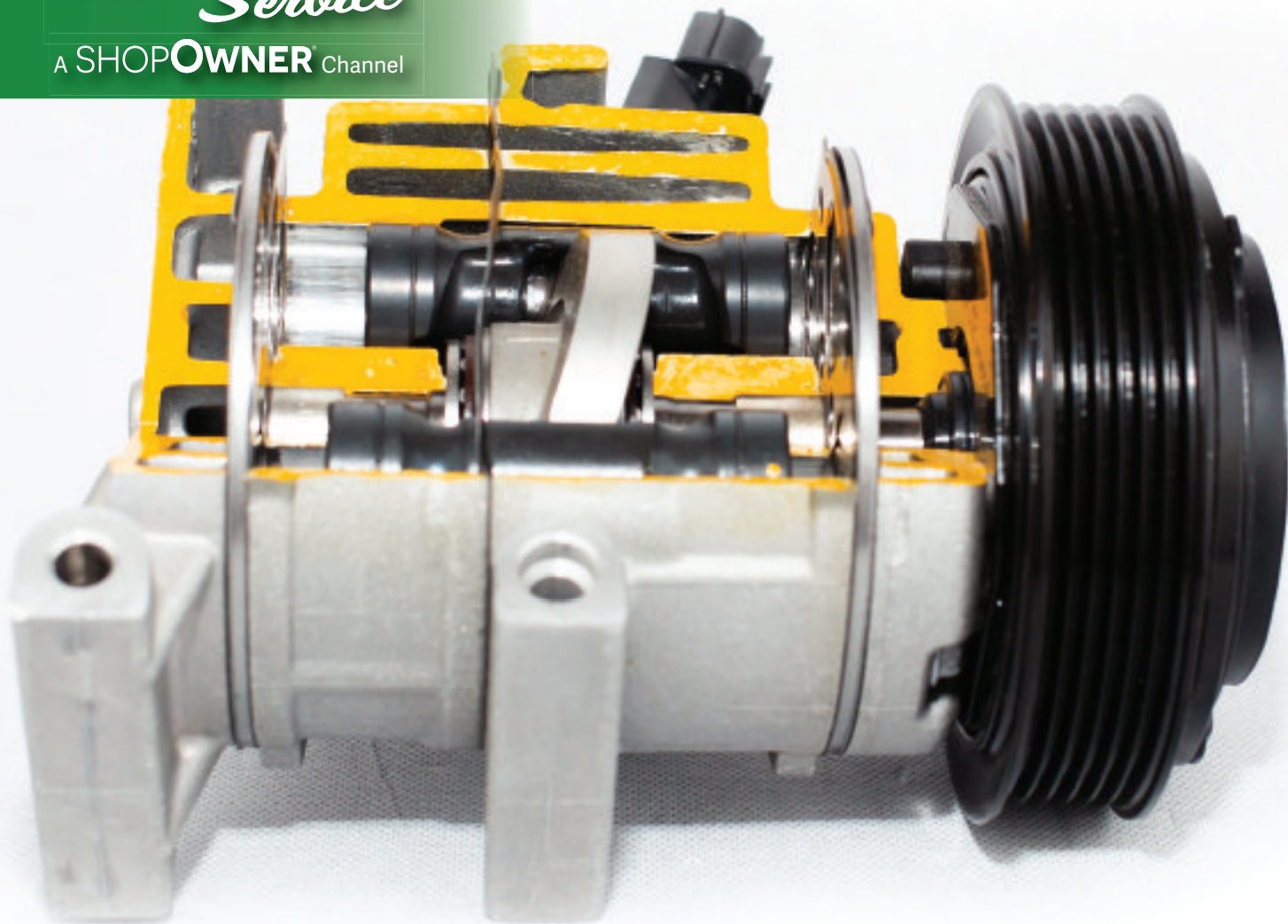
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STAYING COOL WHEN IT COMES TO ELECTRIC A/C COMPRESSOR SERVICE

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OR



Did You Know?

Proper compressor lubrication is crucial to a successful repair and system longevity. Using the wrong type, viscosity or amount will compromise compressor performance and system integrity. The use of oils that contain dye, sealers or other additives that do not meet SAE J2670 standards may impact the system and void your warranty.

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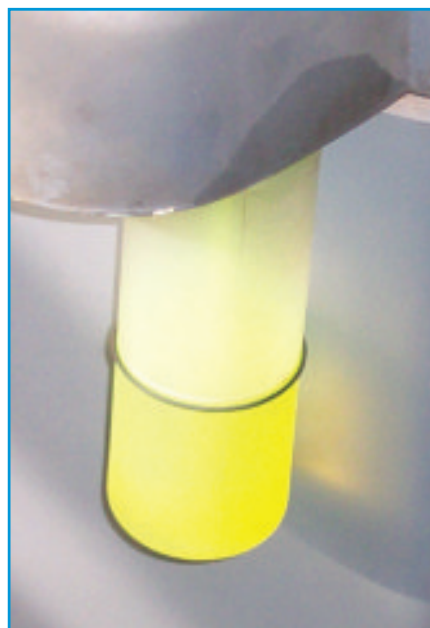
rislone.com

HVAC

First and foremost, let's talk about safety. Safety is extremely important when working with high voltage. These compressors can have as much as 400 volts to operate, such is the case with Tesla. That's a lot of voltage and nothing you want to mess around with! These high-voltage (HV) circuits can be identified by the orange wiring that is routed to them. If replacement of a compressor is required, always follow the manufacturers' procedures to shut down the HV source. These procedures will always require the usage of HV Class 0/1,000-volt gloves, along with a leather glove on top, to protect the gloves from damage. A category III-rated multi-meter is also required to safely verify the high-voltage components being serviced are no longer live circuits with high voltage. Finally, it is always a recommended practice to have a second technician nearby with a high-voltage insulated emergency hook in the event of accidental high-voltage exposure. This hook will allow a technician to be safely pulled away from the vehicle as the high voltage will tend to grab the affected person, not allowing them to be released from it on their own.

It is important to pay attention to the type of oil used in an eCompressor, as it usually differs

from the oil used in mechanical-driven compressors. There are countless manufacturer TSB's regarding this topic. HV compressors require special Polyol Ester (POE) A/C refrigerant oil that is non-conductive. The specific type of oil is identified by the vehicle manufacturer. All non-conductive POE oils are not the same! It is extremely important to not use any compressor oil other than what is recommended by the manufacturer. This oil provides high dielectric properties, which helps to maintain the integrity of the compressor's electrical windings and prevent high voltage from bleeding through the compressor itself, and possibly electrocuting the technician. It is





also important to never mix PAG oil with these systems. Just 1% of PAG oil in the system can lower the insulation resistance of a compressor from over 10 mega-ohms to under 1 mega-ohm. This can cause a DTC to set and even shut down the compressor itself. Many vehicle manufacturers will require replacement of the entire A/C system if PAG oil has cross-contaminated the system.

And, finally, pay close attention to the dye you are adding to these systems. Just as the wrong oil can contaminate a system, the same thing can happen if the wrong dye is used. There is a specific dye for electric compressors. Hybrid electric vehicle leak detection dye is Polyol Ester-based and is specific to the vehicle.

The dye used for non-hybrid electric vehicles is PAG oil, which is hygroscopic. Using it in a hybrid vehicle, even in the smallest amount, can create an air conditioning compressor failure. The oil in the dye

breaks down the insulating properties of the windings on the electric motor portion of the compressor. These windings are immersed in compressor oil, and ester oil is used to protect the insulation on the windings to prevent electrical leakage. The addition of PAG oil into a hybrid air conditioning system designed for ester oil may result in an air conditioning system malfunction.

A straight-forward approach to avoid cross-contamination is to use dedicated hoses and injectors for each type of refrigerant oil. A/C equipment that has been used for conventional A/C systems can contaminate the HV-powered system.

Servicing electric A/C compressors will require a different approach and some special precautions that are different than the belt-driven compressors, but if you follow the recommended service procedures, your repair will go as "cool" as the air coming out of those A/C vents. ■



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by **Andrew Markel**, Director of Content

NEW AND OLD TECHNOLOGY TO CURE BELT NOISE

No internal combustion engine has a constant crankshaft speed. An engine slows down as the piston compresses the air and fuel mixture, and speeds up as the mixture is ignited. You can't see it with the naked eye but the small, sudden changes in speed can cause slipping, noise and unwanted movement in the belt. So, what is an engineer or technician to do?

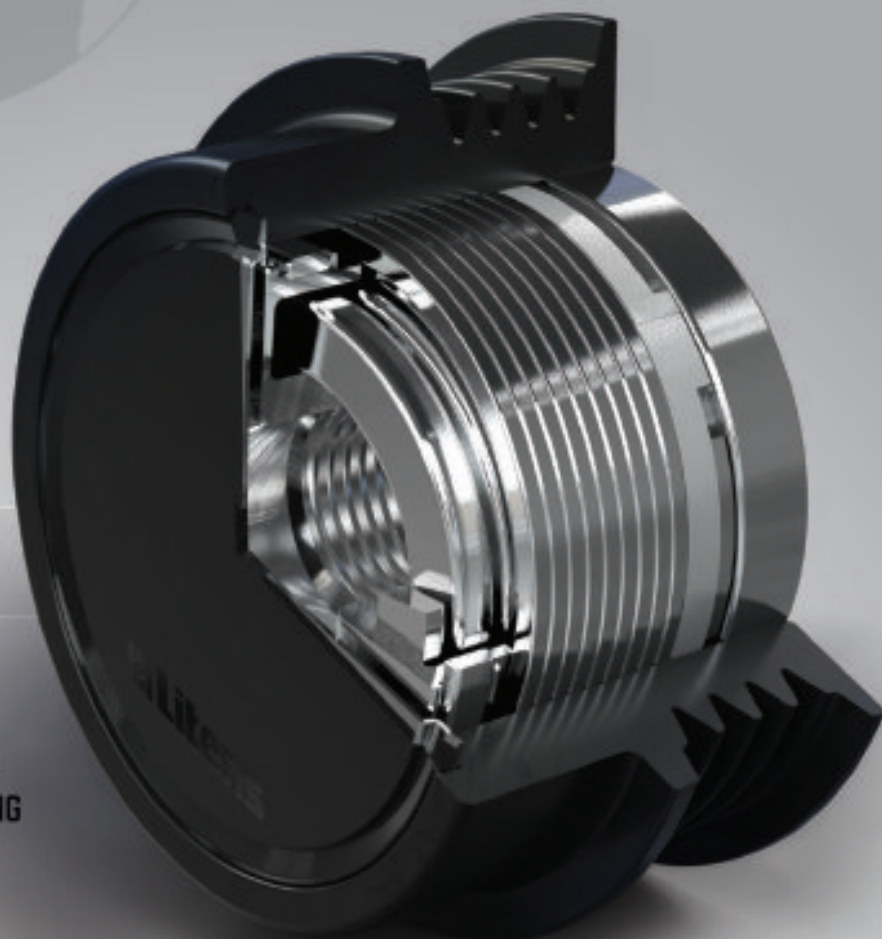
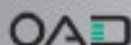
The first option to control noise is to increase the tension of the belt. When the amount of tension is raised on the belt with either a manual adjuster or automatic tensioner, it can do three things to the belt. First, it makes the belt drive system less efficient because it takes more power to drive the components. Second, as belt tension increases, the wear on the belt can increase. Third, higher tension levels put more stress on the bearings in the alternator, power steering pump and idler pulleys. For engineers, belt tension is a balancing act

between noise, efficiency and longevity of the belt.

There are other engineering options to achieve that balance without increasing tension on the belt. Harmonic balancers on the crankshaft can dampen crankshaft speed changes at the source. Alternator decoupler pulleys can decouple the alternator from the drive belt system, and some can even dampen vibration. In addition, new automatic belt tensioners have dampening components that can keep the tension constant.

HARMONIC BALANCERS

A harmonic balancer is like a punching bag for the crankshaft. There are two primary components in a harmonic balancer: inertial mass and an energy-dissipating element. The inertial mass consists of an outer ring that could have the grooves for the belts and an inner hub that connects to the crankshaft. The outer ring contains



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the mass to dampen the small changes of speed in the crankshaft.

Between the two metal components is the energy-dissipating element, which is a rubber or elastomeric compound. This ring of rubber can cause the two metal parts to go out of phase as much as 1° to 2° as it absorbs the vibrations in the crankshaft. When the energy-dissipating element flexes, it changes the motion into heat.

WHAT TO LOOK FOR:

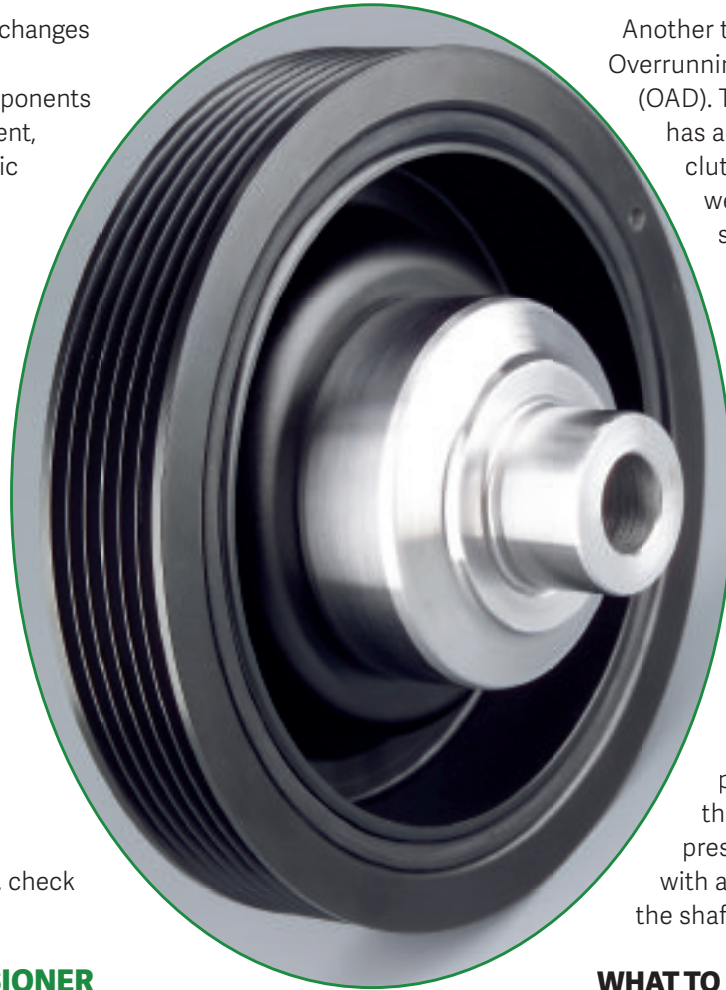
- Incorrect timing marks are a sign the outer ring has separated from the inner ring.
- Worn edges on the belt can be a sign that the outer ring is no longer aligned with the rest of the accessories' pulleys.
- If you have an odd engine vibration and no misfire codes, check the dampener for damage.

AUTOMATIC BELT TENSIONER

A worn automatic belt tensioner has consequences beyond a loose belt. When an automatic belt tensioner wears out, the belt and attached accessories will start to take an extra pounding because the tensioner can no longer dampen the power pulses of the crankshaft. The effect on these components is similar to when a car has bad shocks that slowly destroy the suspension.

WHAT TO LOOK FOR:

- Look at the gap between the arm and body. If the gap is uneven, it is a sign the bearings that hold the shaft have failed.
- Look for rust deposits on the outside of the body and arm. The rust is typically from the spring and other internal components.
- Remove the belt and spin the pulley on the tension. Worn bearings can cause noise and alignment problems.



Another type of special pulley is an Overrunning Alternator Decoupler (OAD). This type of pulley also has a one-way overrunning clutch inside the hub, as well as an internal torsion spring to further dampen vibrations in the belt drive system. The spring acts as a shock absorber to cushion the hub. This reduces noise at idle and low engine speeds and helps dampen harmonic vibrations at higher speeds.

How can you identify these types of alternator pulleys? OAP and OAD pulleys usually thread onto the alternator shaft. Solid pulleys typically slide onto the alternator shaft or are press-fit and held in place with a large bolt on the end of the shaft.

WHAT TO LOOK FOR:

- Raise engine speed to 2,000-2,500 rpm in Park (auto trans) or Neutral (manual trans) and then shut off the engine. Listen for any noises from the OAD after the engine is shut off. A worn-out bearing will generate a "buzz" noise during this test. If the OAD is noisy during this test, replace it.
- Remove the cap, and with the proper tool inserted into the front of the OAP, rotate the alternator's shaft in both directions. In the overrun direction it should feel smooth, and in the drive direction, it should have a spring feel.
- If the pulley is locked up, replace it.
- If the OAD has no spring feel in the drive direction, replace it.
- If the OAD requires more than 9-13 in./lbs. (1-1.5 Nm) of torque to turn in the overrun direction, replace the OAD.
- If the OAD is not smooth in the overrun direction, replace it. ■

DECOUPLER PULLEYS

Many late-model vehicles are equipped with special pulleys that are engineered to reduce noise, vibration, and harshness and extend the life of the alternator.

An Overrunning Alternator Pulley (OAP) has a one-way clutch mechanism inside the hub that allows the belt to turn the alternator in one direction, and allows the alternator to "freewheel" and spin at its own speed when the engine suddenly decelerates.

A good OAP pulley should lock up and turn the alternator rotor when it is turned one way, but release and freewheel when it is spun in the opposite direction. If the internal clutch mechanism is bad, the pulley may slip and fail to drive the alternator, or it may remain locked all the time — increasing noise, vibration and stress on the belt drive system.

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MODERN TURBOCHARGER DIAGNOSTICS

by Andrew Markel, Director of Content



Ask the owner of any turbocharged late-model car or truck and chances are they have no idea there is a turbocharger under the hood. This is because the management of boost pressure and turbine speed has become a science. Gone are the mechanical elements that open when the boost hits a peak. Now, sensors

and actuators manage boost pressure, so the driver does not notice a turbocharger spinning at 200,000 rpm.

From a diagnostic perspective, many things can change the performance of the turbocharger. But, the turbocharger is rarely the source of the problem. Often, it is the sensors and valves that prompt codes for over- and under-boost conditions.

THE EXHAUST PATH

The turbine speed is ultimately governed by the wastegate. The wastegate channels the gases around the turbine and back into the housing and exhaust system. The compressor side of a turbocharger pressurizes outside air. The amount of pressure produced is controlled by a valve that can be called a blowoff, diverter or bypass valve. The valve bleeds off pressure and diverts it back into the turbocharger's inlet or the air cleaner. The diverter valve also prevents the turbocharging from surging when the throttle body is closed.

Surging involves air

reversing direction in the charge pipe and intercooler. This can damage the turbocharger's shaft and bearings.

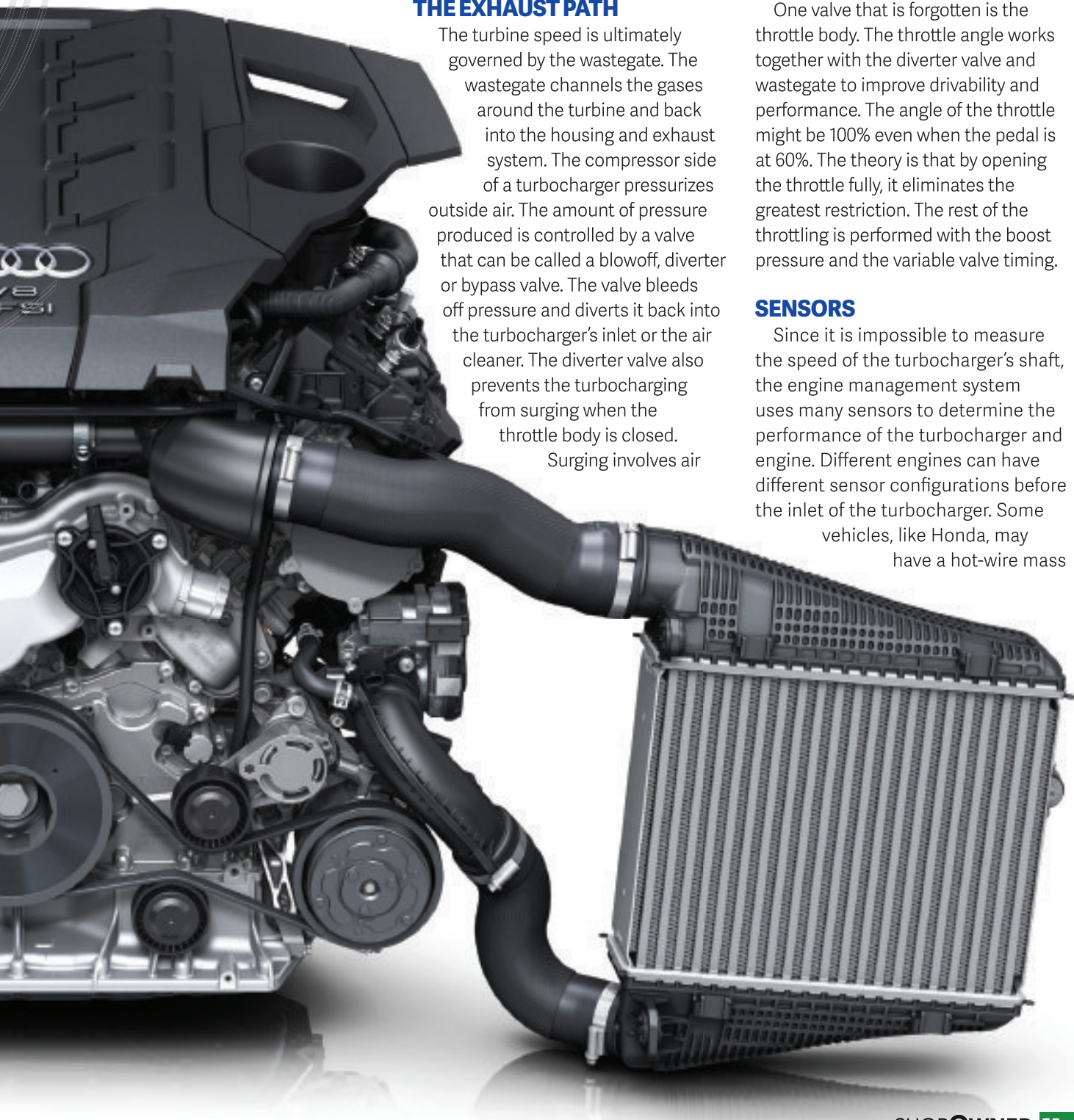
When the turbocharger compresses the air, it is heated. This is why the next stop is an intercooler. With a large surface area, the air is cooled by the intercooler before it enters the engine. After the intercooler, the air enters the charge pipes and eventually goes to the throttle body and intake manifold.

One valve that is forgotten is the throttle body. The throttle angle works together with the diverter valve and wastegate to improve drivability and performance. The angle of the throttle might be 100% even when the pedal is at 60%. The theory is that by opening the throttle fully, it eliminates the greatest restriction. The rest of the throttling is performed with the boost pressure and the variable valve timing.

SENSORS

Since it is impossible to measure the speed of the turbocharger's shaft, the engine management system uses many sensors to determine the performance of the turbocharger and engine. Different engines can have different sensor configurations before the inlet of the turbocharger. Some

vehicles, like Honda, may have a hot-wire mass





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Engine



airflow sensor. Other manufacturers may use a manifold air pressure sensor and air temperature sensor like that on some GM Ecotec engines. But, some systems will not have any sensors before the turbocharger. Instead, the system may use the ambient air temperature like some Fiat/Chrysler MultiAir engines.

The sensor following after the turbocharger will be a boost sensor. The placement of the sensor is typically after the intercooler. Some manufacturers will combine an air temperature sensor with a boost sensor. To make it even more confusing, some manufacturers may call a boost sensor a MAP sensor.

Cold weather can affect boost sensors. Condensation can build up around and inside a boost sensor and cause the sensor to malfunction and read the boost levels lower than normal. Some engines will have multiple sensors for boost. If a boost sensor is out of range, it will cause a code P0236.

Like any naturally aspirated engine, the oxygen or air-fuel ratio sensors play a critical role in the turbocharger operation. If the oxygen sensors can't determine if the engine is running too rich or lean, it might reduce boost pressures to prevent damage to the engine. The same is true for knock sensors.

ACTUATORS AND CONTROL

In the past, wastegates and blowoff valves opened and closed according to a set pressure inside the intake or charge pipe. When the upper limit

was reached, wastegate or blowoff valves opened. On modern engines, the operation of these valves can be independent of pressure. The engine management system can operate the two valves to reduce lag and keep the turbo spooled up.

Most modern vacuum-actuated wastegate or blowoff valves use a vacuum pump mounted to the exhaust camshaft. A pulse-width actuated solenoid controls the movement. The ECM will vary the duty cycle to open the valve. In most cases, 0% will indicate a closed valve, and 100% will represent a fully opened valve.

Some systems will have the solenoid or electric motor directly controlling the diverter and wastegate valve. This makes for a more responsive valve that does not need vacuum to operate. Hyundai and Audi use these types of solenoids.

P0299 UNDER PERFORMANCE

The engine management system knows the expected level of boost pressure for a given condition. Code or DTC P0299 indicates the boost pressure is below expectations. Different vehicles might have other criteria for setting a P0299 DTC. One vehicle may specify the lower boost levels must occur for more than three seconds at a given throttle angle. Most require multiple incidents over one or two key cycles. If you have a scan tool, you can access the freeze-frame information when code P0299 was set.

Many components and conditions could cause a P0299, such as a restricted air filter or blocked catalytic



converter. Why? If the engine can't ingest or expel air, it can't create boost.

One of the more common causes of a P0299 is a stuck or leaking wastegate. If exhaust gases are bypassing the turbine, the compressor can't spool up. The wastegate's shaft can become frozen in the exhaust housing. Also, the housing can crack where the flap seals against the seat and cause a leak.

On the control side, it is possible for a solenoid to fail in the open position and cause the actuator for the wastegate to stay open. A leaking wastegate can also occur if carbon deposits build up around the wastegate flap. Carbon deposits are caused by oil, which could come from leaking turbocharger shaft seals. But, oil could also be coming from the PCV system. If the PCV system is not functioning correctly, it can cause the engine to ingest large volumes of oil droplets and crankcase vapors.

Diverter valves can fail to seal and cause a P0299 code. Most of these leaks are caused by the seals on the sides of the valve's piston in the compressor housing. The greater the boost pressure, the greater the leak.

Leaks in the plumbing and intercooler can cause a P0299 code. These leaks will often occur at the couplings between charge pipes.

Finding the leaks can be difficult due to the packaging of the intercooler behind a bumper. A smoke machine can help find the leaks, but you may need to upgrade it. Most smoke machines are designed to test EVAP systems and can't generate enough pressure to cause a coupling or cracked intercooler to leak.

If you find a small pinhole leak at the bottom of some intercoolers, it might be a design feature. Some intercoolers will have a small hole to allow condensation and oil to drain from the intercooler. This can be seen on some Ford F-150s with the 3.5 EcoBoost engine.

One of the least common causes of a P0299 code is a failed turbocharger. This type of failure happens when a lack of lubrication causes wear on the shaft, bearings and seals. Wear to the shaft can cause endplay. The turbine and compressor can come in contact with the housings and slow, or even stop.

Another cause of a turbocharger failure is the flow of engine coolant. Late-model turbochargers will cool the center section with coolant and oil. When the engine is turned off, an electric pump will circulate coolant through the center section. If the pump is not functioning, oil inside the turbo can oxidize and restrict the oil passages.

But, one of the most common causes of a P0299 code is a faulty boost sensor. The boost sensor can fail and under- or over-report boost pressures. It can often cause a code P0236 to be set. This is where a mechanical boost gauge or pressure transducer can help to diagnose the problem. When inspecting boost sensors, check to see if the sensor has good power, ground and reference voltage.

P0234: OVER-BOOST CONDITION

An over-boost condition typically occurs when the diverter valve or wastegate fails to open. The criteria for setting a P0234 can vary, depending on the manufacturer. The main criteria is

the boost exceeded a specified level for a period that is usually two seconds.

Most manufacturers will have other criteria for code P0234. The criteria can include engine RPM and ambient air temperature. When an over-boost condition is detected, the engine will enter a "limp mode" that restricts engine rpm.

One often-ignored cause of an over-boost condition is the preload for

the wastegate actuator. The preload is adjusted by changing the length of the rod that goes between the vacuum actuator and the arm of the wastegate. Setting the preload may involve counting threads, or it requires a vacuum gauge to determine when the wastegate cracks open. If you are installing a new turbocharger, you might have to set the preload. ■

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FUEL PUMP CONTROLS FOR PRESSURE AND VOLUME

As fuel injection took over, the first electric fuel-pump circuits were just a relay and fuse on the power side and an ignition switch on the control side. Control over the fuel pressure was performed with an analog regulator that adjusted for loads with a vacuum signal.

The fuel pump operated at full battery voltage no matter the load on the engine. This is not good for the life of any electric pump, and it caused significant noise inside the vehicle. It also required a return line to the fuel tank, which presented many difficulties for the EVAP system in detecting small and large leaks.

The earliest effort to improve fuel pump life was to install a series of ballast resistors. As the load on the engine changed, the resistor would be switched. It worked a lot like a resistor motor controller for a blower motor.

The regulator on the fuel rail not only controlled fuel pressure but also volume, by controlling the flow of fuel with a diaphragm, springs and vacuum.

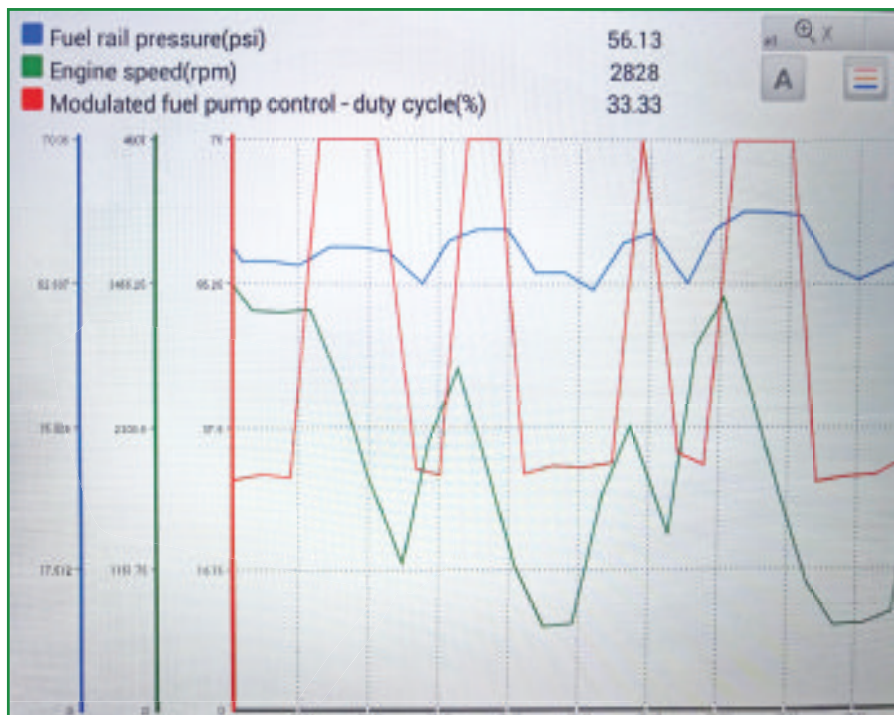
The major shift occurred when fuel pumps began

to be controlled with pulse-width-modulated voltage. The fuel pump is driven by a signal that changes the power to control the speed of the motor and pressure delivered to the fuel rail during the duty cycle. The duty cycle is the measured period of time it takes for a signal to complete an on-and-off cycle expressed as a percentage. On some vehicles, you can view the percentage with a scan tool.

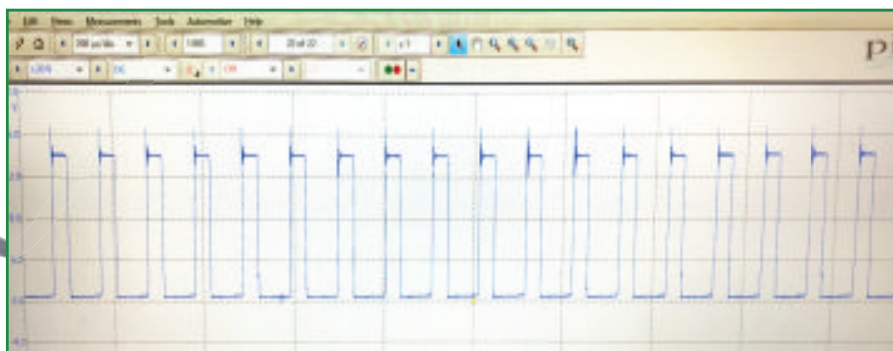
The driver for these fuel pump circuits is typically part of the engine control module. As engine loads and fuel trims change, the duty cycle increases or decreases.

Manufacturers have moved the driver for the fuel pump to modules in the rear of the vehicle. Some manufacturers moved the control of the pump to a rear electronic module; some moved it to a dedicated fuel tank module that also performs EVAP control.

As the control for the fuel pump moved to modules, codes for fuel pumps became more common. Some of



FUEL PRESSURE SHOULD STAY IN A 3-5 PSI RANGE AS LOAD AND ENGINE SPEED INCREASES AND DECREASES. WHAT WILL CHANGE IS THE DUTY CYCLE OF THE FUEL PUMP.



the most common codes you will see are codes for the fuel pump circuits. These typically indicate that the circuit is open or the voltage is too high or low, which indicates short or high resistance in the circuit. Some of these codes are generic, but if the module is separate from the engine control module, you could be dealing with manufacturer-specific codes.

The module that drives the fuel pump is typically looking for data PIDs from the engine. The data PIDs for fuel pressure can be critical in a diagnosis of a fuel pump and can save technicians from hauling out the fuel-pressure gauge and the assorted fitting to make a connection. Some vehicles have also eliminated the test port on the

fuel rail. But how do you know if the fuel-pressure sensor is bad?

The fuel-pressure sensor usually has three wires and operates on five volts. As the fuel pressure increases, the resistance changes. The sensor monitors fuel system pressures and the performance of the pump. If the sensor is not getting a clean five volts, the voltage on the signal side will change. On some systems, this could cause the pressure to read lower than normal and create some fuel pump performance codes.

Observing the fuel-pressure PID during a test drive can give technicians insights into the health of the pump. If the pressure drops suddenly when accelerating, it could be a sign the

pump is failing. The pressure should not change much during differing engine loads and speeds. This is because the pump is responsible for providing the correct volume while the pressure remains the same. Fuel pressure for most vehicles should stay in a 5- to 10-psi range. But, techs should make sure to look at the service information for the specifications.

Other data PIDs used to regulate the fuel pump include the engine position sensors. Additional data used to control the pump could be the engine load and fuel requirements. The goal of these sensors is to provide the correct amount of fuel pressure at the fuel injector so when the fuel injector opens, it shoots an accurate amount of fuel into the cylinder with a proper spray pattern.

Sensing if there is a problem with the fuel pressure caused by a pump that's not producing the correct pressure and volume might be detected in several data PIDs like fuel pressure and fuel trims. Drivability symptoms of a weak fuel pump might be a loss of power.

Some vehicles will record the fuel pressure as part of the freeze-frame data if a code is stored. This can help technicians track down an intermittent fuel pump problem.

Since the fuel pump module needs information for various sensors, it usually communicates on a serial data bus. If modules aren't communicating, the fuel pump can't be adequately controlled. The key to investigating these problems is to communicate with different modules to see which data PIDs are present and which ones are missing. ■

DIRECT INJECTION FUEL PUMP BASICS



A direct injection fuel pump can't increase its speed independent of the engine to increase its output or pressure, so it has to control the volume of fuel that is compressed. This relationship is what makes direct injection high-pressure fuel pumps a mystery to some technicians and even engineers. But once you understand the relationship between the pump and control solenoid, your diagnostic skills will grow.

High-pressure fuel pumps are mechanical and are typically driven by a camshaft. A lobe on the camshaft pushes on a follower or roller that moves a piston. The piston in the pump has two cycles, suction and compression. The solenoid on the side of the pump controls how much fuel is compressed during the compression stroke. During the suction cycle, the solenoid will allow fuel from the low-pressure side of the fuel system to enter the pump. As the piston starts to travel upwards, the solenoid will remain open. The fuel is pushed into the low-pressure side of the fuel system when open. When the solenoid is shut, the low-pressure and high-pressure side of the fuel system are isolated.

If there is low demand, the solenoid will remain open longer and a smaller volume of fuel is compressed. If there is a higher demand on the engine, the solenoid will close sooner, and a higher volume will be compressed. The length of time the solenoid is open will determine how much fuel reaches the injectors.

The operation of the solenoid is engine-position dependent. The ECU and pump use the camshaft position sensor to know the position of the pump's lobe on the camshaft. With engine position information, it can accurately time the events of the solenoid on the high-pressure fuel pump. If you hook up a scope to the solenoid, you will see a "peak and hold" signal that will change as demands on the engine change. On channel B, you can graph the camshaft position sensor to understand the location of the lobe.

The supply pump in the tank also can work as a limp-home pump if the high-pressure pump fails on some engines. When this happens, it will increase the output of the supply pump, open the solenoid on the high-pressure pump and change the open times of the injectors. This engine will have restricted performance. If the supply pump is weak or failing, it has been observed on some vehicles that the suction from the high-pressure fuel pump can suck fuel from the tank and keep the vehicle running, but with a great loss of power.

Diagnostic fundamentals for GDI are not that much different than conventional fuel injection systems. These systems inject the right amount of fuel directly into the cylinder. These systems are very efficient and are able to get the right amount of fuel into the cylinder so no fuel is wasted by not having to spray on the back of the intake valve.

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A differential allows two connected wheels to spin at different rates. The two wheels are connected using spider gears. If the spider gears do not spin on their axes, the two axle shafts spin at the same rate. If the spider gears start to spin, the axles spin at different speeds. How the direction of the rotation changes and which axle is spinning faster determines which one gets the most power.

The ring gear produces radial forces. The changing speeds of the axles produce tangential forces on the spider gears. A tangential force can be caused by different rates of the wheels going around a corner or when torque is applied to the differential (the "one-wheel peel"). A limited-slip differential helps to control the tangential forces, so the radial forces produced by the pinion and ring gear are transferred to the wheel that needs the power. There are several differential designs you might see in the field.

OPEN DIFFERENTIALS

As the names imply, these differentials just have spider gears in the differential. They let the wheels spin at different rates when going around a corner. The gears in the carrier need to be splash-lubricated by the ring gear. The level of the lubricant housing is critical.

CLUTCH PACK OR CONE DIFFERENTIALS

The most common style of limited-slip differential uses clutch packs on both sides of the carrier to limit the movement of the spider gears. If a wheel starts to spin and

increase torque-induced tangential forces, a ramp or cone applies pressure to the clutch pack to lock the carrier and axle.

For these differentials to work properly, the condition of the fluid and additive package is critical. Some of these differentials require special fluid or you have to add a small amount of friction modifier.

TORSEN DIFFERENTIALS

A Torsen differential is a geared differential that uses four to six or more worm gears attached to spur gears. As torque is applied to the gears, they are pushed against the walls of the differential housing, creating friction. The friction resists the relative movement of the axle shafts. This locks or distributes the torque to the wheels on an axle. These can be found on performance cars and

off-road trucks.

ELECTRONIC DIFFERENTIALS

Some automakers are using the ABS system to control the differences in the speed of the wheels on an axle. This can make an open differential act like a limited-slip differential under certain conditions. By pulsing or locking the brakes on one corner, it can send power to the opposite side of the differential. This works well at low speeds. With this system, the brakes can be used to free a wheel from a slippery ditch or eliminate torque steer.

Some SUVs and performance AWD cars and trucks are utilizing what looks like a locked differential, but the system has clutch packs on the sides of the differential. The clutch packs can lock or completely disconnect a driveshaft. It can even perform the



TECHTIPS

"holy grail" of differentials — torque vectoring.

The torque-vectoring differentials can control the amount of power going to each wheel connected to the axle using hydraulics or electric solenoids. Some high-horsepower FWD vehicles have a basic torque-vectoring differential (such as the Ford Fiesta RS) to control torque steer.

DIAGNOSTICS

Differentials can fail. The most common damage is to the carrier bearings and pinion bearings. When these bearings start to experience play, the relationship between the pinion and ring gear changes. No matter the style of differential, the noise made by the misaligned teeth will occur under deceleration and acceleration.

Before replacing an axle or differential, look at what is attached to the differential. If the driveshaft has worn joints or a loose center support bearing it will impact the bearings that hold the pinion. For a solid axle, the health of the wheel bearings is directly related to the carrier bearings. If there is any play, it can damage the differential.

An open differential can experience a failure of the spider gears. This is typically a sign the vehicle has been abused, for example the driver dumping the clutch or performing a neutral drop. Oftentimes, a differential can be damaged by a driver trying to get out of a snowbank or mud.

Limited-slip differentials that use friction and clutches can wear over time and prevent the differential from distributing power side-to-side. The driver might notice more tire spin and, in some cases, the differential might lock and the driver might lose control of the vehicle.

No matter the type of differential, the fluid inside is its lifeblood. There is a variety of oil for differentials and transmissions. Some manufacturers recommend a friction modifier additive package.

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NOTE: This bulletin applies to vehicles equipped with Brembo 6-Pot Fixed Caliper Brakes (Sales Code BR7) or High Performance Brakes (Sales Code BNN).

COMPLAINT

When making a sharp turn at low speed (parking lot) maneuvers, a click noise is heard. Most of the time, the noise can be heard if the windows are open.

REPAIR PROCEDURE

1. Remove both front brake rotors.
2. Clean hub face where the rotor surface contacts the hub face to remove any dirt or corrosion, using scotch britepad or similar style scouring pad that will not scratch the



Figure 1

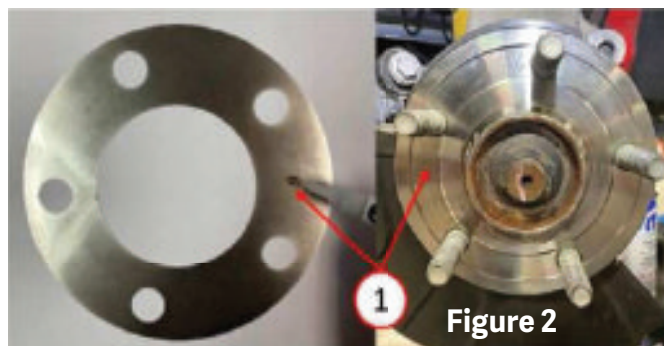


Figure 2

surface. Clean all mounting surfaces as seen in **Figure 1**.

3. Use a small amount of adhesive between the friction disc and hub to hold disc centered on hub (**Figure 2**).

4. Install the friction disc onto both hub flanges. (**Figure 3**).

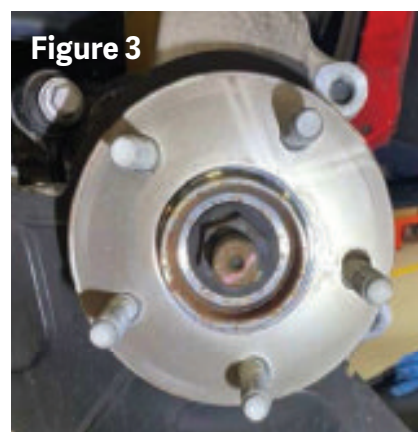


Figure 3

5. Put both rotors back onto the hubs and apply a small amount of adhesive in the center of the friction disc. Put both friction discs on the outside of the rotors.

6. Finish installing both front brake rotors/calipers.

PARTS INFORMATION

- 8530288AA Brake Friction Kit (Challenger and Charger)
- 8530289AA Brake Friction Kit (Durango and Cherokee)

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FORD

AUTO STOP-START OPERATION

MODELS

Ford and Lincoln Models with Auto Stop-Start

The auto start-stop system helps improve fuel economy and reduce emissions. When specific vehicle system conditions are met, the auto start-stop system will activate by shutting off the engine. Such conditions are when the vehicle is at a complete stop, the brakes are applied and the engine is at normal operating temperature. If these conditions are not met, the system will not activate.

Conditions such as battery charging or heating and A/C requirements may cause the engine to restart before releasing the brake pedal. This feature has characteristics which may lead to questions from owners. The Owner's Manual provides an overview of the auto start-stop system. Understanding auto start-stop activation requirements and vehicle system control inputs will provide service knowledge.

SYSTEM INDICATORS

Vehicles equipped with auto start-stop have a variation of the following indicators, depending on the specific

vehicle's instrument cluster and option content. Auto start-stop system messages are displayed in the instrument cluster or message center.

- Under normal operation, the green indicator illuminates when the auto start-stop is enabled. **(Figure 4, top icon).**

- The grey indicator illuminates when one or more system operating conditions necessary to activate the auto start-stop system engine stop, and are not within range of the start-stop system requirements. **(Figure 4, middle icon)**

- A flashing amber indicator illuminates when a vehicle system concern is present, and the driver needs to restart the vehicle manually. **(Figure 4, bottom icon).** Perform complete vehicle diagnostics when the amber indicator is illuminated. The driver can disable the auto start-stop system using the deactivation switch. It is important to note that the auto start-stop system is automatically enabled after every key cycle.

AUTO START-STOP SYSTEM INPUTS

- Accelerator pedal is released.
- Brake pedal is applied.
- Brake on/off switch activated (indicates ON).
- Clutch pedal cruise control deactivator switch indicates the clutch pedal



Figure 4

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is released. Clutch pedal is in full top position of travel (manual transmission only).

- Brake system pressure is approximately 70 psi or greater.
- ABS is not active.
- Brake booster vacuum is present and a vacuum change does not occur while the vehicle is stopped.
- Gear selector lever is in neutral for manual transmissions and drive for auto transmissions.
- Battery temperature is between 41° F and 140° F.
- A/C system is OFF, or there is no change in the A/C system request while the vehicle is stopped.
- If the A/C system is ON, ambient temperature should be less than 95° F.
- Road grade while stopped is less than 15%.
- All doors remain closed and the occupied front seats have the seat belt

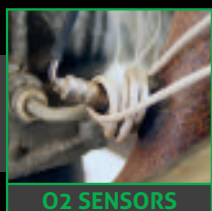
latched.

- The 110v alternating current inverter (if equipped) is under 10w electrical load and the electrical load does not change while stopped.
- Trailer harness is not connected.
- Tow/haul mode is not active.
- 4WD is in the 2WD position and does not change while stopped.
- Electronic locking differential (ELD), if equipped, is not engaged.
- In-car temperature is steady and no change is requested from the heating or A/C system.
- Engine coolant temperature is at the normal operating temperature.
- Max A/C or defrost is not selected.
- Blower fan control is at one speed setting and a speed change request does not occur while the vehicle is stopped.
- Rear defrost is not selected and a rear defrost request does not occur

while the vehicle is stopped.

- Battery and charging system voltage is greater than 11.3 volts.
- Electrical load is less than 65 amps and a voltage or amperage load change does not occur while the vehicle is stopped.
- Steering wheel angle is less than 90° from the center position and a steering input change does not occur while the vehicle is stopped.
- Hill start assist is not active.
- Automatic transmission fluid temperature is less than 230° F.
- Fuel level is greater than 1/8 full and the low fuel warning is not active.
- Auto start-stop system restarts are limited to 10, unless the vehicle speed exceeds 2.5 mph.
- Auto start-stop functionality operates independently only from vehicles equipped with electronic brake boost.

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O2 SENSORS



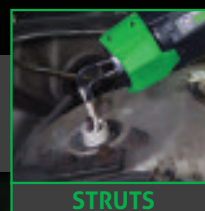
LUG NUTS



GRAPHICS



GEARS



STRUTS

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Auto Start-Stop System Input Changes That May Initiate An Engine Start While Stopped

- Battery voltage drops below 11.3 volts.
- Brake system pressure drops to less than 482 kPa (70 psi), or the brake system pressure is indicating the brakes have been released.
- Clutch pedal position switch indicates clutch pedal is fully depressed (clutch pedal is in full bottom position).
- Additional brake system vacuum is requested.
- Rear defrost is switched on (engine restarts after 30 seconds).
- HVAC system is in A/C or heat modes.
- Blower fan speed request is changed.
- Automatic temperature control temperature setting is changed.
- For model year 2016 and prior, gear selector position is moved to any gear except park. Moving to park allows the shutdown to continue.
- For 2017 models and forward, the gear selector position is not in park, neutral, drive or sport modes.
- Accelerator pedal is pressed.
- 110v inverter electrical load greater than 10W is detected.
- Vehicle electrical load is increased to greater than 70 amps.
- Vehicle is operating in 4H or 4L mode.
- Steering wheel is turned rapidly or is at a sharp angle.
- Vehicle speed of greater than 4 km/h (2.5 mph) for more than two seconds has not occurred.
- Elevation is approximately above 3,048 m (10,000 ft).
- Pressing the auto start-stop button

with the engine automatically stopped.

An explanation for disabling the auto start-stop feature may be displayed within the instrument cluster. For example:

- Engine on due to accessory usage
- Engine may be on to support high demand for electrical accessories, such as operating power windows, rear defroster or when using the power point.
- Deactivated by driver – the driver has disabled the start-stop feature.
- Auto start-stop press brake to start engine – the engine needs to be restarted, press the brake pedal to start.

NOTE: The scan tool battery management system (BMS) reset PID only resets the battery's time-in-service and not the battery state of charge (SOC). To update the battery SOC, the vehicle must be driven or allowed to sit (cold soak) more than 6 hours. ■

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Product Showcase



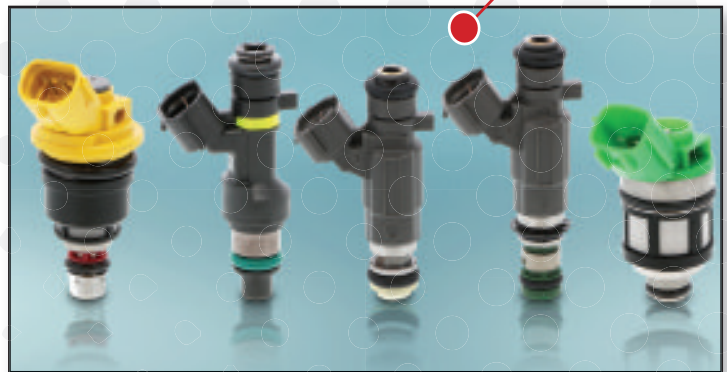
1 AmeriBRAKES' brake pad line is American owned, and 100% manufactured and distributed in North America. Each brake pad is expertly designed, engineered, manufactured, and tested for best-in-class performance, says the company. The copper-free ceramic formula exceeds 2025 regulations and provides a more environmentally friendly braking experience. The full range of raw materials and advanced composites are available for a wide selection of vehicles, including light-duty, medium-duty, heavy-duty, air disc and emergency service applications. Visit www.momentumusainc.com/ameribrakes

2 Mitchell 1's ProDemand auto repair information software introduces enhancements to the estimate guide module that will streamline the user experience. Service writers will benefit from having labor times, OEM parts pricing and part diagrams consolidated on a single page. The ProDemand Estimate Guide is integrated with the Mitchell 1 shop management software, Manager SE, giving shops instant access to maintenance schedules, TSBs, recalls, tracking and labor guides directly from the system's dashboard. For more information, visit mitchell1.com.

3 Spectra Premium's three Multifunction Air Intake Sensors, P/Ns MA389, MA321 and MA394, are designed for 2012-2019 applications covering more than 16 million vehicles on U.S. roads. These sensors are direct OE replacement solutions that feature precisely calibrated ceramic boards and premium materials, like platinum, to improve reaction times, says the company. Each product is tested under extreme temperature, vibration and humidity conditions to ensure real-world performance. Visit ecat.spectrapremium.com for more information.

4 FRAM TrueAir features an innovative N95-grade filter media. Its dual-layered media provides anti-bacterial and anti-viral protection by capturing 95% of harmful airborne contaminants, as small as 0.3 microns, before they enter the vehicle's cabin. The filter was developed to provide high-level protection against airborne pathogens, including disease-causing viruses and bacteria. FRAM TrueAir filters out 99% of dirt, dust, pollen and allergens. For more information, visit fram.com.

Product Showcase



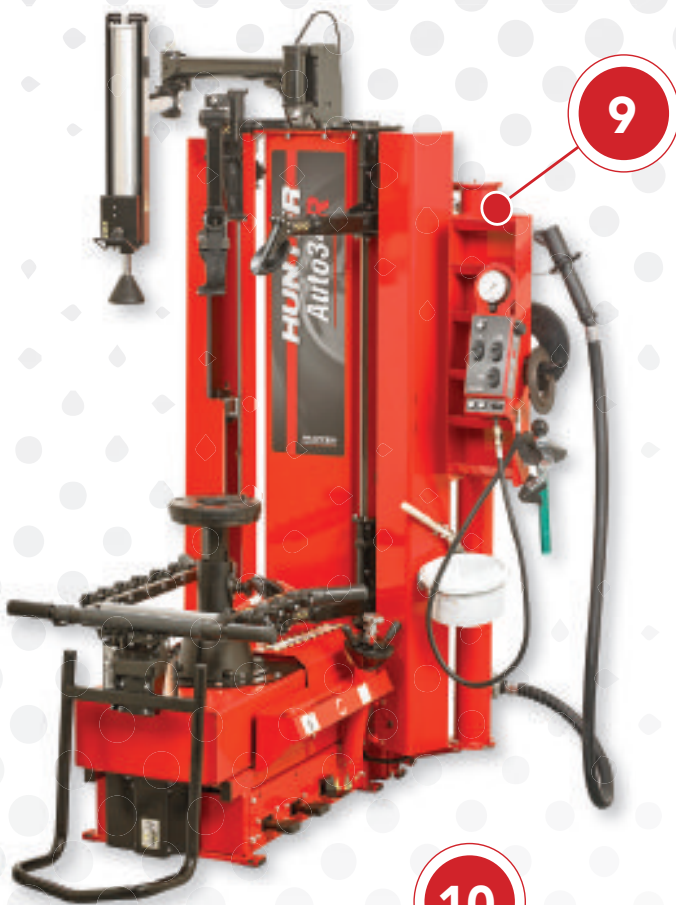
5 Mevotech announces the availability of Supreme front outer tie rod ends (MS60668/MS60669) that feature greaseable self-lubricating, sintered metal bearings for enhanced part service life. They also feature an increased part forging providing additional assembly strength, while a wider-diameter wrench flat and included hardware assist the professional technician during installation. Mevotech now offers complete front-end coverage within the Supreme line for the 2018 and newer Honda Accord. For more information, visit mevotech.com.

6 Compatible with any smoke machine, **Redline Detection's** EasyConnect kit allows technicians to quickly hook up a smoke machine into an EVAP system for fast, accurate diagnostics and leak detection on vehicles with no EVAP port connectivity. Most late-model vehicles no longer have an EVAP service port and quick disconnects make hooking up a smoke machine difficult. With EasyConnect, technicians can snap the T-shaped adapters into an easily accessible line, like a line near the purge valve, then connect their smoke machine to the EVAP system. EasyConnect forms a complete seal for fast, accurate leak testing. For more information, visit redlinedetection.com.

7 Continental has expanded its line of OEM fuel injectors to offer new application coverage for a wide range of Infiniti, Nissan and Subaru models from 1996 to 2011. Five part numbers have been added to the fast-growing program to deliver expanded coverage for over 1,140,000 VIO in North America. The fuel injectors are direct OE replacement parts and identical in fit, form and function to the OE part. They deliver the same genuine quality of OE components supplied to automakers worldwide, says the company. For more information, visit continentalaftermarket.com.

8 Four Seasons has released three new Motor Resistor Kits featuring a quality direct-fit blower motor, resistor and harness connector in a single carton. These problem-solving kits are application-specific and designed to reduce warranty claims by providing all of the electrical components that commonly fail together when replacing a blower motor. Each kit includes a Four Seasons blower motor, resistor and harness connector. Designed for specific applications with high failure rates, the kits can eliminate having to do a blower motor replacement more than once. For more information, visit 4s.com.

Product Showcase



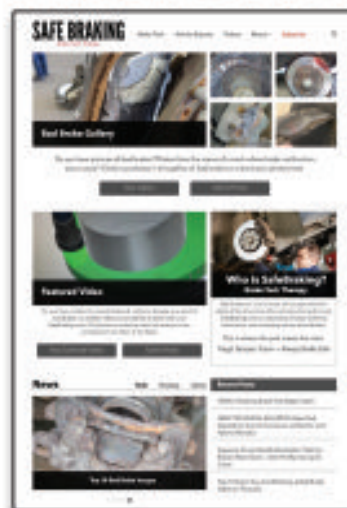
9 **Hunter Engineering Company's** new Auto34R Tire Changer is designed to quickly and easily service the broadest range of assemblies, while also dramatically reducing the opportunity for wheel damage through operator error, says the company. The Auto34R's speed and ease of use derive from its innovative telescoping chassis that brings the wheel to the rollers and tool head. The new mechanism clocks the rollers and tool head to match the curve of the wheel. The compact sliding chassis considerably reduces the need for floor space. For more information, visit hunter.com.



10 The new **John Bean Tru-Point** is an advanced driver assistance system (ADAS) calibration tool and all-in-one solution that allows shops to validate if the vehicle meets the OEM-required alignment specifications, as well as the proper target placement procedures. It is equipped with top-of-the-line software technology and allows for one-person operation, saving time and eliminating the need for extensive training, says the company. Simple, real-time and visual target placement instructions will allow a shop to streamline the ADAS calibration process from beginning to end. For more information, visit mytru-point.com.

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TODAY'S PLAYLIST

WHAT DOES THE ROAD SOUND LIKE TO YOU?



DOUG KAUFMAN
EDITOR
DKAUFMAN@BABCX.COM
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***"Thank God for the man
who put the white lines
on the highway."***

If you check on Spotify, Pandora or any other music streaming service, you find dozens - if not hundreds - of "driving" playlists, songs that someone has ranked as their favorites for the times behind the wheel.

As much of the country gets set to welcome in road trip season (here in Northeast Ohio being the exception - we never know when summer will actually show up... spring either, for that matter) one of the most important decisions needs to be made - what music will you take with you when you go?

When it comes to actual music in the car, my preferences are pretty varied while driving - sometimes it's hard rock. Sometimes it's classic country. Sometimes it's classic classical (who doesn't love a little Wagner now and then?).

Here are some of the top "driving songs" that have been playing in my personal mental jukebox.

"I've Been Everywhere" - this chaotic TripTik was actually written by an Australian singer Geoff Mack in 1959, with Australian, New Zealand and Great Britain/Ireland versions alongside though Johnny Cash's North American version.

"Get Out Of Denver" is another frenetic travel story of a good trip gone bad. Singing along, I can usually keep up with Bob Seger for about three or four lines before tripping over my own tongue.

"Red Barchetta" is a song by Rush that describes a future many of us never imagined could actually happen, when internal combustion engines were replaced with

"gleaming alloy air cars." We're not there yet, but 2035 isn't all that far away anymore.

"Hot Rod Lincoln" - Speaking of vintage... Commander Cody and His Lost Planet Airmen tell the tale of a race between a Cadillac and a Model A Ford with a Lincoln V8 engine. Bill Kirchen's memorable guitar lick makes me feel like I'm riding right alongside every time I hear it.

"Running On Empty" - Jackson Browne captures the unseen passing of time and failed plans so well it hurts. "I don't know where that road turned into the road I'm on." But we keep moving...

"Irene" - this song by the Clarks, an amazing band from Pittsburgh, tells another story of a life lived through memories of a series of vehicles. Rides in long limousines, white and black, bracket the not entirely happy life of a person who didn't know how to say no to life's options. "Life's just as kind to you as it is mean," sings writer Scott Blasey.

"Lover" - as I mentioned at the beginning, we Ohioans never trust the weather to be on our side and this song by recently passed local legend Michael Stanley is appropriate for any time of year. "The Turnpike's slick, the snow's as thick as thieves," is catchy, but the true gem in this song is an audience favorite: "Thank God for the man who put the white lines on the highway."

What gets your motor running when you head out on the highway? Whatever you're listening to, I hope you turn it up and sing along on the journey. ■

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