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April 2016

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AUTOPRO WORKSHOP

Vol. 135, No. 4

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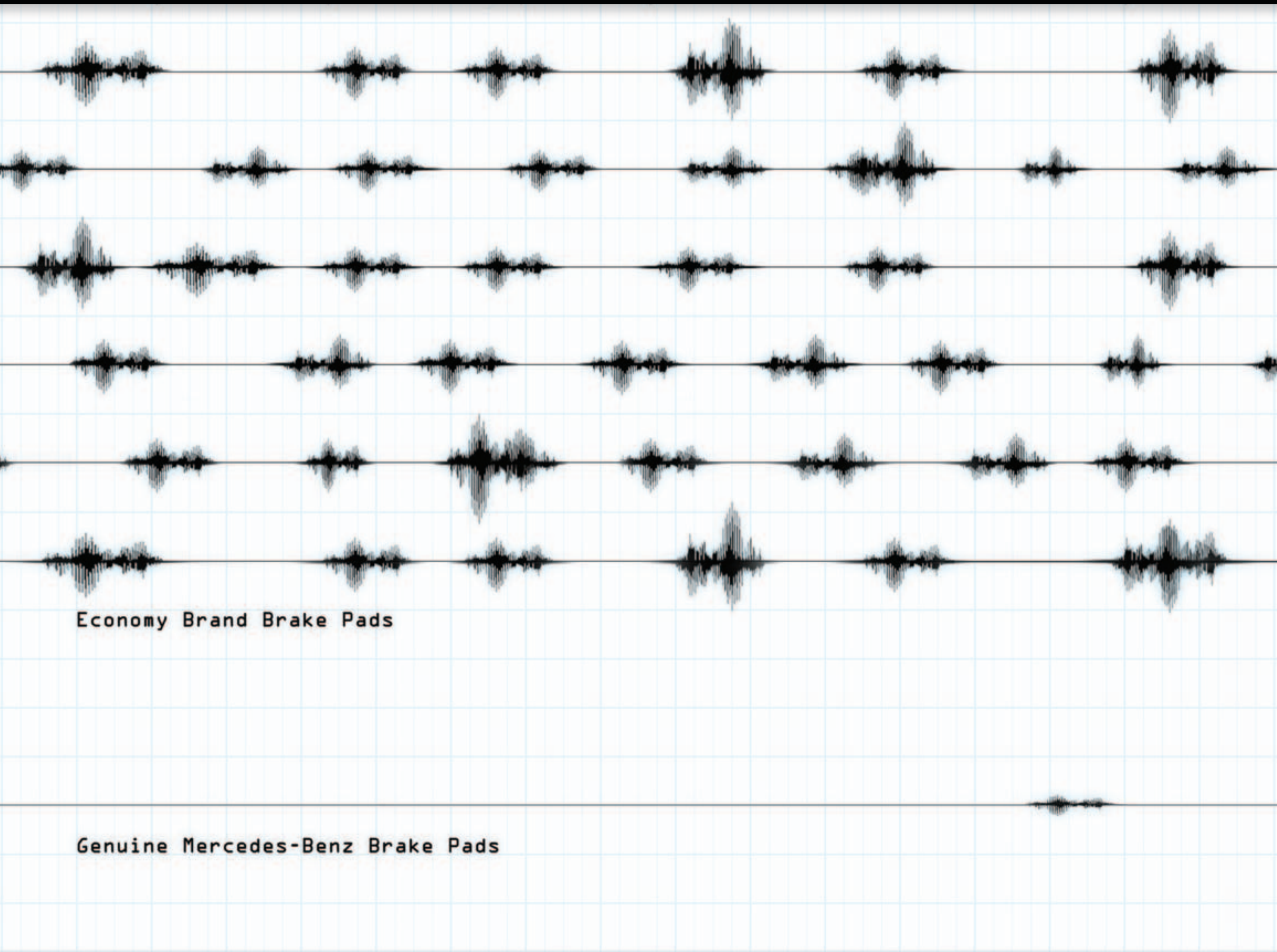

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Ingenious Garage Hacks

1

You may know that pantyhose make for decent emergency windshield wipers, or that hand sanitizer can thaw a frozen door lock. But ingenious garage hacks can make life inside the shop a whole lot easier.

So get started. You're certain to discover how a little imagination can help get any job done.

1. A doctor's otoscope can be as useful in a blind hole as it is in an ear canal. Simply remove its cone section for a mini-flashlight (with three-power magnifier). Its light shines from the center, eliminating shadows.

2. To collect stray nuts and bolts, flip a sandwich bag inside out with a magnet in hand and run it across the floor or workbench. Then flip the sandwich bag, remove the magnet and easily dump the strays where they ought to go.

3. Literally keep smaller tools at hand by repurposing an old glove. Make a belt loop by cutting slits in the cuff, and snip the fingertips. Screwdrivers, wrenches and pliers will hang securely in the fingers without the weight of a full tool belt.

2

4. Make sure cordless tools are ready to go by charging them overnight, without overcharging. Just plug each tool into a surge strip connected to a programmable timer, and set the timer to run for about three hours each night.

3

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GENERAL MOTORS OFFERS NEW GM GENUINE PARTS WEBSITE

The new website contains a variety of exclusive information that is dedicated to the aftermarket segment and provides specific information about GM programs, technical information and repair documents.

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CAR CARE COUNCIL WOMEN'S BOARD TO AWARD RECORD AMOUNT OF SCHOLARSHIPS IN 2016

The Women's Board will award a record amount of $50,000 in scholarships to deserving female students studying to enter the auto care industry in 2016.

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automechanika
CHICAGO

COMMITMENT TO TRAINING

INDUSTRY TRAINING

Automechanika Chicago to offer free training events

Automechanika Chicago and its organizers Messe Frankfurt and UBM Americas | Automotive Group (formerly Advanstar Communications, Inc.), have launched a series of single-day training programs in cooperation with leading technical colleges in select markets to help support automotive repair professionals in the service repair and collision repair markets. The FREE training programs will begin in May as part of a new "Commitment To Training" initiative supported by the generosity of industry sponsors.

"We're very fortunate to have the involvement of leading companies in the service repair and collision repair market as we continue our ongoing efforts to properly train shop owners, managers and technicians," said Jim Savas, Vice President of UBM Americas, Automotive Group. "This program, in partnership with vocational colleges in Michigan, Illinois and Wisconsin, will feature instructors known for providing outstanding content that can help shops keep pace with changing vehicle technology."

The "Commitment to Training" initiative is an opportunity for automotive professionals to not only get trained on topics of their choice, but also share their passion for training by contributing their knowledge

[Automechanika Chicago] CONTINUES / PAGE 8

Photos: UBM Americas

BREAKING NEWS

TRAINING

TST BIG EVENT DRAWS 360-PLUS FOR TRAINING

MICHAEL WILLINS | GROUP CONTENT DIRECTOR

FISHKILL, NY – The 13th annual TST Big Event was bursting at the seams in March as more than 360 shop owners and technicians were on hand for a single-day training event featuring some of the nation's best instructors.

G. Jerry Truglia of Technicians Service Training (TST) said the training program each year helps techs stay current with diagnostics and repair procedures as vehicles become more complex with every model year.

"You have to update so you don't evaporate," said Truglia during a break in the conference. "Without

[TST Big event] CONTINUES / PAGE 6


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[TST Big event]

CONTINUED. FROM PAGE 4

staying up to date, you're going to go down the tubes real quick. Technology is passing you by."

He also noted the importance of conveying professionalism in the shop so that customers feel comfortable walking in the door. "If you don't respect yourself, dress professionally, have a clean shop, stay up to date and get certified — all of which show your professionalism — how the hell do you expect the customer to take you seriously? How do you expect to make good money?" said Truglia. "You've got to be smart."

TST was able to discount the price for this year's event due to the support of the following: (Diamond sponsor) *Motor Age*; (Platinum) Automotive Test Solutions; (Gold) Autolite/FRAM and AirSept; (Silver) Autologic, Midtronics, Drew Technologies, Neutronics, Redline Detection, Launch Tech, PTEN and Bosch/OTC; (Bronze) Run-Rite, Flow Dynamics, BG Lubri-Care and General Technologies Corp. (GTC); AE Tools & Computers, AESwave, ASE, Associated Equipment Corp., Automotive Training Group (ATG), BOSAL, iATN, MotoLogic, Power Probe, Ross Tech and USA Tools.

The event kicked off with a morning session taught by Dave Hobbs, *Motor Age* contributor and trainer for Delphi Corporation, who talked about telematics and advanced body electronics diagnostics. Hobbs explored various electronic systems in today's vehicles, including new technology that is just arriving or will soon appear in cars and in shops.

His presentation featured numerous case studies that helped attendees understand diagnostics and troubleshooting processes for some of today's new systems. Crash avoidance systems, for instance, including blind spot detection, lane change assistance, autonomous emergency braking and adaptive cruise control, have resulted in an influx of internal radar modules that make the customer safer, but challenge today's techs.

"We have got radar going everywhere," Hobbs told the audience. It's critical for repairs to be done properly on all safety features, to avoid putting vehicle owners in danger. Airbags, for example, must be properly configured. "Timing in nanoseconds is the difference between the airbag hurting you, [saving you] or the airbag being worthless," said Hobbs.

Mobile technician Edwin Hazzard offered a quick look at real-world tips for diagnosticians. He advised shops to dig for information from all sources, and to have a very simple, systematic approach to identify problems.

Trainer Bernie Thompson covered advanced leak detection to help technicians simplify and shorten the diagnostic time for finding system leaks. He explored various forms of leak detection processes, including everything from soap bubbles to smoke machines, gas and sound.

Following Thompson was special guest John Anello, who provided real-world examples about radar systems that reinforced the issues Hobbs brought up in his presentation.

DVDs and books for the training event are available at www.tstseminars.org.

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[Automechanika Chicago]

CONTINUED. FROM PAGE 4

with like-minded professionals. Industry training opportunities, trends and challenges will be presented through weekly newsletters, whitepapers, eBooks, webinars and live events.

To date, two single-day training events have been scheduled and a third will be announced shortly. The first begins at 7:30 a.m. on Saturday, May 14, at Washtenaw Community College in Ann Arbor, Mich. The second will be held Saturday, October 15, at Fox Valley Technical College in Appleton, Wis. Each one-day event will feature breakfast and lunch for all attendees, as well as three-hour technical and management training classes in the morning and afternoon for collision repair and service repair audiences.

To register for the Live Training Event at Washtenaw Community College, visit-MotorAge.com/WTE.

Instructors scheduled for the Washtenaw event include:

- Mike Anderson of CollisionAdvice.com will provide a keynote presentation to all attendees during breakfast, as well as his presentation of two three-hour courses — "Financial Best Practices" and an estimating course, "Write it Right."
- Pete Meier, Director of Training for UBM Americas | Automotive Group, will teach "Practical Electrical and Scope Techniques."
- G. Jerry Truglia, of ATTS and TST, is one of the nation's premiere trainers on proper diagnostic processes, and he will present "How to Diagnose P0420s and P0430s (Catalyst Below Threshold) DTCs" and "Critical Thinking Diagnostic Skills" for service repair technicians.
- Brad Mewes, principal at Supplement, will offer shop managers "Business Sale/Succession Planning" advice in his session.
- Larry Montanez, of P&L Consultants and contributing technial editor for sister publication *ABRN*, is a leading authority on welding and structural repair, and will instruct two courses, "Advanced Materials, Metallurgy and Repairability" and "OEM Equipment Requirements, Repair Protocols and Procedures" for the collision audience.

"We are excited to partner with Automechanika Chicago to bring together industry professionals and faculty as they learn the latest changes in the field," said Brandon Tucker, Dean of Advanced Technology & Public Service Careers for Washtenaw Community College. "This also allows us to showcase our world-class facilities and equipment. Partnerships like this only strengthen the skillset of our faculty and in turn the students in our programs."

Register today at MotorAge.com/WTE

Supporters of the "Commitment To Training" initiative who are making this free training program possible include Abaris Training Resources, Axalta, CARQUEST Technical Institute, Delphi, Garmat, Global Finishing Solutions, Mitchell 1, Pico Technology, Polyvance, PPG and Schaeffler Automotive Group.

"A partnership between Fox Valley Technical College and Automechanika Chicago allows us to showcase our talents to make collision repair technicians, damage appraisers and virtually anyone involved in the collision repair process more aware of the intricacies associated with repairing damaged automobiles," says Dan Poeschel, Associate Dean – Transportation at Fox Valley Technical College. "This is a perfect opportunity for technicians to network and learn from industry experts and from each other.

The one-day training events have been developed to support the training programs at Automechanika Chicago, a training event and exposition that trained 2,000 technicians in 2015 and hosted 6,000 attendees. The show is scheduled to return July 26-28, 2017 at McCormick Place West in Chicago. To learn more about Automechanika Chicago, visit www.AutomechanikaChicago.com.

Study: Independent repair shops boost social media use for marketing

Independent repair shops are increasingly using social media to promote their services and to offer coupons and specials, according to the 2016 Independent Repair Shop Study by *Aftermarket Business World*, a sister publication of *Motor Age*. Shop participation in four popular social media sites increased this year compared to last year's study.

Facebook was the most popular social media site used by shops, as 74 percent of those who said they use social media use Facebook to promote their business. This was up 1 percent from last year's study.

The next most popular channel, Google+, increased from 26 percent of respondents last year to 47 percent this year. Shop usage of LinkedIn increased from 10 percent last year to 15 percent this year, while use of Twitter was up from 11 percent last year to 13 percent this year. Respondents were allowed to select more than one social media channel if they used multiple channels.

Forty-five percent of shops said their sales of select products increased in 2015 compared to the previous year, while 51 percent said sales stayed the same.

Optimism reigns as 52 percent of independent repair shops said they expect to sell more in 2016 compared to last year, while 47 percent expect to sell the same. Of those who expect to sell more, 25 percent said sales would increase 1 percent to 5 percent and 13 percent said sales would increase 6 percent to 10 percent.

When it comes to gross margins, 44 percent said their product margins improved in 2015 compared to 2014, and 54 percent said they stayed the same.

Some 47 percent said they expect their gross margins to improve this year, while 53 percent said they would hold steady.

Forty-two percent of respondents said the top product need of their customers is quality, 21 percent said price, 14 percent said availability and 17 percent said OEM form, fit and function.

Regarding preferred suppliers, 37 percent of respondents said they prefer to buy from auto parts retailers, 35 percent from warehouse distributors and 19 percent from jobbers.

Methodology: The Independent Repair Shop Product Study was fielded to readers of *Motor Age* magazine via email. Visit MotorAge.com/socialstudy for complete survey results.

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MANAGEMENT

BUY VS LEASE

BREAKING DOWN THE FUNDAMENTALS OF EQUIPMENT LEASING

BY **BRAD MEWES** | CONTRIBUTING EDITOR

THE automotive industry is evolving. Cars are becoming more complex. The tooling, training, and equipment required to fix cars continue to increase. In short, the cost of operating a service repair business continues to increase.

What is equipment financing?

While it is common in the automotive repair industry to purchase equipment outright, in other industries that have higher capital intensity, purchasing expensive equipment is a foreign idea. Take, for example, commercial construction. It is cost prohibitive for many commercial construction firms to own the heavy equipment required to complete a project. Instead, the heavy equipment — tractors, cranes, etc. — are leased, financed or rented.

Financing equipment or facility upgrades is commonplace in many industries. While many of us were raised with the notion that debt is bad, the reality is that debt is simply one tool of business finance when prudently used. A core tenant of corporate finance is that the liabilities of the firm ought to match the assets of the firm. So if a business acquires an asset with a projected 15-year life, the business is well served to finance the asset over the course of 15 years. In that way, the expense and cash flows related to the asset are appropriately spread over the useful life of the asset.

Take, for example, an investment of \$30,000 by a service repair shop that is purchasing upgraded scan tools and other diagnostic equipment. The investment may only lead to the com-

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pletion of a few thousand dollars of repairs annually, which seems absurd on the surface. However, when the cost is spread over the useful life of the assets acquired, say 10 years, the expense appears much more reasonable. While the business may still recognize an initial loss in the first few years of the investment, it is likely the business will recognize a return in later years that will more than offset the initial investment.

The benefits of equipment leasing

There are a number advantages leasing brings to a business, all of them revolving around improved cash flow and flexibility. Equipment financing is more than merely moving numbers around on a spreadsheet. Appropriately managed, equipment financing will actually help reduce the risk of your firm and increase the stability of your cash flows.

Tax advantages: Depending on the structure of the lease, lease payments can reduce taxable income in a more appropriate manner than depreciation alone. Seek out the counsel of a licensed tax advisor to discuss your specific situation. But generally speaking, operating lease expenses can be fully deducted when incurred for tax purposes.

100 percent financing: When leasing equipment, most equipment lenders will lease up to 100 percent of hard equipment costs, and many will also finance the soft delivery and installation costs as well. In traditional bank financing, there is often a down payment required and banks are less willing to finance soft costs.

Balance sheet: When you lease an asset, you pay for the right of use, not the right of ownership. As such, items that are leased do not appear on your balance sheet as an asset. And a lease does not appear on your balance sheet as a liability. Because there is no liability on the balance sheet, there is no collateral required to offset the liability and your business assets remain unencumbered — a very important aspect if you are considering future sale. If you are looking to grow, utilizing leases will also make your asset base appear more productive, which is important if you are seeking financing for acquisitions.

Flexibility and obsolescence: Another key advantage of leasing rather than owning equipment is avoiding equipment obsolesce risk. Many companies opt to lease computer equipment and software to stay up to date with rapidly changing technology. Lease terms can be for a few months, or for the entire expected life of an asset, depending on the need of the business.

Common types of equipment financing

There are a lot of different options when considering ways to lease or finance equipment. But these are the most common I see when helping clients finance equipment:

- Operating lease (Fair market value lease)
- Capital lease (Dollar buy-out lease)
- Vendor financing
- Bank financing

Operating lease: This is what most people think of when discussing leases — an operating lease allows for the use of an asset without owning the asset. Operating leases are often structured to have a "fair market value" purchase option at the end of the lease term where the lessee has the option, but not the obligation, to purchase the asset at the current market value. A vehicle lease is an example of a common fair market value lease.

As mentioned above, the expenses associated with an operating lease are generally fully deductible for tax purposes. Check with you tax preparer regarding your specific situation.

Capital lease: Whereas an operating lease transfers the risk of ownership to the lessor, a capital lease more closely resembles a traditional loan, but without actual ownership. The lease term tends to be longer than operation leases. Capital leases include a "dollar buy-out" clause at the end of the term, whereby the asset is transferred to the lessee. Because capital leases very closely resemble ownership, they also have different tax treatment than operating leases. Again, check with your tax advisor to get specifics on your exact situation.

While capital leases and traditional financing are very similar, capital leases have two main benefits over bank financing. First is the ability to finance 100 percent of the asset. Second is the ownership and collateral. In a capital lease, the lessor owns the asset until the lessee purchases the asset at the end of the lease term. Because the lessor owns the asset, no collateral is needed by the lender.

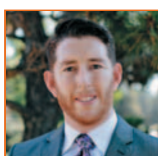
Bank financing: Your commercial bank likely provides general equipment and/or expansion loans. These loans are structured as traditional fully amortized notes, meaning the interest and principal is spread out over the full term of the note. Depending on the bank, a down payment is often required.

Bank loans are secured by a UCC filing. Many banks file a blanked assignment where all the business assets are pledged as collateral. These pledges of collateral may seem innocuous, but can become very onerous in the event the business seeks additional financing for growth or there is a change in control due to a sale.

Vendor financing: Some vendors will provide financing for the purchase of equipment. Rather than carrying the note, most vendors partner with a financial institution to provide credit to the purchaser. These loans tend to resemble a line of credit, similar to a credit card. The initial terms can be quite attractive but can quickly become onerous if the principal is not repaid within the teaser time frame.

Managing finance options

The financial demands necessary to manage shop equipment will continue to increase as the industry evolves. Building a relationship with a local banker will go a long way in helping simplify some of the complexity around purchasing and financing equipment and ensuring you have access to financing when you need it. MA



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CONTINUOUS LEARNING

FIND TECHNICIANS AND MANAGERS WHO CONTINUALLY SEEK OPPORTUNITIES TO LEARN

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

IF YOU want good people on your team you better learn how to grow them! Unless you have talented associates, you will never be able to enjoy much free time with family or your own interests. Not to mention, the shops we see that are the most successful have better talent than their competitors. So, if you want to stay the best shop in your area, you might want to download our Employee Appraisal Checklist after you listen to our youngest coach, Kevin Chzaszcz, explain how he did it and how you can grow your team to watch your back!

Entering the automotive world straight out of college, I took what is seen as a nontraditional career path. After moving up to service manager within a couple of years, I was persuaded to go back to school part time to get my MBA. That was when I truly learned about hard work; I worked 60 to 80 hours a week on the counter and then had another six hours a week of class. Most days off I spent writing papers and doing research. Not an easy or fun task, but in the end I accomplished my goal. I would recommend continuing education to anyone looking to further their career or improve their business. Too often education is only seen as degrees and certificates, but it is so much more.

Running or managing a small business is more than a full-time job; it requires going out of the way to take care of customers, our employees and our facilities, leaving little time for continuing education. Staying till midnight to finish a repair or getting that call late at night that the security alarm has gone off is nothing new. Yet, while all this is happening the world is changing, cars are changing, the employees we are hiring seem to be getting younger and younger and demanding new benefits.

Photo: Thinkstock

Continuous learning

How can we keep up with the changes when the business overwhelms our life so that we can barely keep up the day-to-day activities? To be a successful business, we must stay ahead. This means continuous learning. Some people think continuous learning means classes, studying and huge piles of debt. But there are other ways to learn. We live in a time where we have more information than we know what do with. Case in point: how many times has your newbie technician been stuck on a job and asked for help and you said, "Did you look it up on YouTube?" I am sure this has happened dozens of times. If it hasn't, you now have a new way to free up dozens of hours a year by not having to give step-by-step directions. On top of that, we have the pay services Identifix, Mitchell 1, MOTOSHOP and so on that are packed with information, trouble trees, TSBs and wiring diagrams. It is also important to point out the rise of MOOC (massive open online courses); these are both credit and noncredit courses on a range of topics. The most prestigious colleges in the country offer many courses for free in this format, and the best part is that you can take them for free in the comfort of your home on your own schedule. Can these new tools replace traditional classroom and hands-on education? No, but they can certainly supplement them.

What does education represent in a potential employee? Of course as shop manager, we have different things we are looking for in a service advisor/manager or a technician. Traditionally, a technician is taught through experience only and picks up some ASE certifications or dealer certifications along the way. Our current system says that if a person is not fit or not able to go to college then you have to go into a trade. We need to look at this. The tech's ability to do an

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alignment, replace shocks and hook up a scanner, plus 20 years' experience would traditionally make him or her a master technician.

We need to question this because even with the wisdom of the years and excellent parts replacement capability, a technician is no longer a master technician. Becoming a true diagnostic master technician takes a lot of research, persistence and continual learning. For example, a great technician I worked with took a calculus class for fun to support his friend and received an A. This technician clearly has a desire to learn, no matter the topic. This desire will give him great diagnostic ability, and he will be able to keep up with the changing technology. It's not the fact that he can do calculus but the fact that he can comprehend it and that he would be willing to learn it. This ability showed itself every day when he faced a difficult problem: he would be all over the forums, the paid services and Google searching to find the solution to the problem. This is the technician of the future and he or she may come with a four-year degree or just a strong desire to learn.

Your road to retirement

With businesses becoming harder and harder to sell, is it really possible to work in your business your whole career and then sell it and retire? Probably not, so this means that you will need your business to run without you and turn it into passive income. So what does this have to do with education? Well, it's going to take a dynamic person to run and improve your business in your absence. This person will have to be able to manage all the day-to-day tasks as well as try to grow the business so they can improve their own income. When we are looking to entrust this much responsibility to a single person, a strong educational background will show they have the ability to act independently and have the desire to improve themselves. If an employee has been doing night classes over the last four years earning a degree, then they had to balance school, family and a full-time career. This is the kind of person that can move your business forward and can put in the extra work to do so. They are not looking to do a clear set of tasks and clock out when the day is done. They will want to be an active participant in your business. Make sure you are able to give this to them.

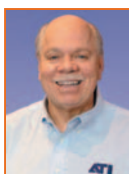
Grow minority partners

Many automotive business owners feel intimidated about hiring people with degrees and higher education. They believe their employees should work their way up from the shop, or they steal employees fully trained from their competitors — bad habits and all. In addition, they can't imagine that a person with a degree would want to be a manager for them, assuming they would prefer an office job. Running a small business offers those with education the security of a traditional job while having the opportunity to hone their skills and try their ideas. Just because they took the time to get educated does not mean they want to take the risk of trying to start their own business or be stuck in a cubicle all day. Maybe they are sick of working in some big corporation, or want some say in what they do. People change careers all the time, especially now, so why can't our industry attract some of these people? Other retail establishments certainly are. You could also offer them a non-controlling minority partnership with a built-in buy-back provision if you felt strongly about their ability.

Employee appraisal checklist

No matter the quantity of resources out there, there is no substitute for having the right attitude and a hunger for learning. When you find an apprentice technician or service advisor who wants to learn and advance, this may become his or her strongest attribute. The walls of seniority, bureaucracy and career tracks are coming down quickly. We are currently 65,000 short on technicians and this gap keeps growing. The opportunity is there for anyone willing to enter this industry. Dealerships are making fast-track programs to rapidly train technicians to become master techs because their pool is so small.

Why not try to grow our own and support the good employees we already have? We have the amazing opportunity to offer stability, growth and community in each of our shops. Do you have an in-house employee feedback program? It's a great place to start and the cost is very small. Everyone wants to feel like they are learning, growing and moving forward. Having an in-house program, with a checklist for the employee and management to monitor the results, can be a huge boost for the staff. For a copy of our ATI employee appraisal checklist, download it at www.ationlinetraining.com/2016-04 for a limited time. MA



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Chris "Chubby" Frederick is the CEO and founder of the Automotive Training Institute. ATI's 115 associates train and coach more than 1,400 shop owners every week across North America to drive profits and dreams home to their families. Our associates love helping shop owners who are having the same struggle as many of them have had, and who are looking for the same answers — and in some cases looking for a lifeline. This month's article was written with the help of Coach Kevin Chzaszcz.

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INVEST IN KNOWLEDGE

YOUR SHOP'S KNOWLEDGE BASE IS A HUMAN CAPITAL ASSET TO YOUR BUSINESS

BY **BOB GREENWOOD** | CONTRIBUTING EDITOR

THE automotive aftermarket industry, whether it is an independent shop or a national company, spends a tremendous amount of money each year on all its various training courses, seminars and information programs. The purpose of these actions is to increase the knowledge of employees and management that is required to maintain today's vehicles in a safe and reliable condition, understand new products and enhancements and continue with ongoing business management and employee development.

These types of training build employee and management knowledge of understanding, which in turn, when all is performed correctly over time, makes everyone more productive. Effectively executed productivity leads to enhanced company profitability, which in turn leads to higher wages for all. This ongoing knowledge development is very necessary, as it is designed to secure the company's future.

The industry also spends a great deal of money on various types of physical shop/company equipment required to execute its day-to-day business professionally. This is also a very necessary outlay of cash a business must plan for. When used properly, up-to-date equipment increases productivity, which in turn increases profits and wages of the company.

The problem with both examples is that under today's business accounting rules they are treated very differently. Consider the following:

Training courses, seminars and information programs of any kind that are for business purposes, as mentioned above, are treated as an immediate expense for "accounting purposes," which means they are written off completely in the year that they are incurred. For example, if the shop/company spent $5,000 or $100,000 on training in one year, these monies are an immediate expense. This means the shop/company's net profits are immediately reduced.

Physical equipment that is acquired for the shop/company, on the other hand, is considered a "capital investment" and written down over time. Let me give you a simple example: Let's say current equipment purchases are written down at 20 percent each year on a declining basis (Note: use your actual accounting rules to calculate your numbers.) For example, if the shop spent $50,000 on equipment, the first year expense would be $10,000 ($50,000 x 20 percent), the second year the expense would be $8,000 ($40,000 x 20 percent) and the third year expense would be $6,400 ($32,000 x 20 percent), etc. This depreciation method does not reduce the net profit

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by the total amount of monies spent in that given year on equipment.

Both "expenditures" when executed properly, increase productivity and profitability. Both expenditures realize a business return over time as an investment. Due to the way they are handled for accounting purposes, which is allowed under tax law, they can mislead management. For example, imagine spending $45,000 between equipment purchases ($35,000) and training ($10,000) in one year. The $45,000 cash is gone, yet on the expense statement management will see $10,000 as an expense to training and $7,000 as an expense ($35,000 x 20 percent) to equipment depreciation. Management can very easily fall into the trap that if the "training" expense is cut back, the bottom line and cash flow would improve after examining the expense statement of the business. We know that type of thinking in the real world in our industry will lead to disaster, but when things are tight, expenses are the first to be examined. Very rarely do you hear management wanting to cut back on equipment purchases because 1) Management understands equipment in a more defined manner and its contribution to the back shop and 2) It is a physical, tangible item. However, the entire cash spent on equipment is not shown as a current year expense to bring the awareness of how much real cash was truly spent. It is shown on the balance sheet as a capital item.

The point to these examples is this: both expenditures are an absolute necessity for survival and success within our industry. This must be clearly understood and acknowledged. The problem is that training staff and management on a continuous basis is never seen as an investment; it is continuously considered and talked about throughout our industry as an expense. This is an incredible mistake when examining the complexities of our industry. To compound the problem with this type of thinking is that this investment is considered by management as intangible and perceived difficult to measure in immediate terms.

Consider an investment in a piece of equipment may see a true dollar increase to the business in day one of entering the business, whereas perceived "knowledge investment" may only see a true return late in year one, or in year two or three. Yet, it must be acknowledged that staff and management knowledge today are truly assets to the business. As with equipment — without it, the shop/company cannot survive.

Consider that even with the most progressive, professional-looking facility, in the best location in town, and containing the best equipment ever, without the right knowledge base inside this facility from the management level to the front counter to the back shop to the back office, the business cannot and will not succeed in today's business climate.

It is important to understand that the shop/company's knowledge base is a human capital asset to the business. Proper investment in this asset realizes a tremendous return, but calculating how much you are investing each year can be tricky. Consider this simple exercise to get the process rolling:

1. Add all actual monies spent (checks written) on various staff technical and management courses and seminars over the past year.

2. Calculate the total number of hours in classes to attend such functions in step one.

3. Calculate all the hours spent doing in-house training (solving technical/business problems) and internal staff training (such as attitude adjustment discussions and/or business vision/industry trends/issues explanations to the staff).

4. Add all the hours spent in step two to the total hours in step three and multiply the total by the shop's diagnostic door rate

5. Take the answer in step four and multiply it by your shop's efficiency rate (efficiency objective minimum of 75 percent; however, many shops are in the 55 percent to 60 percent range).

6. Add together the amount in step one and the final amount in step five.

7. Take the total amount in step six and now artificially add that to the bottom line of the businesses net profit/loss and also add it to the balance sheet of the business under a new heading titled "knowledge capital investment account." This is what you can consider was reinvested last year in the business in which the business does expect to see a return. This is a "knowledge" investment that is inside the business and every year it should increase and realize a return for the business. If the business did not see a proper return on its investment (35 percent for shops and 20 percent for national companies is reasonable), then management must revisit what type of "knowledge investment" is required to get the desired results. If management does not look after this asset properly, then this item on the balance sheet depreciates very rapidly along with the value (worth) of the business.

Now don't run out to your accountant and demand changes, because it is not an accepted accounting procedure. I think, however, that this type of exercise clearly makes a statement that in the automotive aftermarket sector of the industry, the business is constantly working with its "knowledge assets," and when an asset of this type leaves the business, is "lost" or is not properly maintained, the bottom line of the business is dramatically affected.

In today's successful businesses within our industry, knowledge investment is clearly understood. Many others, however, still look at it as a knowledge expense. If personal income and/or business bottom line is not adequate or acceptable to you, then consider looking very closely at your knowledge capital investment account and examine what and how you have invested in it. Are you measuring and managing this important account properly? MA

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NAMING THE TERMS

FOUR IMPORTANT CONSIDERATIONS WHEN NEGOTIATING A PURCHASE OR SALE

BY **BRAD MEWES** | CONTRIBUTING EDITOR

WHEN buying or selling a business, a lot of time and effort is focused on price. But there is much more to business transactions than negotiating a good price or a good multiple. Terms play an equal, if not greater, role in getting a good deal done.

There is an old saying in the deal business: "You set the price, but I'll name the terms."

Business transactions are often discussed in terms of multiples. Buyers and sellers rely on multiples because multiples act as a yardstick. For a seller, there can be a certain satisfaction knowing that you negotiated a healthy multiple. For a buyer, a multiple serves as a reality check to ensure that the price paid for a business is similar to other comparable transactions. Multiples serve as goal posts — a frame of reference for both parties.

But there are so many other important factors to consider when negotiating a business purchase or sale in addition to price. These are four of the more common ones we see when helping clients manage transactions in the automotive industry.

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Consideration

How will you get paid (or pay) when the transaction is complete? Recently, the majority of transactions in the industry have all been cash, or nearly all cash deals where most of the purchase price is paid at the closing, with a small portion held back in an escrow account for a year or two. But this is a recent phenomenon, and likely not to last forever. Most deals use multiple forms of consideration, the common ones including cash, stock, seller notes and earnouts. But each of these forms of consideration is not equal.

Each form of consideration — cash, stock, seller note and earnout — carries a different level of risk, and thus has a different real value. There is a fundamental valuation method in finance called the Capital Asset Pricing Model (CAPM), which effectively states that the greater the uncertainty, the lower the price of an asset (it gets more complex than that — anyone wanting to know more can email me if you want to geek out). In other words, $1 million in the form of earnouts over a year has a real value worth less than $1 million in cash (an earnout is less certain than cash). And the real value of these different types of considerations vary from company to company. Beware — assessing risk and determining what you are actually receiving in a business sale can become very complex very quickly.

Purchase price adjustments

It is common in transactions to agree to certain post-closing, purchase price adjustments, otherwise referred to as a "true-up." The most common purchase price adjustments in automotive deals are adjustments to working capital. The basic definition of working capital is current assets minus current liabilities. But working capital has many accounts, including Accounts Receivable (AR), Accounts Payable (AP), Work in Process (WIP), Inventory and minimum required cash.

Purchase price adjustments are one of the most common sources of post-close disagreements. Agreeing upon the appropriate level of working capital a seller is to deliver to the buyer at close may seem like minutia. But depending on the language of the purchase agreement, it can become quite contentious. Beware, a default to generic definitions and a lack of industry insight can leave you exposed and at the mercy of a more experienced dealmaker.

Indemnification

Indemnification is a form of protection against certain risks in the transaction. It is the act of promising to pay for the cost of possible future damage, loss or

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injury. It is also one of the most complex and heavily negotiated aspects of a transaction.

Negotiating indemnification clauses also may apper to be distracting minutia. But indemnification clauses cover a wide range of subjects: breach of contract, breach of reps and warranties, excluded liabilities, tax and environmental issues. Within the automotive service and repair industries, there are some unique considerations and subtle nuances. While this may appear boiler plate, different buyers have very different risk tolerances to these different issues. This is another area where industry-specific deal insight creates a lot of value.

Escrow, holdbacks and earnouts

It is common in "all-cash" deals for a certain percentage of the purchase price to be held back in an escrow account for a period of time. Escrow and holdbacks are often used to secure future obligations, especially around purchase price adjustments. In the automotive repair industry, a buyer will often insist on an escrow account to ensure a seller delivers the agreed-upon working capital.

Holdbacks are different from earnouts. An earnout is an agreement in which the buyer increases the purchase price if the acquired business achieves a predetermined milestone, such as revenues, referrals, etc. Earnouts are often used when there is a valuation gap between buyer and seller.

You may find the negotiations of the earnout or escrow language painful or borderline ridiculous. Be careful and be prudent — take the time to think through all of the possible outcomes before signing off on your documents, as these provisions can shift a lot of risk to you. Experienced advisors add a lot of value in this area.

Maximize your price and terms

Business transactions get complex quickly. That is why we advocate putting your team together early. In addition to retaining M&A transaction advisors with industry experience, it is important to get both tax and legal counsel involved. A good M&A advisor will effectively manage other advisors, streamlining the transaction process and allowing you to focus on running your business.

Price is only one half of the transaction. Maximizing your terms while minimizing your risk is equally important. Competent M&A advisors bring industry-specific knowledge and insight — benefits that exceed the costs, literally many times over. MA

5 simple ways to increase the value of your business

1. Focus on gross profit. Gross profit is the primary driver of profitability in a business, so if it suffers, so does your value.

2. Keep your overhead and SGA in check. Adjusting your expenses to improve profitability impacts your credibility and causes doubt for buyers. Maximize your value the old-fashioned way — keep an eye on overhead expenses.

3. Manage your WIP and inventory. Don't forget about expenses that don't show up on your monthly P&L. Ultimately valuation is about cash flow, not profit.

4. Dive into working capital. Working capital is cash that your business needs to operate on a day-to-day basis. Poor working capital can bankrupt even the largest companies, so be sure you are actively managing yours.

5. Use a dashboard. A financial dashboard is the easiest way to ensure that you are looking at your numbers every month. It is also the best way to elminiate surprises when building a profitable and valuable company.

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THE TECHNOLOGY FUTURE IS NOW

COLLISION AVOIDANCE TECHNOLOGY ON THE PATH TO DRIVE PERMANENT INDUSTRY CHANGE

BY **LOU BERMAN** | CONTRIBUTING EDITOR

AS A kid growing up in the 1970s and '80s, technology was something that was very popular in movies like *Star Wars* and *Star Trek*; TV shows like *Battlestar Galactica*, *Knight Rider* and *The Jetsons* all showed what life would be like in the future and how the methods of transportation would also change.

My friends, the future is now! Look around and you will see so many car companies incorporating collision avoidance technology into their function and design for practically every new car on the road. It's almost a standard feature, like an airbag. Airbags have no doubt saved lives, and it is with this goal in mind, geared toward consumer safety, that this technology is making its way to every automobile on the road. Consider this: The National Transportation Safety Board estimates approximately 1,700 people are killed in rear-end crashes every year, with another 500,000 injured in those accidents. It is with these and other statistics in mind that lead entities like the National Highway Traffic Safety Administration (NHTSA) to make some of the avoidance systems mandatory.

Here's why: An insurance industry organization concluded that the Volvo XC60, equipped with the company's City Safe collision avoidance system, is 27 percent less likely to be involved in a fender bender.

"These are very large effects," says Adrian Lund, president of the Highway Loss Data Institute (HLDI), which is a subsidiary of the Insurance Institute for Highway Safety (IIHS). Additionally, IIHS tested collision-avoidance systems on 19 new models, giving its highest rating of "superior" to 14 of them.

Many of the vehicles that earned "superior" ratings are luxury models, including the BMW X3, the Mercedes-Benz C-Class and the Acura MDX. The IIHS tests measure the amount of time it takes a vehicle to stop while traveling at speeds of 12 mph and 25 mph. As the vehicles approach a barrier that resembles the back of an SUV, their crash-prevention systems kick in, alerting the driver to brake. Some of the models also feature technology that automatically forces a vehicle to brake to avoid a crash. The crash-avoidance systems rely on a variety of sensors, cameras, lasers, short- and long-range radar, or combinations of cameras and radar. Computers monitor what's going on and, when appropriate, prompt some action from the car or the driver. Those actions may start with attention grabbers, such as a beep, a flashing dashboard icon, or such "haptic" signals as a tug from the seat belt or a vibration in the seat or steering wheel. The more advanced

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systems can apply partial or full braking force if the driver doesn't respond.

Cost factor: Inexpensive technology

For pricing at around $300 (cost to consumer), there are systems available for compact cars that combine a pre-collision system, lane-departure warnings and automatic high beams. They use a camera and laser radar to notify the driver of hazards with an audio and visual alert. If the driver does not respond, it will help mitigate pre-collision speeds by approximately 19 mph if the driver does not apply the brakes on his or her own, and helps provide additional stopping power if the system determines that more is necessary. Manufacturers say that the pre-collision system covers speeds "at which at least 80 percent of rear-end collisions occur."

For $500 (cost to consumer), there are upgraded packages available for "mid-size and premium models," which include all of the above plus pedestrian detection and adaptive cruise control, thanks to the fitment of millimeter-wave radar. Like the pre-collision system, the pedestrian-detection system works at relative speeds of between 7 and 50 mph and can reduce impact speed by approximately 19 mph. The radar cruise-control system works like most others, sensing cars ahead and adjusting vehicle speeds to compensate. Manufacturers plan to eventually make the systems accessible to some 70 percent of European customers, with plans for additional North American implementation.

Insurance: How this technology affects the consumer

HLDI examined forward collision systems offered on Acura, Mercedes-Benz and Volvo vehicles. PDL frequencies for Acura and Mercedes models were 14 percent lower when the vehicles were equipped with forward collision warning with autonomous braking than when they weren't. IIHS estimates that one in three fatal crashes and one in five accidents with injuries could be prevented if all passenger vehicles were equipped with forward collision warning, lane departure warning, blind spot detection and other safety systems.

IIHS also found that some models of Volvo, Mercedes-Benz, Honda and other manufacturers with crash avoidance technology had 14 percent to 16 percent fewer accident insurance claims, compared with the same models without the technology. In another study, the Israeli government last year commissioned Ron Actuarial Intelligence, an Israel-based consultancy and manager of motor bodily injury (MBI) insurance data, to study the effectiveness of collision avoidance systems by measuring the influence of a forward collision warning system (FCW) and a lane departure warning system, developed by Amsterdam-based Mobileye, on the expected claim cost in Israel. The study, which used software by business analytics vendor SAS, found that insurance claim frequency dropped by approximately 44 percent for privately-owned vehicles equipped with collision avoidance technology, compared to those without the technology.

Top 7 cars with successful collision avoidance technology:

- Subaru Legacy
- Subaru Outback
- Volvo s60
- Cadillac ATS sedan
- Volvo XC60 SUV
- Cadillac SRX SUV
- Mercedes-Benz C-Class sedan

The flip side

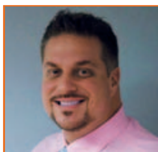
As they say, there is no money in the cure. While crash avoidance systems, backup cameras and other safety features avert accidents and injuries, cars and trucks with the technology are more expensive to repair when they do get into crashes. Some safety systems also don't work well in bad weather and at night, and some drivers are turning off the systems because of annoying alarms and false alerts.

"Ron Actuarial Intelligence's study is a great empirical proof point of where we are on the road to the end of auto insurance," comments Donald Light, director of Celent's Americas Property/Casualty Practice. "As collision frequency drops, losses drop, and competition will force premiums down."

Certainly in years to come, this technology seems to be a determining factor that could further reduce severities in the collision repair industry. That also has a ripple down effect through the economy that supports an industry. In 2013, there were an estimated 42,809 collision repair shops in the country that repaired 12,149,854 accidents, representing a total market value of more than $29 billion. When you look at the numbers, you can see that the emergence of accident avoidance technology and self-driving cars look to drive loss severities and incidents to all-time lows, and one could argue the beginning of the end of a once prevalent industry.

Then again, maybe not just yet. A prior report from HLDI in 2012 showed that it typically takes approximately three decades for technologies to spread through the fleet or total cars on the road. The current analysis uses similar methodology but focuses on collision avoidance features. The analysis agrees with the 2012 report in that it expects it will takes decades before most vehicles on the road could have a given feature, either because it came as standard equipment or was offered as an option. It would be at that time that you could then apply the surveyed data to every car on the road. Either way, it certainly seems like the clock is ticking.

Although the collision repair industry and the insurer segment will be greatly impacted by new collision avoidance technology, these systems will still need repair, along with the mechanical aspects of vehicles on the road today. And many of these technologies will be on vehicles that are coming into your shop. So be sure your technicians are properly trained on how to work with these systems. MA



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SHOP PROFILE

A snapshot of one of the industry's leading shops

JERRY'S AUTOMOTIVE SERVICE, INC./
WAUKESHA, WISC.

Keeping the trust

The quality received from Jerry's Automotive Service keeps customers coming back again and again

BY **ROBERT BRAVENDER** | CONTRIBUTING EDITOR

"There are some great shops out there, and I love it when my competition is good, because that will only make me better," says John Haunfelder, owner of Jerry's Automotive Service, Inc. How good is Jerry's? Let's just say there's lots of competition in metropolitan Milwaukee.

Established in 1958 by Jerry Neuwirth, John went to work there as a teenager in 1977. "His shop always had a strong reputation," Haunfelder recalls. "They did a lot of different repair work — they were the 'can do' shop. I remember when the job posting came out — all of the guys [from high school] were talking about it. I was down there within the hour to be interviewed."

Rising through the ranks, Haunfelder eventually bought the operation in 2000.


Owner John Haunfelder

"When you purchase a business, you dump everything you have into it and everything you will ever have," he declares. "Failure's not an option, so you're going to explore whatever avenue it takes to make it work. But Jerry was a very good businessman, and I learned a lot from him. He gave me a good background in not only how to fix cars, but also in handling customers. Once I bought the business from him, I was able to run with it and continue to grow.

"You've got to know what your expenses are and make sure you make enough to stay afloat, or else you're doing no one — from your technicians to your customers — any favors," Haunfelder explains. "I keep it a little more basic: I've got three or four factors I look at monthly and things I check, like technician times on jobs and productivity, certain margins on parts; I've got a real good handle on it, making sure we're keeping it where we can make money."

JERRY'S AUTOMOTIVE SERVICE, INC.

John Haunfelder
Owner

Waukesha, Wisc.
Location

1
Number of locations

15
Years in business

15 / 9
Total number of employees / techs

22,000
Square footage of shop

11
Number of bays

128
Weekly car count

$460
Average RO

Continuous training

Haunfelder has dealt with every change in the industry over the past few decades, from shop management systems to diagnostic systems. "Literally everything has changed pretty dramatically," he notes. "I'm still a technician; I used to float in the shop but now I stay up front more. I still confer with my techs a lot, and if something's beating them up, we'll put our heads together."

To that end, they've been doing more in-shop meetings, typically once a month, adjacent to whatever seminars are available regionally. "We try

Photos: Jerry's Automotive Service


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to hit the bigger ones, like Automechanika Chicago," Haunfelder reports. "If there's a new piece of equipment (my crew is) not comfortable with, we'll go over it, do our due diligence ahead of time and we'll work with the equipment, use it on several cars. The guys can ask questions of one another; they can show one another; it's been a very good tool."

Business minded

For business advice, however, Haunfelder usually follows his own counsel. "Everyone's got a wonderful way to run your shop, but they're not running shops," he argues. "The 20 groups are nothing but managers getting together and sitting in each other's shops and evaluating what they're doing. If I'm going to sit in a shop to work on anything, it's going to be mine.

"(Advisors) tell us you should book so many jobs per tech, bill so many hours per that job," Haunfelder relates. "I don't spend a lot of time on that. I could fill my day doing all that fun stuff, but you can tell when you're getting too crowded, to move to the next day. I'll talk with my service advisor that tomorrow's pretty full; better save it for someone who's in real trouble, a good customer, otherwise we're into the next day or the next. We're constantly conversing as to what's what.

"We are a very strong shop, a financially secure shop," contends Haunfelder, "and we have great clientele. Do I stay in my office all the time and work on my business? No. Do I devote time to thinking ahead and planning what our next steps are to keep us current, ahead of the curve? Certainly. Do I need 8 hours a day to do that? Certainly not."

Haunfelder also concedes they do very little marketing. "Could I do more with my website? Yes," he answers himself. "Are we starting to see more appointments made online? Yes, we are. But about 95 percent of what we do is still done over the phone. Some customers only use email, but I still think a lot of people want to talk with someone when they set up the appointment. Certain clients could type for two days or they could talk with me for five minutes. I can narrow the problem down with three or four questions: how many miles are on the car? What are your plans for the car? Do you plan on keeping it 5-10 years or a year or two? It depends on the scenario, what kind of problem you are having."

Customer service

One thing that hasn't changed — customer service can make or break a company. Here Haunfelder has everyone helping out: "Of course techs make money working on the cars," he explains, "but they test drive with customers, verify complaints and listen to problems so that they can quietly get them addressed. And I expect my guys to be pleasant with customers, because you've got about a three-minute window for a customer to buy in. If the tech doesn't say anything or doesn't look at them, they're going to be uncomfortable. Say a couple nice words, ask a few good questions; now the customer has greater confidence in your ability to fix their car."

A super clean facility and plenty of amenities are musts for the modern shop. But beyond the WiFi and wide variety of periodicals in the waiting area, Jerry's also offers loaner cars. "If someone gets in a pinch at the last minute," Haunfelder notes, "if their car breaks down and it's not going to be ready till tomorrow — 'here, hop in our car, get to work, we'll see you tomorrow.' You can just ease their tension ten-fold. You try to tailor your customer base towards those who appreciate that extra service, and you do all you can to keep those people." MA

Jerry's Automotive held an in-house GM theft system clinic.

ROBERT BRAVENDER
CONTRIBUTING EDITOR

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

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IN TODAY'S MARKET, IT IS UPDATE OR EVAPORATE

Motor Age contributor and industry trainer G. Jerry Truglia shares his thoughts

BY **CHELSEA FREY** | SENIOR ASSOCIATE EDITOR

With more than 43 years of experience in the automotive field as a technician, service manager and shop owner, longtime *Motor Age* contributor G. Jerry Truglia has seen many sides of training. From certifications — some of his include ASE World Class, Triple Master Auto, Truck, School Bus Technician, A9 (Light Vehicle Diesel Engines), ASE L1 (Advanced Level), L3 (Light Duty Hybrid/Electric Vehicle Specialist), Compressed Natural Gas (CNG), and Undercar Specialist and Service Consultant — to being the founder and current president of Technicians Service Training, Truglia stands as a lauded leader in the industry and as an inspiration for those new to service repair.

A quick glance at Truglia's list of wide-ranging titles and accolades could prove to anyone that working in the service industry requires a high level of technical knowledge, experience and dedication. However, Truglia says the biggest challenge he has faced and still sees in the industry today is a lack of respect. "Technicians and mechanics are not looked up to, but rather looked down on. It's hard to get paid for what you know if you're not respected," he notes.

"G" Jerry Truglia

Truglia recognizes that respect within and for this highly technical industry goes hand in hand with maintaining expertise and professionalism through training. He states, "Training is very important because the vehicles and the systems on them constantly change. If we do not update, we will evaporate." Helping the image of technicians and mechanics involves certification, Truglia adds. "ASE certification shows professionalism. Other hands-on training, such as the TST electrical/computer certification, is important as well."

Truglia, who has co-hosted *Motor Age* webinars with Director of Training Pete Meier, encourages those in the industry — both rookies and veterans — to remember that training is available in many forms. "Read everything you can and get involved in training. Utilize the internet by watching webinars and training videos on YouTube."

From presenting multiple times at SAE World Congress and at the Clean Air Conference and IM Solutions to authoring a variety of automotive books, Truglia has always explored different avenues in the service repair world, and he encourages fellow mechanics and technicians to do the same. "If a mechanic or technician can explore different jobs in the industry, they will find the job that works best for them and/or one that they can switch to in the future. Since the job is physical, there comes a point when a tech can no longer physically perform as well and may want to move on to being a service advisor, manager or something else." Truglia continues, "As the Army states, be all you can be. My wide range of involvement has taught me that if you work hard and keep yourself updated, you can move on and up. It's a great industry that has been good to me. As technicians, we can only expect to get out the effort we put in our industry." Clearly, Truglia is a perfect example of that. MA

"I CAME BACK A SECOND DAY BECAUSE I DIDN'T WANT TO MISS OUT ON SEEING ANYTHING. IT'S NEVER ENDING. I COULD WALK AROUND FOR THREE DAYS AND STILL NOT SEE EVERYTHING." —TIM WILSON, AMC 2015 ATTENDEE

COUNTDOWN TO AMC 2017

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SOCIAL INSIGHTS

• View all 51 episodes of "The Trainer"

Are you a fan of "The Trainer" video series starring *Motor Age* Director of Training Pete Meier?

You can now view all 51 installments of Pete's quick takes on solving diagnostic head scratchers, learning proper repair techniques and tackling those puzzling vehicle problems that can pull into your shop at any minute. Watch all of Pete's videos — free — on YouTube.

Take a look at our playlist to learn everything from performing a safety inspection to testing the positive side of an electrical circuit.

MotorAge.com/traineronline

• Chubby's Tip of The Month: Encourage your techs to grow

New employees are like moist sponges — in the beginning of their career, they are very open and ready to soak up information and training.

Chris "Chubby" Frederick, *Motor Age* contributor and the CEO of Automotive Training Institute, talks about how creating and maintaining the right environment to foster training, education and advancement in your shop is crucial for encouraging your technicians to grow. Click here to watch the video.

MotorAge.com/helpgrow

• How to avoid shop catastrophes and ensure business success

"On Nov. 20, 2014, I watched my entire life go up in flames. In less than an hour, everything I had built over 15 years, including my home, was gone after a truck caught fire, burning the entire shop and 12 customer vehicles to the ground." *Motor Age* reader and shop owner Joey Kaylor shares his story of loss, and is open about some missteps he made in his business. Learn from his story and don't let the same thing happen to your shop.

MotorAge.com/protectinvestment

• The right pay plan can empower your employees to improve their own performance

"How do I motivate my employees to do what I expect?" That is a question *Motor Age* contributor David Rogers has heard over and over from his shop owner clients.

But that question takes many different forms from the best training programs for your service advisors to building company culture to offering bonuses and salary raises.

There's one trick that can accomplish all three: an incentive pay plan.

The right pay plan can empower your employees to improve their own performance, while at the same time take ownership over the success of the business. But, this process is easier said than done.

Over the years of owning a shop and consulting with shop owners, Rogers has seen just about every pay plan known to business. And most of them don't work because most of them focus soley on money.

Keep reading to find out exactly what your pay plan needs to focus on in order to transform your employees.

MotorAge.com/payplan

• Join our automotive training groups on Facebook and LinkedIn

Earlier this year, we launched Facebook and LinkedIn groups for Automechanika Chicago's Commitment to Training program. The program was created to provide readers with the latest information on training topics, best practices and events. If you haven't already, sign up for the Commitment to Training newsletter and find us on LinkedIn and Facebook for access to exclusive offers — including free training.

Newsletter: SearchAutoParts.com/cttnewssubscribe
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TRAINING EVENTS

MAY 12-14
• Mitchell 1 Shop Management Workshop; *Hotel Solamar*
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• 2016 NACE/CARS Expo
Anaheim, California

SEPTEMBER 16-18
• 2016 CAN Conference
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OCTOBER 8
• Automotive Engine Rebuilders Association Conference; *Speedway Motors Museum of American Speed*
Lincoln, Nebraska

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

MIND OVER METAL

BRINGING AUTO SERVICES TO THE CUSTOMER'S DOOR

Service house calls are convenient for customers, an opportunity for service providers

BY **LARRY SILVEY** | CONTRIBUTING EDITOR

Are you sick and don't feel like dragging yourself to the doctor? In many cities you can call one of the increasing number of doctors who make house calls. If you're a resident of San Francisco or Los Angeles, all you have to do is download the app, Heal, communicate your medical need, and a doctor will be at your door in 60 minutes or less. Yes, the health care system has been "Uberized."

Now let's apply this concept to auto care. Do consumers want to be bothered taking their vehicles to repair shops? And more to the point of this blog: do you think your customers would like you to make house calls?

Before you answer that question, consider the mindset of the typical consumer. GfK MRI, a leading consumer research firm, reported that more than a third of surveyed Americans feel stressed in their daily lives and that they are losing control. Moreover, 71 percent of that group say they can't finish everything they need to in a day, which often leads to working weekends. Although this study was limited to American consumers, there are stressed-out consumers around the world who find it difficult to keep up with daily responsibilities.

That said, it's logical to think that any kind of personalized home service — from house calls by doctors to house calls for car maintenance and repair — can help relieve some consumer stress, whether it's in busy metro areas where the traffic itself can be overbearing or in hard-to-reach rural areas.

There's always been a need for house call auto repair, but no one had thought of responding to this need seriously until Uber took the taxi industry to task. One such company — Your Mechanic — uses the web to pair users, who want the luxury of staying at home or the office, with certified service providers. After all, who wants to spend their time in a shop or dealership watching a pre-selected TV channel? Plus, the cost for service should be significantly lower because the overhead isn't associated with a physical shop. According to Your Mechanic, less overhead also means more money for the technicians doing the work. (Although most of Your Mechanic's technicians moonlight from their full-time jobs, they may be enticed to work full-time for Your Mechanic if they can earn higher wages, No worries unless they are your technicians!)

To take advantage of this service, consumers simply need to go online via app or computer, explain what they need, get a fixed price and book an appointment. In the case of simple maintenance or repair work, this booking process works well. Understandably, any maintenance or repair work out of the ordinary probably involves a technician going to the home or office to inspect the vehicle and to write an estimate. The inspection is free as long as the customer books the work with Your Mechanic. In essence, Your Mechanic can do a large portion of what a shop can do with the added convenience of doing it on location.

So if you're running a repair shop, there are a few ways to respond to this phenomenon. You can ignore it, you can start a standalone business dedicated to house calls, or you can offer it as a service provided by your existing business. If you choose the latter and the repair requires more than what can be done on the spot, you can take the vehicle to the shop, much like a doctor would do if a patient needed to be admitted to the hospital. Administered correctly, making house calls with the option of shop follow-up (and the return of the vehicle to the home or office) could mean getting business you wouldn't otherwise get.

Although Your Mechanic has yet to experience the success of Uber, there's no doubt that a growing number of customers will use the service. How much and how fast are to be determined. But surely we haven't heard the last of this subject. Suppliers, distributors and brick-and-mortar shops will have to respond. Now who is feeling stressed?

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Larry Silvey is president of his own motor vehicle marketing communications agency called Larry Silvey Media LLC. A 30-year industry veteran, his experience runs the gamut of the motor vehicle industry in publishing, research, education, and marketing and public relations.

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UNDERCAR

OCTANE OR PROOF?

Using a siphon line to obtain fuel sample.

ALCOHOL'S EFFECT ON DRIVABILITY DIAGNOSTICS AND HOW TO IDENTIFY THESE ISSUES

BY **JAIME LAZARUS** | CONTRIBUTING EDITOR

In chemistry, alcohol is an organic compound that occurs naturally on earth — and in space! I will not get into the scientific and technical aspects of the various types of alcohol, their chemical compositions or any other aspect they possess, with the exception of how we in the automotive fields are affected by them. Just keep in mind that alcohol contains carbon, hydrogen and oxygen molecules, because I'll be touching on how these relate later in this article (spoiler alert!) and that alcohol mixes well with oils (like gasoline) and it bonds to water.

Alcohol has many forms and many purposes; it can disinfect wounds, clean oils and greases from surfaces, can produce cooling effects through evaporation, it burns at relatively low temperatures, can sedate the person drinking it and the list goes on. Alcohol and its many variations (ethanol, methanol, etc.) have also been used as a motor vehicle fuel and as a fuel additive for decades. Ethanol (Ethyl Alcohol) is one byproduct of a type of fermentation. Most grains, fruits, flowers and some wood will produce some form of ethanol as they decay, but to do so, yeast must be present. Ethanol is the type of alcohol that is commonly used as a fuel additive. We'll focus on that aspect in this article.

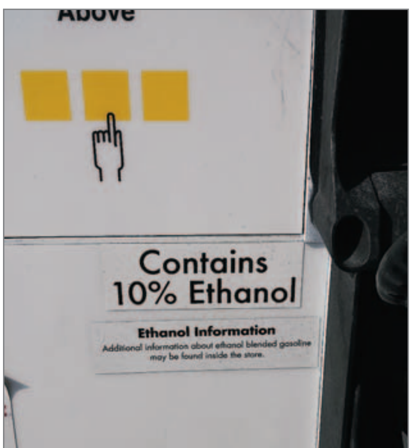
Throughout history there have been

Photos: Jaime Lazarus


It doesn't matter how one retrieves their fuel sample.

many who distilled alcohol for use as a fuel. It burns "cleanly" — meaning it produces little to no soot — and almost completely* (See page 46). It's been used to fuel furnaces, boilers, steam engines and almost from the time cars were mass produced, those too. Sometimes alcohol is blended with other things like when it's used to propel rockets, for example. Top Fuel dragsters and funny cars use a blend of alcohol (Nitromethane) to produce well over 7,500 horsepower!

In the past few decades, federal laws went into effect, which forced gasoline manufacturers to include up to 10 percent alcohol in the motor vehicle fuels sold to the general public. At the time, the United States relied heavily on foreign-supplied crude oils, and the federal government felt we could reduce that dependency by blending alcohols with the final product. Yes, there were (and still are) numerous arguable points regarding the laws, which I will not delve into on these pages. The fact remains: we were introduced to a whole new world of diagnosing alcohol-related problems immediately upon implementation, problems that didn't exist before the laws.



Gas pump signage is required by law.

Alcohol "poisoning?"

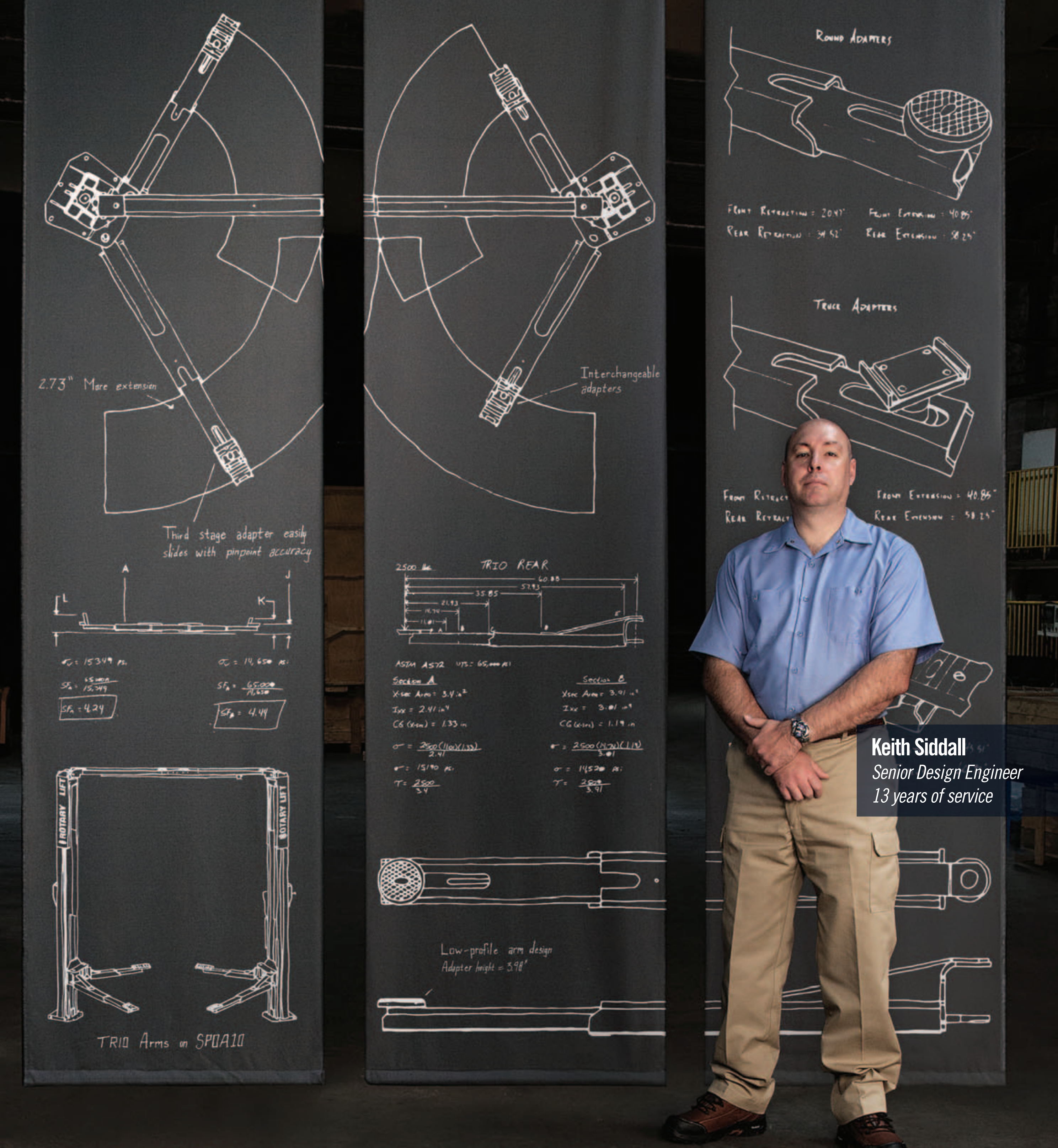
Prior to the introduction of alcohol-blended fuels, it was rare to find cars exhibiting the adverse symptoms of "alcohol poisoning" that became commonplace afterwards. The first cars I dealt with arrived in the service bays sporadically and had little if anything in common, so it was perplexing each time one would arrive. In the end, they all did have one thing in common though — a thorough questioning of the owners after each of their repairs revealed the same reason for the failures.

Most of us had no idea what to expect when alcohol blends were first introduced. The automobile manufacturers had done some tests, but for the most part their publicized reports included warnings of decreased mileage per gallon and little else. Some in the scientific communities knew to expect more than that. Almost everyone who worked on anything that used motor fuels, however, was poorly prepared for what rapidly developed into some catastrophic and expensive damage to fuel-related components.

Once alcohol-blended fuels appeared on the scene, large numbers of cars with fuel leaks started appearing in the automotive repair shops. Lots of cars started leaking raw, unburned fuel. Initially, that was the only indication that something had changed. We repaired them using what we'd always stocked and usually within a few months, the owners would return with the same complaints. It didn't take long before we knew there was a chemical reaction taking place and that we had to adapt to our changing environment. Shame on us for not reading the current *Motor Age* magazine issues at the time!

There were the cars that either ran poorly or not at all. The vinyl, rubber and neoprene components that were exposed to fuel or its vapors were disintegrating! Some items crumbled, some turned to "mush," yet others swelled much larger than designed. In every case, all became unusable. I'm referring to fuel cap seals, fuel tank and pump hoses, fuel pumps themselves, vacuum lines, carburetor seals and accelerator pumps (I may have just lost some of the younger generation – sorry!), even vacuum brake boosters failed regularly prior to the introduction of ethanol. Most air conditioning systems at the time were controlled using vacuum motors and valves. Yes, those failed as well because of the exposure to the fuel vapors in the intake manifolds, from where their source of vacuum originated. All of the failing items contained some amount of carbon and were broken down when introduced to alcohol.

With the advent of ethanol-blended fuels, everyone suffered an incredible financial burden; we had to replenish our complete inventory of bulk fuel and vacuum hose, the carburetor kits that



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didn't include the "new" Viton accelerator pumps and seals were suddenly obsolete, as were the fuel pumps we stocked! Huge numbers of fuel filters and gas caps had to be disposed of or else we were potentially liable should a leak occur on an item we sold.

Lots of other industries started seeing problems and at first, like us, didn't understand what was happening and why. The power equipment manufacturing and repair industries are a good example. Those businesses were suddenly inundated with everything from lawn mowers to snow blowers that were leaking fuel and not running well, if at all. Whether they were two stroke or four, every piece of equipment failed in one way or another. I suppose one could say it was good for business, but I'd argue it was horrible for the consumer.

> **"Factoid: The world's leading producer of ethanol is Brazil, where more than 20 percent of its cars are able to use 100 percent ethanol as fuel!"**

The impact today

Let's fast forward to modern day. We've had alcohol-blended fuels for going on 30 years now, so all the problems we saw are gone. Am I right? Well, not all of the alcohol-related problems are gone, but there are very few alcohol-related leaks anymore. The problems I am seeing are with diagnosing "alcohol poisoning." I call it that because a little alcohol is alright, but the systems cannot compensate when there is too much. Cars are sort of like people in this way.

What are the symptoms of too much alcohol in the fuel? That depends on the vehicle design. The US uses Gasohol (maximum of 10 percent ethanol) and E85 (85 percent ethanol) ethanol/gasoline mixtures. Flex-fuel vehicles in the US can run on 0 percent to 85 percent ethanol (15 percent gasoline), so it's hard to "poison" an E85 car. If you put 85 percent alcohol in a car not designed for it, you will have dramatic results. It is relatively easy to diagnose the catastrophic mistakes like that, but the cars with "slightly" more than a 10 percent blend are far more common and those are much more difficult to accurately diagnose.

Because the modern computer systems are able to compensate so well for almost any mechanical wear of engine components, we diagnosticians tend to try and eliminate those as causes of the typical complaints you will receive when a vehicle's been poisoned. They're similar causes of poor performance, poor mileage, rough start, no start, rough idle and MIL illuminated complaints.

It cannot be stressed enough how vitally important a thorough customer analysis questionnaire (call it what you will) is, especially when it relates to this type of requested repair work. There is a possibility of wasting a lot of time unnecessarily without good information. Your questionnaire should include questions like "Do you get fuel at the same location all the time?"; "What octane rating do you use?"; "When was the last time you refueled?"; "Did this problem develop after a refueling?"; and "Do you use any fuel additives?" among others.

As a tech, in most cases we would address those complaints head on, just like we're taught, whereas when armed with the right answers, my diagnosis may start at another point in my routine. This is not so we can circumvent the typical initial analysis phase of the diagnostic routine; it's simply to provide us with better direction. We still need to begin our analysis with a verification of the customer complaint, a thorough visual inspection, a review of the scan data and DTCs, maybe a functional test of systems that have set DTCs, etc. We should also review the repair and maintenance records to help guide our diagnosis.

Dealing with the cause

I know many a good technician who has been befuddled by the seemingly nonsensical scan data he/she observes on the vehicles that have slightly more than 10 percent ethanol. Those customer complaints can be caused by so many things! But wouldn't it be irresponsible for us to jump to any conclusions that are mechanical in nature, no

A graduated beaker

In this tiny test tube, fill the H_2O up to its line.

10% alcohol indicated

Jonathan Dwyer
ASE-Certified Technician
Wayne, New Jersey

Mike Rowe
Huge Fan
of Stopping

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matter how possible it seems that they would cause the complaints, without performing an alcohol content test on the fuel system? How embarrassing would it be if you put cam phasers, did a throttle body and induction system cleaning, serviced all the filters, replaced the spark plugs and still had the same problems? Not just embarrassing but how can we charge the customer without actually addressing their complaint?

The alcohol content in fuel cannot be seen or smelled. The test isn't usually time consuming, and it is 100 percent accurate! That alone should perk your attention! But wait — there's more! The test kits are very inexpensive and readily available. Whether you purchase a graduated beaker or even a fuel analysis vial or you use a glass or plastic bottle, jar or similar container, the important part of testing for alcohol content is accuracy.

I use both a 100 ml graduated beaker along with a stopper, which fits the top that I bought from a pharmaceutical supply company (around $22, also available at your local drug store) and I have the "Tiny Tester Alcohol Content Tester" I got from www.tinytach.com (P/N: DTI-66, less than $10). Your test involves precisely filling 90 percent of the measured area of the container with a sample of the fuel from the vehicle. Then you add 10 percent of the measured area with water (for the alcohol in the fuel to bond with). If you are using something like a 12-ounce bottle that once contained a liquid, I suggest you fill it with 9 ounces of fuel, add one ounce of water. In all cases you should have some air at the top of the container.

30% alcohol indicated

You cap the container, shake vigorously for a few seconds and wait a minute. Then carefully vent off whatever pressure may have built up and shake it again for a few seconds. All you have to do now is wait five minutes then observe the fluids. There will be a separation line formed where the gas is "floating" on the water. Wherever that line is helps you determine the amount of alcohol in the fuel.

No, it's not magic! The alcohol that was in the fuel will bond with the water (remember earlier I mentioned the alcohol has hydrogen and oxygen, just like water?). The separation line will be at the 10 percent mark, plus however much percentage of the gas contained the alcohol. If the fuel contained 10 percent alcohol and you used a 100 ml beaker, then you would have 10ml of water plus 9ml (remember, we are calculating the percentage of alcohol that's in a 90ml sample), so the separation line would be at the 19ml mark.

However, if there is more than 10 percent alcohol in the fuel, that additional amount would be indicated as a higher separation line where the gas floats on the water! A 15 percent content would show a line less than 24ml on my beaker. An 80 percent content (as I have seen when someone used the E85 pump to fill their tank accidentally) will show a line at the 82 ml mark. It's that simple!

Oh, you're wondering what the first vehicles I'd encountered — the ones that had alcohol poisoning well before alcohol-blended fuels were mandated — had in common. Okay, here's the explanation. After replacing the damaged components and questioning the owners, it became obvious they typically shared a common Saturday ritual. They all watched motorsports throughout the day on TV.

I never realized how many commercials advertised fuel additives on Satur-RACE-day! Those commercials usually had some famous racecar driver(s) proclaiming, "Yup, they'll clean your combustion chamber, get you gobs more mileage, you'll see a huge performance increase…" Well, I found out all those sick cars' owners had (ab)used fuel additives!

Can you guess what the primary ingredient of most fuel additives is?

All those sick cars' owners must have had another commonality — that they all ignored directions! Most of the additive bottle's instructions for use read something like "add six ounces to 20 gallons of fuel." It seems they thought if you'll get good results with a little bit of additive, then won't you get great results with a lot? You got it right! They poisoned their cars so badly that the alcohol content created catastrophic failures in anything the fuel or its vapors could touch. I heard similar stories from folks in colder climates regarding "dry-gas" fuel additives.

The sad part is this still occurs today! You'll see them in your service bay soon, if you haven't already! Just remember to incorporate a fuel/alcohol content test in your initial analysis so you won't misdiagnose the customer complaints.

**(From Wikipedia): Ethanol combustion in an internal combustion engine yields many of the products of incomplete combustion produced by gasoline and significantly larger amounts of formaldehyde and related species such as acetaldehyde. This leads to a significantly larger photochemical reactivity that generates much more ground level ozone. These data have been assembled into The Clean Fuels Report comparison of fuel emissions and show that ethanol exhaust generates 2.14 times more ozone as does gasoline exhaust.* MA


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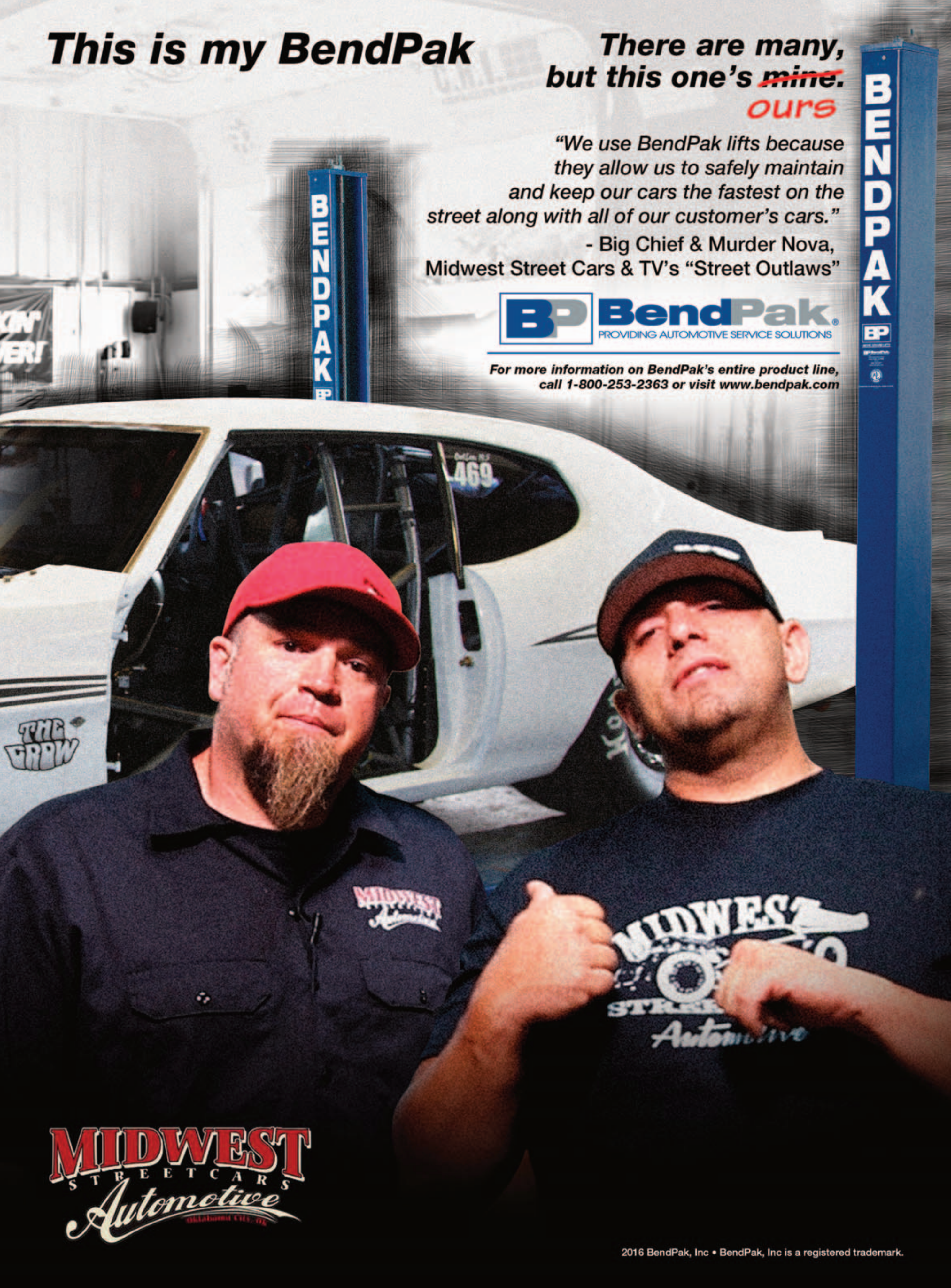
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The heart of the matter

AN AUTOMATIC TRANSMISSION RELIES ON ITS HEART – THE FILTER, PUMP AND RELATED SEALS – FOR QUALITY PERFORMANCE

BY **WAYNE COLONNA** | POWERTRAIN PRO PUBLISHER

IT IS no secret that having a good working heart is a necessary element towards enjoying quality of life. The same is true for an automatic transmission. The quality of the filter, pump and related seals are critical to the proper operation of the transmission and its length of life. Its veins reach out to apply clutches and brakes as well as lubrication and cooling circuits. A failure with the pressure circuit is no doubt an undesirable event.

An interesting aspect to pumps is the design manufacturers choose to use in their transmission. This couldn't be any more evident than with GM and Ford in their joint venture to build a six-speed front-wheel-drive transmission.

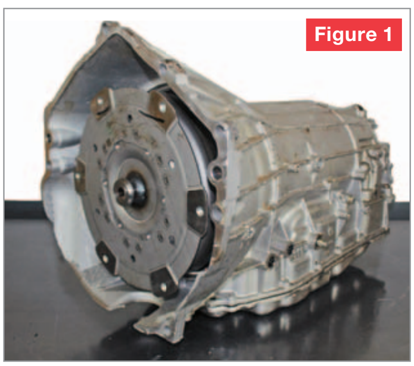
Figure 1

GM went with a crescent-style pump while Ford went with a gerotor pump. GM has a long history of using both a crescent-style pump and a variable displacement vane pump (VDVP). Ford has had a history of using both crescent-style and gerotor-style pumps. Gerotor-style pumps are less expensive to manufacture than crescent-style pumps and can package nicely in a small diameter space. The same is true with "compact vane-type pumps," which have become widely used in a variety of applications.

The positive displacement rotary vane pump has history as far back as the late 1800s. The variable displacement vane pump showed up about a half century later. The first time I ever saw a rotary vane motor was in my impact wrench back in the early '70s.

Today we are seeing this style of pump being referred to as a "twin-pipe vane pump" or "twin-stroke vane pump." General Motors uses this style pump in their new 8L90 transmission (**Figure 1**), which they call a "Binary Displacement Vane-Type Pump."

There are several advantages for using this style pump. Its compact size allows it to be positioned in an "off-axis" location. An "on-axis"-style pump is typically located in the front of the transmission. The torque converter can then be used as an input drive member of the pump. This style set-up however, extends the length of the transmission.

An off-axis pump provides the manufacturer with the freedom to locate the pump in such a way so as to save on the length of the transmission. With the 8L90, this pump is an integral part of the valve body inside the main case. When the pan is removed, the main filter inserts directly into this pump (**Figure 2**). The pump is chain driven (**Figure 3**) by the torque converter, which lugs to the pump drive gear called a Drive Sprocket (**Figure 4**). When the valve body is lifted off of the transmission, the pump can be unbolted and removed from the housing (**Figure 5**). Immediately you will discover three critical seals: a beaded pump gasket (pump cover to the valve body pump housing), a fluid passage sleeve (sits in the pump suction [bypass] circuit), and the pump seal (between the pump pressure plate and valve body pump housing).

Removing the first of two retaining rings will allow the pressure plate to slide off of the pump's drive shaft (**Figure 6**). Two locating pins are then removed (**Figure 7**) from the pump cover. Using a pencil magnet or equivalent, each of the pump vanes can be removed, followed by the pump cam (**Figures 8 and 9**).

When the second retaining ring is

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

Photos: Wayne Colonna

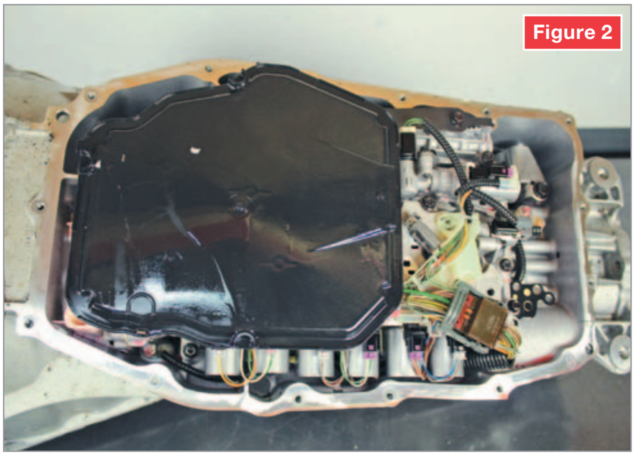


Figure 2

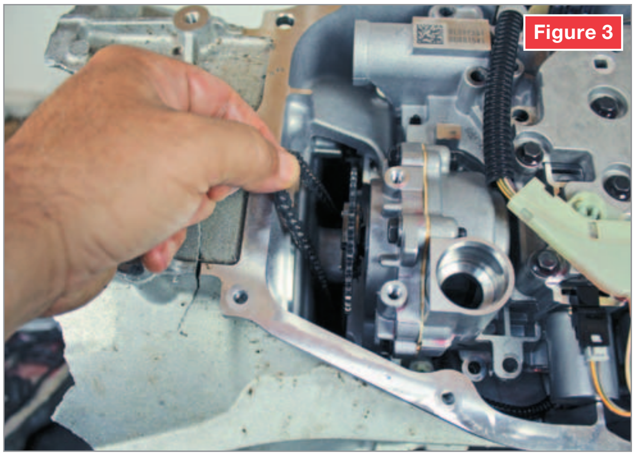


Figure 3

removed (**Figure 10**), the pump drive gear and rotor can be separated from the pump cover (**Figure 11**). What will come into view is yet another critical seal located between the pump drive shaft bearing and the pump's driven sprocket (**Figure 12**).

The pump drive shaft is locked to the driven sprocket by a sliding tension clip. Locate the clip's tab, seen below the seal in **Figure 12**. This tab needs to be lifted up and out of the slot in the driven gear and pulled forward (**Figure 13**). This will unlock the drive shaft from the driven gear to gain access to the pump cover seal for servicing (**Figure 14**).

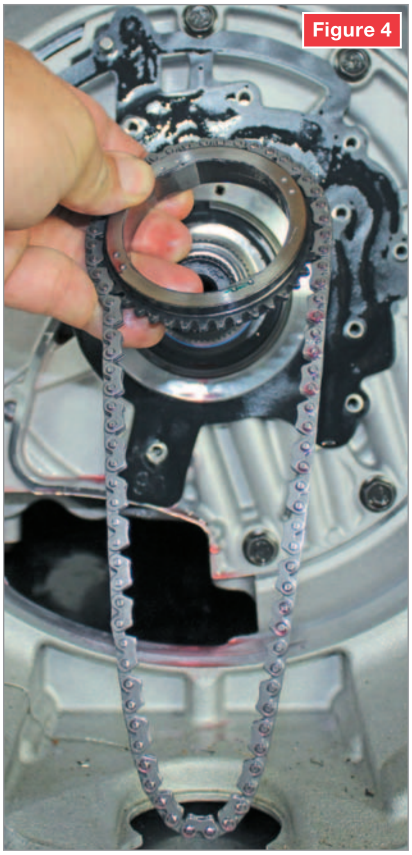


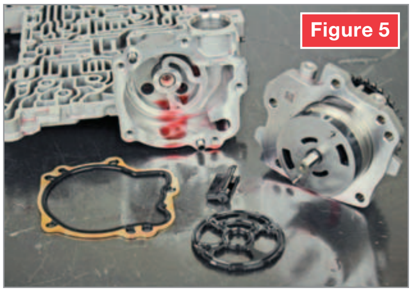
Figure 4

This is the heart of the transmission. The filter and pump assembly with all of its seals need to be right. They are critical components and if compromised, can result in costly repairs. Using substandard parts here might save some pennies upfront, but could cost many dollars later.

Besides having increased flexibility in packaging locations for this style pump, it also aids in fuel economy. This has certainly become a major issue with manufacturers due to federal regulations concerning Corporate Average Fuel Economy (CAFE) ratings they have to meet. The mandatory overall fleet in miles per gallon to be met for 2016 is 34.1. The Obama administration is now pushing the auto industry to be at 54.5 mpg by 2025.

With this news, every aspect of the car is being looked at for fuel economy. And this style of pump is just one such example. The design of the pump provides two discharge ports that it can alternately output through. Or, it can output through only one discharge port. When it alternately outputs through both discharge ports, it is in the full displacement/volumetric output of the pump. When it only outputs through one discharge port, it is in a partial displacement/volumetric output of the pump.

This means the pump can provide full or partial volumetric output on demand. Unlike the on-axis variable displacement vane pump, this binary displacement vane pump can respond faster to partial or full volumetric output. During non-peak demands and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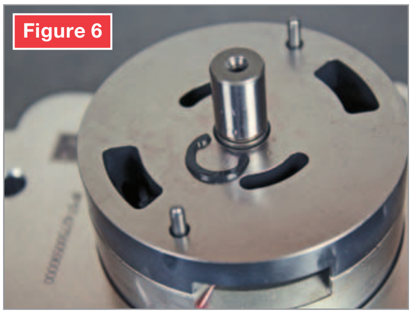
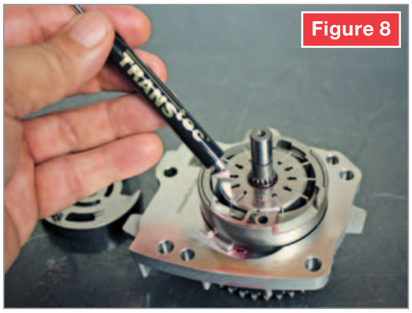


Figure 6


Figure 7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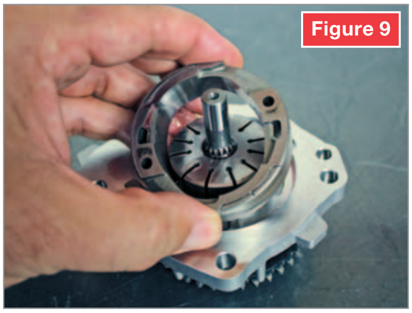
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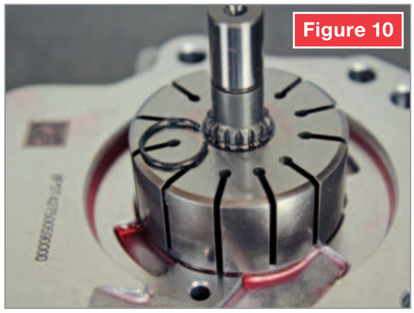


Figure 10

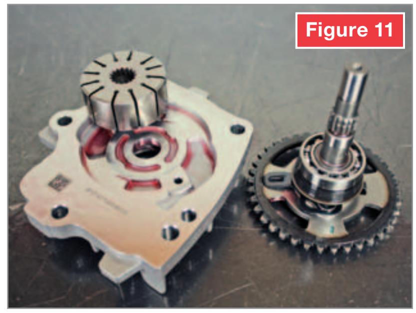


Figure 11

steady state operations, the pump can be in the partial mode, at which time there is less load on the engine, which equates to fuel economy. The pump can quickly adjust to full volumetric output when torque increase demands it so.

The variable displacement vane pump in comparison was not as fast to adjust as it had a slide to move. Additionally, the very nature of the slide also allowed for internal leakage affecting its efficiency. And as previously mentioned, the binary displacement vane pump provides a much faster response between partial and full volumetric output as its control is not within the pump itself.

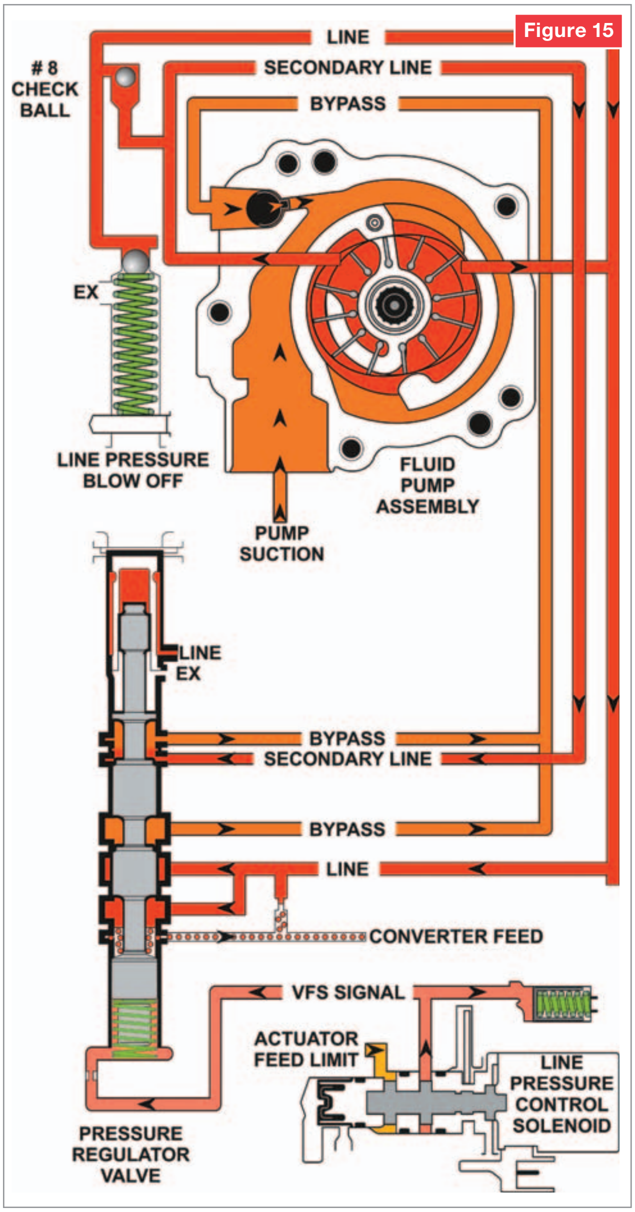


Figure 15

The binary displacement vane pump's two discharge ports in the 8L90 are referred to as "Line" and "Secondary Line." Both are routed to their own dedicated locations at the pressure regulator valve. On their way to the pressure regulator valve, these two circuits connect together through a shuttle ball (**Figure 15**). When the pressure in the secondary line circuit is low, the line circuit pushes the ball against its seat, closing this connection. But when the pressure in the secondary line becomes greater than the line circuit, the ball unseats and the two circuits are joined together. This is probably why GM calls this ball the number 8 ball, as it is in an unfavorable position. Talk about being pushed around!

So how does the line and secondary line circuit go from being two separate circuits to the secondary line supplying pressure to the main line circuit? Glad you asked, as this equates to the partial and full volumetric output operation of the pump.

The "Line" circuit is regulated at the pressure regulator valve in a typical fashion and is the main pressure supply to the transmission. It also supplies pressure to the converter feed circuit. A line pressure blow-off ball can be found in the main line pressure circuit as well.

The "Secondary Line" is connected to a pump suction circuit at the pressure regulator valve called the Bypass circuit. As torque increases, variable force signal oil from the pressure control solenoid moves the pressure regulator valve to close off the bypass circuit. As the bypass circuit (pump suction) is being closed off from the secondary line circuit, the pressure in the secondary line circuit increases. Eventually, this pressure exceeds main line pressure, pushing the number 8 ball open and joining the two circuits together.

Understanding the operational efficiency of this style of pump, stepping into the throttle is not the only way for it to go from a partial to a full volumetric output. Placing the transmission into gear is one such example. When a gear selection is made, a significant demand is placed on the pump to supply the necessary volume of fluid to load a clutch assembly. It will be the transmission range sensor's job to inform the computer of the gear engagement to initiate the pump's full volumetric output. As quickly as a command can be made for full pump output is as quickly as a command can be made to produce a partial output. Throughout a drive cycle, this pump is constantly running between full and partial output. It meets the needs of the transmission while increasing fuel economy.

With the pressure regulator valve controlling the pump's

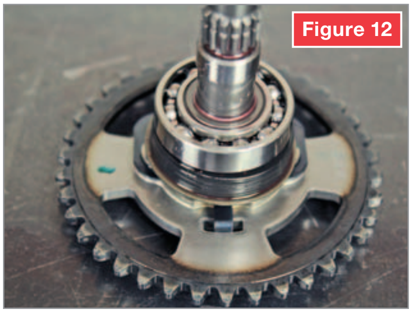


Figure 12

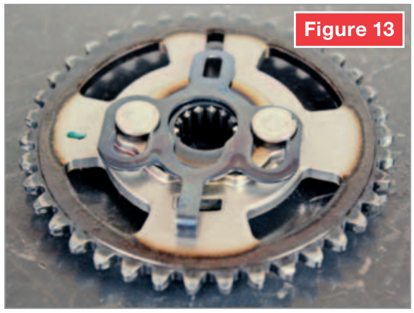


Figure 13

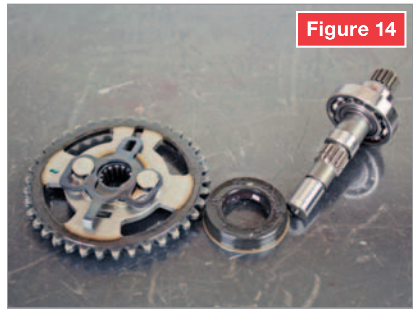
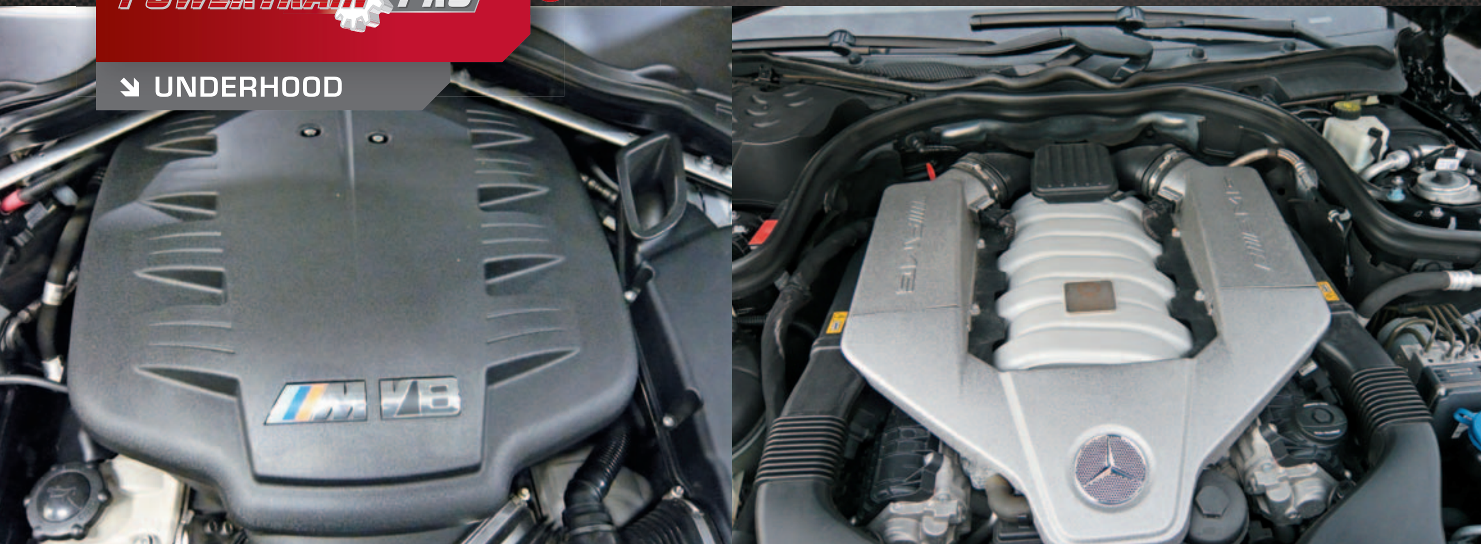


Figure 14

volumetric output, this adds to the heart of the matter. Due to the continuous demands placed on the pump to alternate between partial and full volume output, no doubt that pressure regulator valve bore wear can be a concern; especially if the wear takes place in the bypass and secondary line circuit area. When full volumetric output is called for, it will not be there. If the number 8 plastic check ball becomes compromised, it could allow the main line to dump into the secondary line circuit and get sucked up by the pump. This would not be the added fuel economy the engineers had in mind.

Thinking in terms of being a transmission cardiologist, it would be nice to schedule a stress test to ensure that everything from the filter to the pressure regulator valve is functioning well. The difficulty in scheduling such a test is that a line pressure tap is not made available with this transmission. The best that can be performed is a scan-o-cardiogram to see what the pressure control amps are doing in comparison with tap and steady-state tap cells.

This reminds me of the cardiologist who owned a 2015 Corvette that needed to have his 8L90 transmission rebuilt. The transmission was completely disassembled and cleaned with all the parts spread out. The doctor had just stopped by to see how things were progressing with his Corvette. The talented young builder brought him out to the shop to show him his transmission and said, "Look at all these parts I have to put together. I have to do it just right for it to be able to work flawlessly. In many ways we are similar. But I sure would like to get paid the same way you do." To which the cardiologist replied, "Yes, you are right; in many ways you can draw a comparison. But, if you can rebuild that transmission while it is still running in the car, then you can get paid the same way I do."



Both BMW M Series and Mercedes AMG Series vehicles boast engines that have more power than any other platform offered by either manufacturer.

BORN FROM MOTORSPORTS

A LOOK AT THE BMW M SERIES AND MERCEDES AMG

BY **MICHAEL MILLER** | CONTRIBUTING EDITOR

Like many automotive manufacturers, BMW and Mercedes have extensive racing backgrounds that yield the benefits of technological and performance advancements to their production models. However, both of these manufacturers also create a series of vehicles that share more with their race-driven brethren than that of their mass-produced counterparts. The vehicles not only boast more powerful engines, but also possess improved braking and suspension components to take full advantage of the horsepower bestowed upon them.

Considered by some to be the world's first motorcar race, the Paris–Rouen held in 1894 saw a single Benz in the field, which was driven by Émile Roger, who finished 14th. During the 1914 French Grand Prix, the DMG Mercedes 35 HP racecars took all three podium spots. BMW's first victory was on June 14, 1936 when Ernst Henne drove a BMW 328 at the Nürburgring at the vehicle's debut.

BMW M GmbH

BMW Motorsport GmbH was created in Munich in 1972 with only a small staff whose goal was to monopolize the racing world. (Something I've always wondered about was the meaning of GmbH, as it is seen after the name of several German companies. Gesellschaft mit beschrankter Haftung means limited liability, which is similar to an LLC or Limited Liability Company.)

In 1979, BMW Motorsport had its own new location within the BMW factory. The 3.0 CSL — dubbed "The Batmobile" because of its massive rear wing — was the first creation of this team. Porsche 911s were prevailing over all racing classes that had regulations, requiring the vehicles on the track to be based off its production counterpart. A retired racecar driver, Jochen Neerpasch was the competition's manager of the motorsport division of BMW at the time and created the M1. This vehicle was the first of the BMW M Series and was also the first vehicle to wear the iconic blue/purple/red M Series badge. The M1 was created in 1972,

The M Series vehicles display the iconic blue/purple/red badge displayed by the original M1.

Photos: Mercedes, BMW

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with styling by Lamborghini, but not available for purchase until six years later. Regulation changes stated that a minimum number of the racing version of the M1 needed to be sold to the general public in order for it to be entered for competition. Unveiled at the 1978 Paris Motor Show, the BMW M1 became the first M Series vehicle also available to the general public. The M1 model E26 was produced from 1978-1981; it boasted a 3.5L engine with over 273 horsepower. The total production was slightly more than 450 units. Then came the 535i, first the E12 Model from 1980-1984, then the E28 from 1985-1988. Also the M635 CSi (E24) coupe was produced from 1984-1989; this was actually the first M6. Finally the well-known M Series vehicles started to be commonplace with the first M5 (E28 from 1984-1988; E34 from 1988-1995; E39 from 1998-2003; and the E60 and E61 from 2004-2010), the M3 (E30 from 1986-1991; E36 from 1992-1999; E46 from 2000-2006; and finally the E90, E92 and E93 from 2007-2013). The M6 (E63 and E64) was produced from 2005-2010. There was

Performance enhancements go beyond the engine compartment on a BMW M Series; a total vehicle concept is used to ensure the entire vehicle is capable of handling the increased power.

A picture of the distinctive fender design of an BMW M3.

even a V-12 engine put in the M8 (E31), which was only produced in 1990. The X5 M (E70) and X6 M (E71) were added beginning in 2009. The first generation BMW M3, with its very stiff body, won more than 1,500 races in the European Touring Car Group A Championship Series. The second-generation M3 used in racing had regular BMW production components except for the tires, pistons and camshaft.

In 1980, BMW Motorsports started supplying turbocharged engines to the Brabham Formula 1 team. The 1982 Brabham BMW F1 vehicle was the first to use a digital engine management system; soon after, M Series vehicles adopted this technology. In fact, the BMW M3 and M5 engineers were responsible for creating the powertrain electronics for the 2000 BMW F1 race cars.

More recently, BMW has developed the F Series chassis with M Series vehicles.

- M2 (F87) 2015-Present
- M3 (F80) 2014-Present
- M4 (F82, F83) 2014-Present
- M5 (F10) 2012-Present
- M6 (F12, F13, F06) 2013-Present
- X5 M (F85) 2014-Present
- X6 M (F86) 2014-Present

So what's with the E and F coding of BMWs? These are chassis codes; the E stands for Entwicklung, which translates to Development. Since the E series were running out of room with the E90s platform, the next logical letter to go to was F.

How are the M Series different from other BMWs?

BMW M Series vehicles start with a basic BMW platform. However, that is where the similarities stop. More than 50 percent of the components that go into making an M Series vehicle are M specific. In fact, when it comes to an M3, more that 80 percent of the vehicle components are modified compared to a regular 3 Series BMW.

Brakes, steering and suspension system components, including anti-roll bars, are changed and some redesigned completely. One of the main focal points is weight reduction, down to the last kilogram. Engine development works hand in hand with the design group to create a vehicle that has both form and function.

The AMG name is actually the first letter of each of the two former Mercedes engineers who created the company (Aufrecht and Melcher), along with the birth place of Aufrecht, a town called Grossaspach.

Similar to BMW, Mercedes AMG creates vehicles that can also stop the massive horsepower their engine creates.

Attention to design and detail is a trademark of Mercedes AMG GmbH.

All the elements of the M Series are tested in the ultimate proving grounds — the legendary Nürburgring, located in Nürburg, Rhineland-Palatinate, Germany, and constructed between 1925 and 1927. During research about the Nürburgring, one thing that could not be determined was how many actual turns there are; different sources have stated 73, 105, 154 and up to 170.

While some manufacturers put a multitude of sensors on a vehicle to gain

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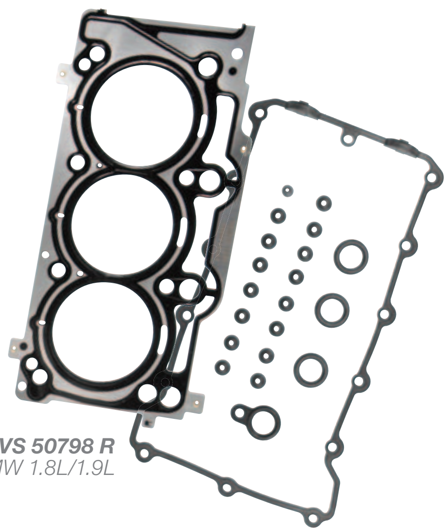

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feedback with which to make adjustments, BMW relies solely on the seat-of-the-pants experience of their test engineers with which way to proceed.

The M headquarters are in Garching, Germany, with the actual design facilities located in Munich. The prototypes are built by hand. The engines are designed and tested in Preussentrasse, Munich. This facility has eight engine test benches, six stationary test benches and two engine dynos.

The M vehicles are produced on the same production line as the rest of the series vehicles, the M3 at one facility and another for the M5 and M6. Interestingly, the carbon fiber roof is made at yet another facility, which utilizes an advanced bonding process where variables such as temperature and humidity are closely controlled. This is crucial, as the roof is a major factor in the overall stiffness of the vehicle.

The BMW X5 M and X6 M were created in 2010, however, they are not developed by the Motorsports division, but by BMW manufacturing themselves. The BMW M Series has developed a performance version of almost all series offered except the 7 Series. BMW has decided to leave the ultimate luxury platform to itself; however, they did partner with another German manufacturer to create the Alpina B7 with a Bi-Turbo V-8 engine.

The shifting selector on a Mercedes AMG C63 with a Speedshift MCT (Multi-Clutch Technology) 7-speed transmission. When in the Sport Plus and Manual modes, gear changes occur at a lightning fast 100ms between shifts.

Mercedes AMG GmbH

Mercedes AMG GmbH was founded in 1967 by two former engineers of the company — Hans Werner Aufrecht and Erhard Melcher — at a race engine development plant. Coincidentally, the first letters of their last names (Aufrecht and Melcher) along with the birthplace of Aufrecht, a town called Grossaspach or Großaspach, create the company's name — AMG. The two initially argued upon meeting at Mercedes because of a difference in temperament and different roles in the company. However, they eventually both realized they complimented each other and collaborated on an engine for the racing department. They were working on the vehicles at night, after work. Melcher covered Aufrecht's apartment in drawings of direct injection, and the two actually produced the first direct injection — the 300SE — in Aufrecht's basement.

The two set up shop in an old mill in Bergstall, Germany. In 1971, they created the 300 SEL 6.8L AMG, which finished first at the 24-hour race of Spa. AMG started getting customer requests for changes, such as exterior modifications. Aufrecht said that their customers forced them to start a company. They obliged, and soon after the 300SL 6.3 became the flagship for them, not to mention a different breed of customer.

Some notable highlights of the company:

- In 1978, AMG outgrew the factory at the old mill and moved about 12 employees to Affalterbach.
- Melcher developed a cylinder head touting four valves per cylinder in 1984. This is when AMG became an engine manufacturer.
- In 1986, AMG put a 5-liter V-8 in a Mercedes E-Class coupe; this vehicle became known as the iconic "Hammer."
- In 1988, Mercedes contracted AMG for its motorsports division and its racing version of the C Class claimed over 60 wins.
- In 1998, AMG won every race in the FIA-GT series, in six of those races they also claimed second place as well.
- A cooperation agreement between AMG and Daimler-Benz AG was signed in 1990; however, the official incorporation of the two companies did not happen until 1999.
- AMG opened a third plant in 1990 with its now 400 employees.
- In 1993, the C36 AMG is the first vehicle produced by both AMG and Mercedes; it would be available in the United States in 1995.
- In 2003, the AMG 5.5L Kompressor engine won the Engine of the Year* Award.
- In 2005 the company introduced the iconic AMG 6.3L V-8.
- In 2006, the AMG Performance Studio introduced two more series: The AMG Signature Series and the AMG Black Series.

In 1999, AMG became a majority-owned division of Mercedes-Benz. However, that is not to say that AMG has gotten away from its racing roots. In 2014, Mercedes-AMG won the Formula 1 Constructors Championship, powered by a 1.6L turbocharged V-6 with 701 points for the year. To put the margin of victory into perspective, second place went to Red Bull/Renault with 436 points — not exactly a close one.

Today, there are more than 1,100 employees at the Mercedes-AMG GmbH plant in Affalterbach, 50 of which are engine builders. All AMG engines are built completely by one

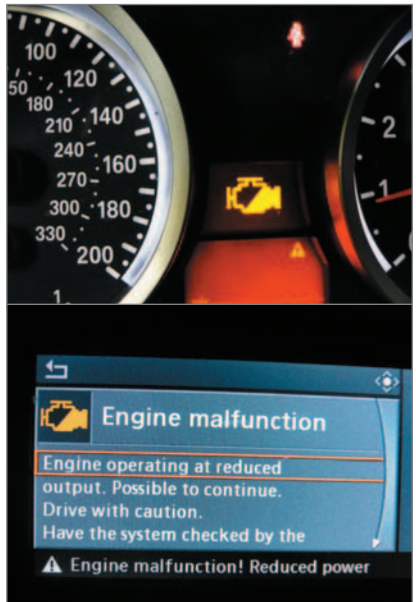

The Throttle-Valve Actuators are hidden under the air intake plenum. Each of the throttle bodies have individual air boots that need to be loosened to remove the air plenum assembly.

person, whose signature is placed on a nameplate on the top of the engine's plenum. AMG Performance Studio also offers tours where visitors can watch the engines being assembled.

Different philosophies

While both BMW and Mercedes have their respective performance divisions, there are some very distinct differences between their philosophies. Mercedes produces AMG versions of several of their vehicles, including SUVs and luxury sedan platforms, whereas BMW had traditionally created an entire vehicle that they consider capable of handling the power. In other words, the overall structure of the entire vehicle needs to be adapted. For example, even the X5 M Series had the suspension tuned with stiffer springs and bushings, modified wishbone suspension and a 10mm lower ride height. Also, until 2010, BMW M Series only used naturally aspirated engines versus the supercharging used on the Mercedes AMG Series. The BMW S65 V-8 and S85 V-10 engines used in the M Series had an astonishing output of 100 horsepower per liter naturally aspirated.

Mercedes AMG has favored automatic transmissions for their vehicles, while the BMW M Series has preferred manual or semiautomatic transmissions in theirs. The BMW X5 M and X6 M were the first M Series to be made



On a short test drive, the Reduced Engine Power light illuminated in the instrument cluster and an error message was shown in the central display area.

available with an automatic transmission to work with the all-wheel drive feature of the SUV. BMW's seven-speed SMG (Semi-Manual Gearbox) Drivelogic transmission utilizes paddle shifters on the steering wheel — similar to Formula 1 racecars — to change gears. The transmission uses a double clutch system that allows gear changes without any interruption in power flow and the Launch Control feature helps to maximize straight-line acceleration from a standstill. The transmission offers five different electronic shift programs while in automatic and another six shift programs while in manual mode for a grand total of 11 different shifting strategies. The AMG Speedshift MCT (Multi Clutch Technology) is a seven-speed semi-automatic transmission, similar to the 7G Tronic used in a majority of the Mercedes C Class vehicles, except that it does not use a torque converter. To take off from a stop it uses a compact wet startup clutch. The Multi-Clutch Technology refers to the ability to have multiple clutches and bands for each gear to support the four different operating modes. Also in the Sport Plus and Manual modes, gear changes occur at a lightning fast 100ms between shifts. The transmission also boasts a Race Start Function that when enabled, allows full acceleration potential while maintaining traction and eliminating wheel spin.

M Series diesel

While Mercedes AMG GmbH has decided against performance diesel versions, diesels have benefitted from the BMW M Series. In 2012, BMW introduced the M550dx and in 2014, the X5 M50d and X6 M50d. All of these M Series vehicles use the N57S Triple Turbo Diesel aluminum engine. It is an inline 6-cylinder common rail utilizing Bosch piezo-electric injectors outputting 381 horsepower and 740Nm of torque. The turbochargers consist of one large and two small units that are strategically utilized to deliver consistent power over a large RPM range. The smaller turbos are capable of spooling up faster to diminish any turbo-lag.

Things still go wrong with high-performance engines

Recently we had a customer bring a 2010 BMW M6 to us with a reduced power light on. This vehicle has a S85 V-10 engine for a power plant. The customer stated that when accelerating, a warning symbol came on the display similar to a check engine light but only half shaded in. The vehicle then went into a limp mode when this occurred; but after restarting, it operated normally again. A short test drive confirmed what the customer had described — the reduced power symbol appeared and the vehicle was brought inside for further diagnostics. The code retrieved was a 2B25 Throttle-Valve Monitoring Bank 1. Something unique about these engines is that they use one throttle valve actuator per bank on a setup of individual throttle bodies for each cylinder. See attached photos for a better understanding. These are definitely not easy to access, as an intake boot on each throttle body has to be removed to lift off the air plenum, so using a scan tool to perform as much fault elimination as possible before disassembly was key. After running the self-test of the throttle actuators, Bank 1 showed a failure during testing. After disassembly and checking connections at the throttle actuator, a new unit was installed and a learning calibration was performed to correct the concern. MA

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TECHNOLOGY
THE NUTS AND BOLTS OF AUTOMOTIVE REPAIR

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DRIVABILITY

BUILDING A CHAMPIONSHIP TEAM

A CONVERSATION WITH JIM OBERHOFER, VP OF KALITTA MOTORSPORTS

BY **PETE MEIER** | DIRECTOR OF TRAINING

Drag racing — that one motorsport in reach of nearly anyone who wants to compete. Just visit your local track — whether it's a quarter mile or only a short eighth-mile run — and you'll see everything from rail cars to family sedans making their way to the finish line. I've even seen 50cc minibikes used in bracket competitions that have gone on to win!

One thing the competitors all share is a passion for their sport. Isn't it part of growing into adulthood to sit at the stoplight and gun the engine in challenge to the car next to you?

It's that same passion that slowly turned this sport into a business worth billions of dollars. The names of the pioneers may be familiar to you: "Big Daddy" Don Garlits, Don "The Snake" Prudhomme, and of course, Connie "The Bounty Hunter" Kalitta.

Even now, at nearly 78 years old, Connie Kalitta still has a passion for the sport and is still active with the team he created back in 1959. Throughout nearly 60 years of involvement as driver, tuner and crew chief, Connie and his teams have amassed six world championships and more than 100 national event titles, covering five different professional sanctioning bodies. Currently, Team Kalitta is home to the 2015 National Hot Rod Association Funny Car champion, Del Worsham, pilot of the DHL-Toyota Camry car. Other teams on the Team Kalitta roster include the Tequila Patrón Toyota Camry Funny Car driven by Alexis DeJoria, the J.R. Todd piloted Sealmaster Top Fuel dragster and the Mac Tools Top Fuel car with Connie's nephew, Doug Kalitta, at the controls.

Recently, I was invited to visit the Team Kalitta Motorsports facility in Ypsilanti, Mich. to get a look behind the scenes and meet the man responsible for the day-to-day operations, Jim Oberhofer. Little did I know at the time, but the lessons and experiences Jim had to share would prove just as valuable to you in your professional careers as it does to those involved in professional racing at any level.

On-the-job training

Oberhofer is the vice president of operations for Kalitta Motorsports, or at least that's the official title on his business card. But he's more than that simple description allows for. He is responsible for the day-to-day operations and the future growth of Team Kalitta, a job he admits he relishes.

In addition to those duties, he is also the lead crew chief for the Mac Tools Top Fuel entry, where he com-

Photos: Pete Meier


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petes not only with the hottest teams in the sport, but with his mentor as well. "Connie loves drag racing," shares Oberhofer. "He's passionate about it. He's paid the ultimate price (referring to the loss of his son, Scott, in a racing accident back in 2008), but he still moves on. He's 78 years old, but he's as competitive as those half his age. For me to do battle against him at the racetrack (Connie is still head tuner for the team and crew chief for the J.R. Todd Top Fuel entry), that's a lot of fun."

"Most of the time, he usually ends up winning," Oberhofer adds with a smile.

Oberhofer's rise to the head of operations began with a passion for cars and racing he learned from his father. "My dad owned a paint and body shop on the east coast of New Jersey and later moved us to Plano, Texas, where he opened a shop there. He was also an avid drag racer, starting with Junior Fuel dragsters in the '60s and moving on to Top Fuel in the mid '70s."

Oberhofer literally grew up around the sport, following his father from track to track even when he was too young to stay in the pits. As he grew older, he learned both automotive repair and collision repair from his dad, working in his shop during the days and helping out at the track on the weekends. At that time, the drag racing community was small and tight knit, and he had the chance to meet Connie and his son, Scott — and they got to know him.

Oberhofer was offered a job with the Kalittas in 1988, where he started using his body and paint skills to repair and paint Funny Car panels and chassis. He even shared a story of painting an airplane for his boss

Jim Oberhofer takes time from his daily responsibilities as VP – Operations for Kalitta Motorsports to pose for a picture in his crew chief attire.

Another championship car in the making? This is Doug Kalitta's ride, which is still under construction.

(who also owns Kalitta Air, a successful air charter business). Reflectively, Oberhofer shares, "I really have to credit my experiences with Connie and Team Kalitta for teaching me how to work on cars, and how to run a business. But even more importantly, it's taught me how to succeed in life in general."

Consider your position in your shop. Where are you in your career path compared to the path Jim followed? If you're fortunate, you'll be working for an owner who understands what Jim learned from his mentor.

Something we can all learn from

"The one thing I had to learn better than anything: delegating. I used to think I could do everything by myself. I learned to surround myself with great people — whether it's on the teams, in the office or in the shop. We take a lot of pride in the fact that we've been able to hire a lot of great people who do a lot of great things for Kalitta Motorsports."

If you're the shop owner, consider the wisdom in those words. You can't do all the work yourself and if you try, you'll quickly burn out, and your business will ultimately suffer. Instead, learn how to recruit and keep the best people you can find, share your goals and ambitions and encourage them (by your own actions and example) to buy into that vision. Make your success their success.

If you're an experienced technician, you can still take advantage from the wisdom of Oberhofer's comments. Your own skill sets aren't going to

Imagine squeezing yourself into this tiny cockpit, with a fire-breathing, 10,000-horsepower engine sitting right behind you!

grow on their own. Oberhofer was clear that he learned much from his fellow teammates and from heeding the words of those proven successful in their individual fields. Tuning a racecar producing more than 10,000 horsepower and capable of reaching 350 miles per hour in 1,000 feet is not something you learn how to do in the classroom. And neither are the skills you need to master (continuously) to remain at the top of your game in the shop. Even a top professional tuner like Oberhofer is in awe of the technologies you face on a daily basis, and even commented on the challenges faced by the professionals in our arena in dealing with ever-evolving electronic systems. "Our cars are still using mechanical fuel injection, but soon we'll see EFI in the Pro Stock class. But even when that day comes, it will be a very basic system when compared to what you guys have to work on," he observes.

And whether you're just starting out

in the industry or you've been a shop owner for years, to reach your ultimate potential you need a goal. You can't get there if you don't know where you want to go!

"When I first came here, we ran two cars: Connie's Top Fuel dragster and Scott's Funny Car, and we had 4-5 people who made up the whole team. We used to put both cars and the tow van in one trailer and we went down the road. And we used to say to ourselves, 'Wow, this is big time!'"

When Oberhofer took over the team's operations responsibilities, the facility they called home encompassed 50,000 square feet. At the time, though, the team was only using about one third of that space and owner Connie Kalitta wanted to lease the extra space to interested outsiders.

But Oberhofer had a dream of filling that space with racecar stuff and begged Connie to hold off. Today, 29 years into his career with Team Kalitta, the facility is just that — filled with racecar stuff including their own in-house chassis building section and a CNC shop used to manufacture needed components. Going into the 2000 season (the year Oberhofer took the reins), the team had the intention of only fielding one car and had a staff of eight employees. Today, the team fields four cars and has a roster of 65 employees, including those focused on areas every business needs to survive — office staff, marketing teams, human resources professionals and more.

From sport to big business

"Back in the early days, racers like Connie would pull people out of the stands to help them work on the car. After an all-day event, they might give them a T-shirt for the help. Now we have all these people on the payroll with bonus programs, health insurance and 401Ks."

A lot has changed, and Oberhofer remembers the transition from sport to big business. "It's really cool to see the passion at the grassroots level." He describes how the old days were filled with people passionate about the sport, his mentor Connie Kalitta among them.

Going fast is important — but so is stopping.

Each team has three or more prepared short blocks on the trailer for every event.

He laments that today business needs may be supplanting the innovation that these early pioneers of the sport brought to the table. It's not that innovation is no longer possible — quite the contrary. But according to Oberhofer, the sport overall has advanced so fast that it has left some of the infrastructure behind.

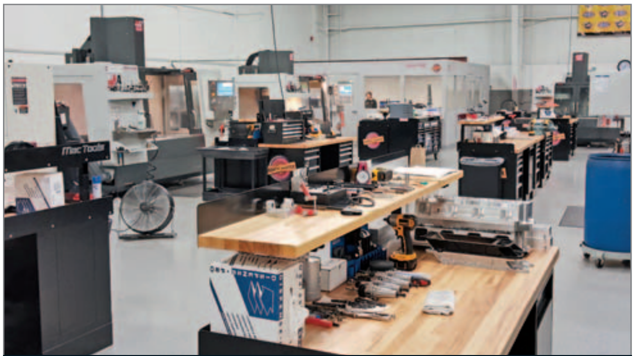
"Many of the tracks we compete at were built in the '60s or '70s, when the thought of running that fast (350+ mph) never even crossed anyone's mind. Common sense has to take over so we don't go completely crazy with what we're doing. But there's still that competition. When you roll up to that starting line, for me as a crew chief, we try to give our driver everything he or shee needs to beat that car in the other lane."

Around the mid-90s, the sport began going to a whole new level. Hospitality became important for sponsors. Drag racing especially lends itself well to sponsors who want to entertain guests, customers and VIPs. Unlike other venues like NASCAR or Indy, hospitality areas could be set up right in the pits and allow easy viewing of the crew as they worked on the cars between rounds. "People love watching the crew tear down a Top Fuel engine and put it back together in under 30 minutes," says Oberhofer. It also acts as a showcase for some sponsors' products — Mac Tools, for example. Doug Kalitta's Mac Tools team (as are all the Kalitta teams) is fully equipped with Mac Tools products for use in the shop and at the track.

The growth of the sport also includes a new TV deal Oberhofer shared with *Motor Age*. Starting in the 2016 season, NHRA will partner with Fox Sports to broadcast 17 of the Mello Yello series events live. The additional media exposure, Oberhofer hopes, will help him take the team even further than he has to date. Even with the stresses of being on the road competing and overseeing the operations of four major race teams, Oberhofer is still as in love with his work as the day he started. "I love what I do; I love coming into work every day. And I am fortunate that Connie has given me the opportunity to run this business as if it were my own." With an added chuckle, Oberhofer says, "And as I'm the first to tell Connie, I'm better with his money than I am with my own!"

One challenge that Oberhofer happened to share is one that many of you have also seen — finding new talent for his team. His solution? Partner with local vocational programs already in place to farm new talent. "Bob Lawson (another Kalitta

Yes, the team uses the tools and products they promote.



Need a part? No problem — the CNC department will make it for you.

A fairly recent addition to Team Kalitta is an in-house chassis build area. This one is being tweaked before the build begins.

professional) and I are on the advisory council for Ohio Technical College. We helped them create a curriculum to help their students who wanted a career in the racing industry, whether it was with our team, NASCAR or whatever. To date, we've hired 12 students from that program and most have been great additions to the Kalitta team."

Sound familiar? It should. We've preached for years on the need for shop owners to involve themselves in their local programs. In addition to Ohio Technical College, Oberhofer also told me of students they've recruited out of other area programs. If a major racing team like Kalitta Motorsports is looking to hire these program graduates, shouldn't you beat them to the punch? Involve yourself in your local school's Industry Advisory Council and you'll have a say in how that program is run and what curriculum is taught. And you'll have a front row seat on each new crop of students, some of whom may be just the great addition you need to propel your own business to the next level.

With the level of competition in the NHRA, every run has to start with a peak engine. That means, in part, heads are changed after every run with new ones. Clutches are also changed after every run.

Educators — you need to pay attention as well. When was the last time you got out of the classroom and into the field, introducing yourself to area shop owners and asking for their participation?

What happened to drivability?

Yes, I know, this story is taking up space in the technical side of the magazine. So to satisfy the requirement, here are some interesting factoids for you. The champion DHL Toyota Camry Funny Car has a wheelbase of 125 inches, a regulated 500 CID engine producing 9,000-9,500 horsepower burning an also-regulated mixture of 90 percent nitromethane and 10 percent ethanol. Its best run, to Oberhofer's best recollection, was a short-lived record time of 3.89 seconds and 327 miles per hour.

The Top Fuel cars campaigned by Team Kalitta have a 300-inch wheelbase and produce more power — 10,000 to 10,500 horsepower. This is possible by using a different ignition curve and blower overdrive rate, and they can get away with it because the engine is mounted over the rear wheels, improving traction.

"You can be more aggressive tuning a Top Fuel car, but the driver has to have more finesse," says Oberhofer. "The opposite is true of the Funny Cars. You have to tune with finesse but drive it like an animal. Trying to tune like an animal and drive like an animal (in either class) will cause you to lose races."

So much for the tech side.

I'd offer this in way of explanation of why I thought this story would be important to you, our readers.

The champion's DHL Toyota Camry Funny Car body will have a large "#1" added before the start of the 2016 season.

Drivability is all about correcting conditions that keep the vehicle from running as best as it can. The lessons Oberhofer had to share go a long way in helping you, no matter your current role in the industry, to correct those conditions that are keeping you from "running" as best as you can. And if even just one lesson shared here adds to your success and future well being, then our ultimate motive of helping you succeed in a tough business will have still been met.

Like our cover says, "Advancing the automotive professional since 1899!" See you at the finish line.

PETE MEIER
DIRECTOR OF TRAINING

Pete Meier is an ASE certified Master Technician and sponsoring member of iATN. He has over 35 years practical experience as a technician and educator, covering a wide variety of makes and models. His primary goal is to bring working techs the information they need.

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HYBRIDIZATION FOR IMPROVED PERFORMANCE

Toyota 2015 F1 Hybrid

HYBRID TECHNOLOGY CAN ACTUALLY MAKE A VEHICLE FASTER

BY **JEFF MINTER** | CONTRIBUTING EDITOR

Since 1999 when hybrid vehicles were introduced in the United States, they have gotten a bad name in terms of their performance. These vehicles have typically been recognized for their ability to get better-than-average fuel economy, but many automotive enthusiasts consider them to be slow and underperforming. In fact, many see them as having been designed solely for environmentalists who are only interested in saving fuel. Given the reputation these vehicles have developed, would you believe that hybrid technology actually has the ability to increase the rate of acceleration? Would you believe that this technology has been used in F1 race cars for going on seven years? This article will focus on the following:

- Why hybrids on the road are typically driven slowly
- Why hybrid vehicle technology can actually increase the rate of acceleration
- How hybrid technology is being implemented into race cars

So, why do people drive hybrid vehicles so slowly? These vehicles are driven slowly so consistently that most people assume it's because the vehicles are incapable of accelerating quickly. The reality, however, is that the vehicles are actually coaching drivers to accelerate slowly, not that the vehicles are incapable of going fast. This driver coaching is designed to help the driver achieve the advertised fuel economy. The coach in this case comes in many different formats, but they all have one thing in common. The commonality is the fact that they somehow "reward" the driver for operating the vehicle in a fuel-efficient (slow) manner. One example of this coaching was on the Ford Fusion hybrid. Ford chose to display an image of a digital plant in the dash display. The more efficiently the driver operated the vehicle, the more leaves the digital plant grew. I tend to think of these driver coaching systems as a type of video game. As with most video games, they are designed to draw the drivers in and subconsciously get them to play the fuel economy game.

What a Prius and a Quattro E share

You may still be reluctant to believe that hybrid technology has the ability to increase vehicle performance, so let's take a closer look. To begin, let's look at the performance limitations of traditional internal combustion engines (ICE). We all know that a traditional ICE doesn't create maximum torque immediately when the accelerator

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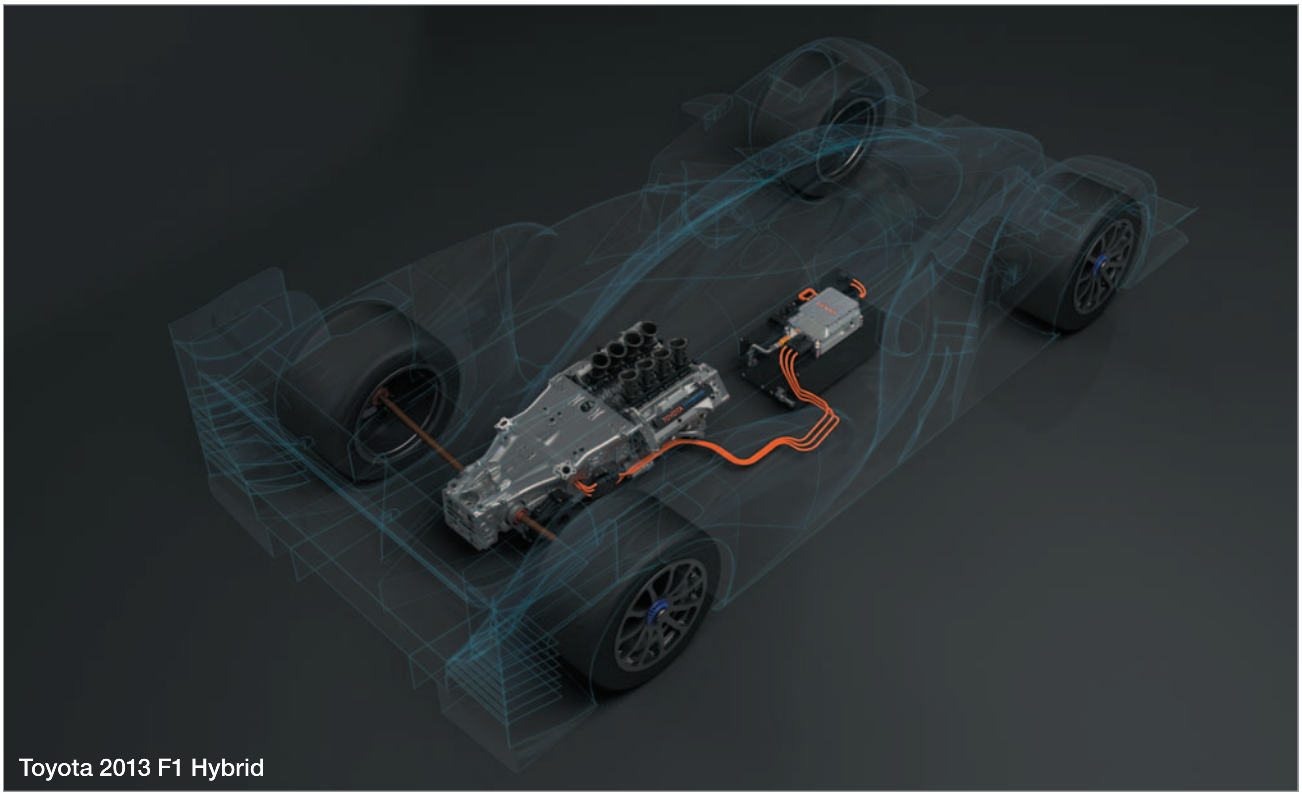
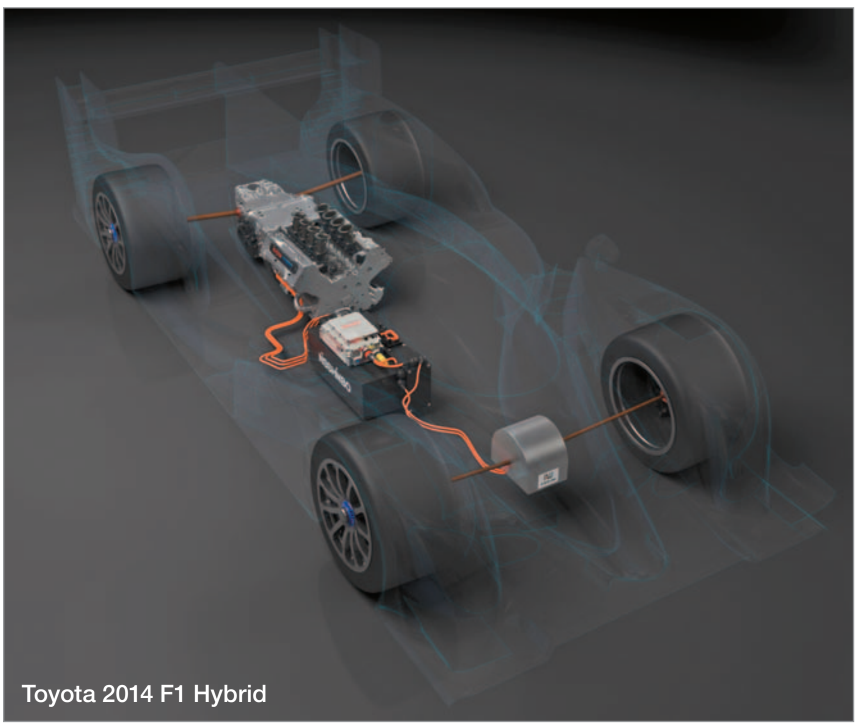

Toyota 2013 F1 Hybrid

pedal is depressed. In fact, for most vehicles there is a significant delay while the engine speed increases to a peak performance RPM. We refer to this ramp up of power as the engine's torque curve. For an ICE, this torque curve looks somewhat like a mountain where in that it starts low, slowly builds up to a peak, and then drops back off. So how can hybrid technology improve this? The key to this performance puzzle is the electric drive system in a hybrid. Electric motors perform much differently than an ICE in terms of the torque curve. Much like an ICE, the torque curve of an electric motor is dependent on the overall design. The difference, however, is that, in general terms, electric motors produce high levels of torque beginning immediately from 0 RPM. In fact, for most electric motors used in hybrid vehicles, the torque available starting at 0 RPM will be near the maximum possible torque the motor can produce.

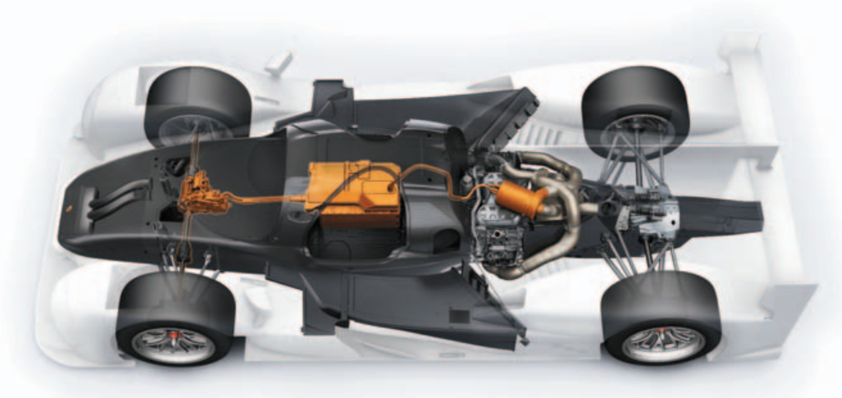
These unique electric motor torque characteristics can be used to supplement an ICE. When a driver of a hybrid vehicle requests maximum acceleration (wide-open throttle acceleration) the vehicle controllers begin a blending of power. The typical sequence will involve the engine controller beginning to ramp up the ICE torque. As previously mentioned, it will take some time for the ICE to reach peak torque output. To improve acceleration during this ramp up of the ICE, the controllers will be commanding additional torque from the electric drive system of the hybrid. Because the electric motors begin producing torque almost instantaneously, the vehicle will have improved acceleration. Of course, there are limitations to all systems. The electric drive system can't sustain long-term acceleration due to the limited power available (dictated by battery storage capacity). In an ideal situation, however, the ICE will have reached its maximum torque production range before the electric drive system runs out of power.

Because of this ability to increase the rate of acceleration, hybrid technology has been slowly making its way into performance applications. Current examples of this trend include the Acura NSX, Porsche Panamera hybrid, Porsche Cayenne hybrid and the Ferrari LaFerrari. All four of those vehicles are using hybrid technology, and it definitely isn't just to improve fuel economy. Because the Porsche models have both hybrid and non-hybrid versions, they provide the opportunity for an apples-to-apples performance comparison. The Porsche Panamera hybrid, for instance, has a 0-60 mph time of 5.2s. That is .8 seconds faster than the base model Panamera S. The performance


Toyota 2014 F1 Hybrid

difference is even more pronounced in the Porsche Cayenne. The hybrid version of that vehicle has a 0-60 mph time of 5.4s, while both the base model and the diesel versions of the Cayenne have much slower 0-60 mph times of 7.3s and 7.2s, respectively.

The performance applications for hybrid technology, however, don't stop with consumer vehicles. Race teams have been implementing hybrid technology for several years, and the latest versions of these systems are using some unique applications of this technology to improve performance beyond what is being done in the consumer market. Formula 1 (F1) racing is a perfect example of this.


2015 Porsche 919 Hybrid Power Systems Cutaway

Performance proven

I'm not an F1 expert by any means, so this article will not go into detail on the rules and regulations that have been put into place specific to hybrid vehicle technology. If you'd like to get details on those, I'd recommend visiting the F1 website (www.formula1.com) or searching the internet for "F1 ERS rules." Instead, I'll focus on the types of hybrid technology that have been used in the F1 cars and how that has transitioned over the years.

Hybrid technology made its initial appearance in the F1 cars as something known as KERS. This began as an option during the 2009 race year, and then became mandatory in all F1 cars for 2010. KERS is an acronym that stands for Kinetic Energy Recovery System. While KERS wasn't required to be an electric drive system, most of the F1 teams chose to go that route. In fact, many of the teams utilized a system from the same supplier (Magneti Marelli). The initial KERS system was relatively simple in concept. It involved an energy storage system (typically a lithium-based battery or a capacitor setup) and an electric drive system. The electric drive system contained a motor/generator, an inverter and the required controllers. These components are all very similar in function to those used in consumer hybrid vehicles.

In the F1 KERS, the motor/generator assembly was connected to the driveshaft. During braking events, the KERS unit was able to serve as a generator. Kinetic energy from the vehicle was transferred through the drivetrain to the motor/generator. The transferred energy caused the motor/generator's rotor to spin, which created electricity. This same concept is used in consumer vehicles and is known as regenerative braking. There are two major gains in using this method to slow the vehicle down. First, rather than wasting the kinetic energy by turning it into heat (as traditional friction brakes do), it allows a portion of that energy to be captured for later use. Second, because not as much heat is being generated during braking, the brakes don't get as hot.

During acceleration events, the KERS unit was able to serve as a motor. Energy that had been stored during a braking event could be used to power the electric motor, which would work along with the ICE to accelerate the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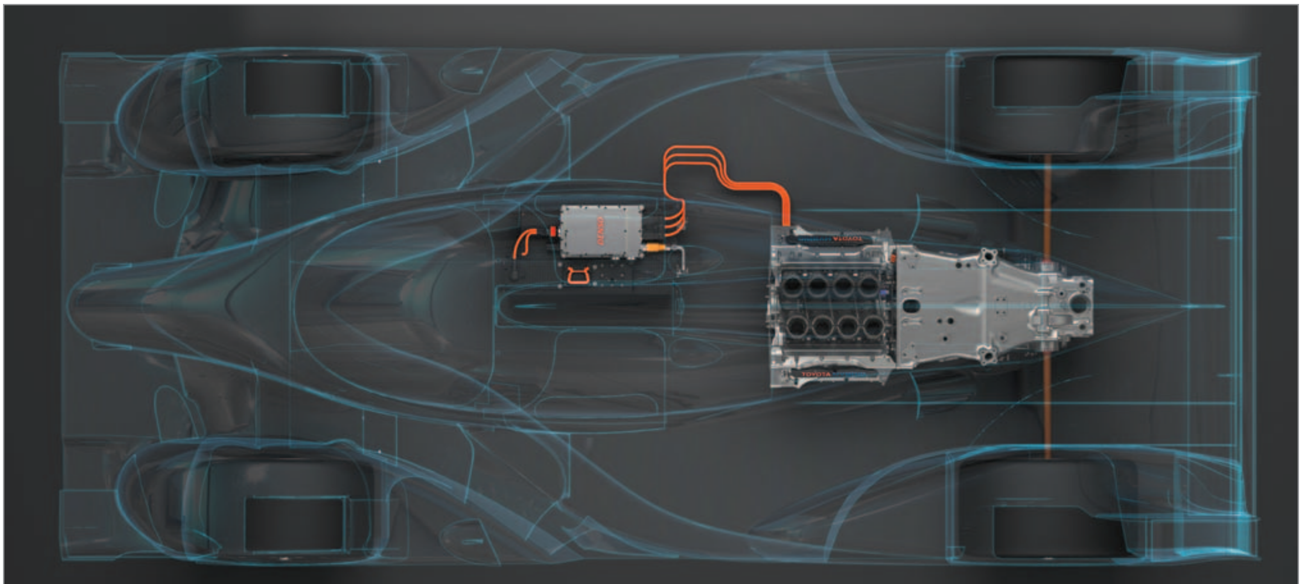

Toyota 2013 F1 Hybrid top view

vehicle. While the controls of this system were obviously fairly complicated, the overall design was pretty straight forward. A form of this KERS system continued to be used in F1 through the 2013 race year.

For the 2014 race season, F1 cars were required to make changes to the KERS system. In fact, for 2014 the name of the system changed to ERS (Energy Recovery System). The "K" was dropped because the system no longer focused just on recovering kinetic energy. The new ERS system was designed to capture both kinetic and heat energy from the vehicle. As you likely already know, internal combustion engines are very inefficient because a large percentage of the energy from the fuel they burn is wasted as heat. One way to help recover some of that lost heat energy is through the use of a turbo charger. The ERS system was designed to further improve the recapture of that lost heat energy beyond what a turbo charger can do by itself.

The ERS utilizes two motor/generator assemblies instead of the single one that was used in the KERS. One motor/generator assembly called the MGU-K (Motor/Generator Unit-Kinetic) serves a similar purpose to the previous KERS. The MGU-K is used to capture kinetic energy from the vehicle, store it in an energy storage system (typically a battery, capacitor or a combination of the two), and deliver additional torque to the wheels when needed.

The real improvement in the ERS design revolves around the addition of the MGU-H (Motor/Generator Unit-Heat). The MGU-H is used to capture heat energy from the exhaust in the form of electricity. That electricity can be used to power the MGU-K to provide additional torque to the wheels, or it can be stored in the energy storage system for later use. To be able to capture the heat energy from the exhaust, MGU-H in the F1 system is connected


2015 Porsche 919 Hybrid Systems Rendering

directly to the turbo. When the MGU-H rotor is spun by the turbo, it serves as an electrical generator.

However, MGU-H goes one step further than just serving as a generator. In fact, it is actually capable of improving the efficiency of the turbo. As you likely know, turbo-charged systems have limitations. Because a turbo charger is driven by the engine exhaust, there are times when it doesn't produce enough air volume to achieve the ideal intake pressure, and times when it produces too much air volume. When aggressive acceleration is requested from a low RPM, a turbo charger typically can't produce the desired volume immediately. This "turbo lag" is due to the time it takes for the exhaust gases to spool up the turbo after the accelerator pedal has been depressed. Turbo lag is one form of efficiency loss in turbo-charged engines. During high RPM operation with the engine under high load, the turbo charger has the ability to produce more volume than is necessary. The excessive air volume from the turbo can cause intake pressures that exceed acceptable limits, which could cause engine damage. To prevent the potential for an overpressure condition in the intake, traditional turbo charger applications are fitted with a waste gate. The waste gate is used to discharge the excessive pressure, which prevents engine damage, but also results in wasted energy.

In the F1 ERS, the MGU-H can help reduce both of these losses. First, because the MGU-H is connected directly to the turbo, it can be used as a motor to increase turbo speed. Stored electricity is delivered to MGU-H allowing it to accelerate the turbo speed much faster than exhaust gases alone could. This helps reduce, or possibly even eliminate, "turbo lag." When the turbo charger is producing more volume than the engine requires, the MGU-H can be utilized as a generator. This prevents the need to bleed off excess pressure through a waste gate, and instead provides electrical energy that can be utilized immediately by MGU-K or stored for later use. Think of this as regenerative braking for the turbo where the braking effect is applied at just the right amount to maximize turbo efficiency.

The changes seen in F1 over the last several years are not unique. In fact, the governing body for the annual 24 hours of Le Mans race issued new rules in 2014 related to vehicle design. Those rules included the requirement for all factory teams competing in the premiere Le Mans Prototype 1 category to utilize a hybrid-electric drive system. So while I don't expect we'll be seeing hybrid-electric technology in a NASCAR race any time soon (at least not beyond the pace car), these applications prove that hybrid vehicles don't have to be slow. MA

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

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INDUSTRY LEADERS SHARE THEIR TIPS

STAYING CURRENT IS EASIER WHEN TOP AFTERMARKET COMPANIES OFFER THEIR EXPERTISE

BY **PETE MEIER** |
DIRECTOR OF TRAINING

Tech tips come from a variety of sources, and some are certainly better than others. And as the technical editor for the magazine, I get them fairly often. Recently, my friends at Bosch sent me one regarding the increasing problem of carbon build-up in Gasoline Direct Injection (GDI) engines that I knew I had to share. So, with all due credit to Stephen Albert, Product Manager – Port Fuel and Gasoline Direct Injection Systems for Robert Bosch, LLC, here it is!

Addressing carbon buildup in GDI-equipped vehicles

Driven by strict emission laws and a growing demand for low fuel consumption, an increasing number of vehicles equipped with gasoline direct injection systems (GDI) are now being seen on roads today. However, a common complaint about these vehicles has been the buildup of carbon deposits inside the cylinder head.


GDI engines typically build carbon on the back of the intake valve and along the intake runner.

What causes carbon deposits in GDI-equipped vehicles?

The cause of carbon buildup can vary by vehicle make, as engine management systems can mitigate the carbon buildup in certain vehicles by something as simple as an ECU update. Essentially, carbon buildup occurs from a combination of low quality fuel, short, frequent cold-weather trips or positive crank case ventilation, which may leave an oily layer around the intake valve. These factors, in conjunction with the operating temperatures of the engine casing, lead to a buildup of carbon deposits.

Timing may also have an effect if the intake valve stays open long enough to be exposed to unburned fuel. Finally, the location of the GDI injectors in the cylinder head plays a significant role in carbon buildup because it does not allow for the fuel sprays to reach the back of the intake valve, making it difficult to keep the intake runners and valve clean.

What is the impact of carbon buildup on drivability, performance, emissions and fuel economy?

With regard to drivability, one of the more common symptoms is a lack of power, especially when driving at higher speeds. Other symptoms could include cold stalling and cold-start difficulties, including rough running when the engine is cold. There is also the possibility of a failed NOX emissions test and/or excessive ping on acceleration.

In some cases, carbon buildup may cause one or more cylinder misfire codes (P030X), which will result in fuel inefficiency and poor performance. This occurs when an insufficient number of cylinders fire while the vehicle is in operation.

If the presence of carbon deposits is not detected early enough or the buildup is severe, the check engine light may turn on and the vehicle is likely to fail inspection.

How is soft carbon different from hard carbon? How long does it take for soft carbon to turn into hard carbon?

Soft carbon is sooty and more easily dissolved than hard carbon and can be remedied with additives, while hard carbon is baked on and is more labor intensive to address. Hard carbon requires manual cleaning such as media blasting.

How long it will take the soft carbon to turn to hard carbon will depend on the motorist's driving habits and the initial cause of the buildup.

What steps can technicians take to remove soft carbon and/or hard carbon?

Soft carbon can be addressed by following the manufacturer's preventative maintenance schedule along with a fuel additive that may be added to the vehicle's fuel system before warm up. The technician can also utilize a fogger system via the throttle body. The fogger is connected to a pressurized dispenser filled with a chemical blend formulated to dissolve baked-on carbon deposits from the valves and passageways.

Photos: Bosch

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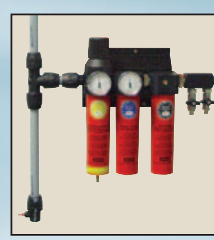

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Increasingly popular as a way to boost fuel economy, GDI places the injector directly in the combustion chamber.

For hard carbon, the process is more involved. The most common procedures call for removing the intake manifold to expose the head's ports, and rotating the engine by hand in its normal direction of rotation so that the intake valves for one of the cylinders are completely closed, then utilizing some form of media blasting.

Can checking certain components when a car comes in for service help to avoid carbon buildup? For example, the high pressure fuel pump, pressure sensor, etc?

Checking spark plugs is a great way to start because it may help to reduce the amount of unburned fuel in the combustion chamber. Follow the regular maintenance schedule. Look for telltale signs for product failure such as the check engine light and poor vehicle performance.

Also, oil changes are extremely important. Customers should always use the manufacturer's specified oil to prolong the life of GDI components, such as the high-pressure fuel pump. If the wrong oil is used or the vehicle does not follow the manufacturer's recommended oil change intervals, it may result in the failure of the high-pressure pump or of other GDI components.

What should technicians do to prepare to service and repair GDI systems?

Technicians should educate themselves on the vehicle manufacturer's maintenance schedule to ensure prolonged life of GDI system components. They should especially learn to identify system failure symptoms so they can be proactive in sharing the information with their customer when servicing these vehicles. Learning about the tools needed to service these vehicles is also important. At the end of the day, technicians are savvy and will build on the principles they already know. By doing so, they will simplify their approach to servicing a complex system.

Should a technician educate customers on the nature of the GDI system and guide them in taking the right steps to avoid buildup of carbon deposits?

Yes, I would highly recommend that technicians share the knowledge with their customers that bring in GDI-equipped vehicles for service. Technicians can advise them to follow the manufacturer's schedule for service, and take a few proactive measures to have their vehicle inspected between services. GDI is a great technology and if serviced properly is nothing to be intimidated by, as a consumer or as a technician. In fact, techs can help their customers enjoy driving a GDI-equipped vehicle.

For information on GDI, visit: http://www.boschautoparts.com/auto/fuel-injectors/gasoline-direct-injection.

Safety first!

GDI is not a new idea. It was first tried in 1925. As its name implies, GDI differs from multiport injection in several substantial ways. First, and most noticeable, is the placement of the fuel injector directly into the combustion chamber.

Clayton Lindgren, product manager and technical specialist for Bosch Engine Systems, explains it this way: "The main differences comparing port fuel injection to gasoline direct injection are with respect to system pressure, injector location, injector timing and fuel spray. Port injectors are exclusively coil driven and utilize a system pressure of 300 to 500 kPa (kilopascals, or roughly 40 to 75 psi for us non-engineer types). They are located in the intake runner."

"In the time domain, there is a single injection event. Their spray pattern is conical and always targets the intake valve(s)," Lindgren adds. "On the other hand, GDI injectors may be coil or piezo driven. These injectors have system pressures of 1-20 MPa (Megapascals, approximately 150-3000 psi). The higher pressure increases mass flow and creates a finer fuel mist, both of which contribute to the trend of engine downsizing while retaining power output."

That kind of pressure can seriously hurt you if you don't follow some safety guidelines. When troubleshooting, servicing or repairing GDI components, keep these tips in mind.

- Always allow the engine to cool before servicing a GDI fuel system.
- Always read and follow the OE specific service precautions and recommendations.
- Always disconnect the negative battery cable prior to performing fuel system service. Some GDI-equipped vehicles cycle the in-tank fuel pump to cool down even when the vehicle is off and the key is out of the ignition. This strategy is used to maintain a minimum fuel pressure to assure acceptable start times.
- Always follow the manufacturer's recommendations regarding the reuse or replacement of high pressure fuel lines.
- Always replace the fuel injector O-rings and tip seals after an injector has been removed. Be sure to install the O-ring and back-up ring in the proper locations (back-up ring below O-ring).
- Use a torque wrench to tighten all fuel fittings to the values in the service manual.
- When evaluating fuel system pressure, use the output from the fuel pressure sensor on the fuel rail as instructed in the service information. Do not attempt to add a fuel pressure gauge to the high pressure side of the fuel system. MA

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Pete Meier is an ASE certified Master Technician and sponsoring member of iATN. He has over 35 years practical experience as a technician and educator, covering a wide variety of makes and models. His primary goal is to bring working techs the information they need.

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RADAR LOVE

TODAY'S ANTI-COLLISION TECHNOLOGIES POSE NEW SERVICE CHALLENGES TO YOUR SHOP

BY **JOHN ANELLO** | CONTRIBUTING EDITOR

I was called to a shop on a 2014 Jeep Grand Cherokee with a 5.7L with only 15,000 miles on it. The shop's concern was with a warning message on the dash that read "Front Radar Sensor Plant Mode." The vehicle was recently involved in a front-end collision and had minor damage to the front bumper fascia. In addition to repairing the cosmetic damage, the shop had also replaced an electronic component located in the lower bumper fascia — the Adaptive Cruise Control Module assembly, which has a radar-sensing device on the surface of the module housing.

This device was not plug and play and required a special procedure to set it up.

I took on this problem knowing the learning curve would be worth the challenge. There are so many operating systems on cars today, and they are constantly evolving to a point where it is almost impossible to learn every system on every year, make and model in the automotive industry. I find the best way is to build a good foundation on how computer systems work and then crash course new systems as they come your way. These systems are all going to need proper power and ground feeds and then feed out reference grounds and reference voltages. There will also be sensors that will help these systems acquire the data needed so their control modules can command their internal driver circuits to perform certain output tasks. This is all dependent upon the strategies that are written into these control modules. There are many resources available within subscribed information systems that will help give you the necessary diagrams, system operation, parts location and functional procedures to tackle these new systems.

The radar systems used on cars today may be either short-range or long-range operation. The short-range systems are generally used for simple tasks such as blind-spot or rear cross-traffic monitoring. The long-range systems are mostly utilized for cruise control systems that may or may not be combined with collision avoidance technology. Once these systems are disturbed or replaced, there will be a need to program and/or calibrate them. This may require special target boards or tools to realign the radar sensors followed by a specific driving routine to

NOT ON CRUISE

2014 JEEP GRAND CHEROKEE
Vehicle Year/Make/Model

15,000
Mileage

5.7 LITER V8
Engine

AUTOMATIC
Transmission

CRUISE CONTROL INOPERATIVE
Complaint

This 2014 Jeep Grand Cherokee has 15,000 miles, a 5.7 liter V8 engine and an automatic transmission.

Photos: John Anello

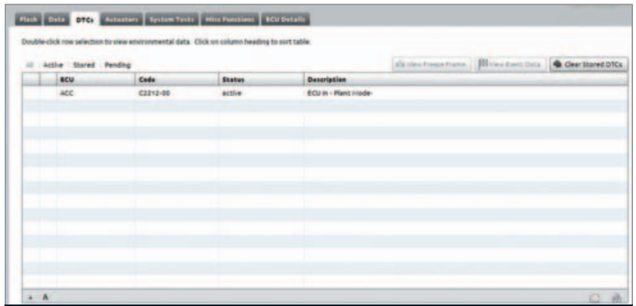

A minor fender bender took out this expensive radar module, and installing it is only half of the job.

fine tune sensor calibration.

When I started the vehicle, I did note the warning message on the dash that said "Front Radar Sensor Plant Mode." I placed the Chrysler WiTech factory scan tool on the vehicle to see if the new Active Cruise Control module was loaded with the latest software because there are many times where a new module may only be loaded with shelf software and not necessarily have the newest update available. I selected the DTC tab and found an active code C2212-00 for "ECU in Plant Mode," and as the code description implied, it is the mode the module is defaulted to during the build process. This code required a special adjustment and calibration procedure to be followed in order to take the module out of plant mode. These procedures may not always be in the factory scan tool and there are many times the scan tool may refer you to a specific document that may be nowhere to be found in your information system. Lucky for me Jeep decided to have this procedure outlined step by step in the "Miscellaneous Functions" menu.

When I selected the Active Cruise Control aim procedure, it specified the procedure would check the horizontal aim of the sensor. It was recommended to first set the vertical adjustment of the sensor with a bubble gauge tool (#10243, sold by Miller Tools). I did not have this tool, and I just couldn't wing the adjustment by eye. Now came the decision we all have to make in our ever-changing business: Do I purchase the $300 tool so I won't lose the job to the dealer? Will I get more of these particular jobs to make the purchase an investment? At this point I needed to get a start into the radar business and it may require many more tools to stay in the game. It's the love and passion I have for this business that keeps me going, and I just can't pass on learning something new. I am willing to invest my time and money because it will only benefit me down the road by helping keep me in the automotive game. I'm

This warning message is telling me that the forward radar needs to be initialized and calibrated. But how?


The DTC stored in the Adaptive Cruise Control module confirmed the need for calibration.

sure there will be many more radar system calls I will have to answer, and I better be prepared to tackle them. So I put the job on hold and ordered the tool from Chrysler.

Within four days I received my new tool to add to my diagnostic arsenal. It was basically a bubble gauge that had a suction cup on the end of it to secure the tool to the eyeball of the radar-sensing device, and it came with a female Torx tool to adjust the two radar housing adjustment screws. I first made sure that the vehicle was on level ground and that the tires were all properly inflated to factory specifications. Then I placed the tool on the radar sensor housing and turned the lower left vertical adjustment screw until the bubble in the gauge was centered. Once this was done, I was now ready to drive the vehicle to perform the auto alignment procedure, which checks the horizontal position of the sensor.

This drive procedure required the use of the scan tool and a specific criteria list of driving conditions. You needed to find a straight roadway where you could maintain a vehicle speed between 42-77 MPH without aggressively accelerating and braking. The steering wheel had to be kept centered without moving it, and you had to avoid a bend in the road. The scan tool would count percentage from 1-100, but each time the conditions are not met, the scan tool will delay percentage count. The radar sensor is searching for environmental objects so you can't drive too close to the car in front of you. You must maintain a minimum of five car lengths of space or you will blind the sensor from seeing roadside objects. It is recommended to stay in the outer lanes so the sensor can see common roadside objects such as guardrails, telephone poles and signs.

The only problem I have with this procedure is that living in the most densely populated state in the country (New Jersey), it becomes very challenging. You are not going to do this during rush hour or even during bad

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We all know about the special tools we need to do our job. Here's another $300 investment I got to make in my business. Hope it pays off!

weather. You need to pick the right window of opportunity or you will be cut off by another vehicle who tries to get in front of you or even pushed off the road by an aggressive driver. If you are smart enough, you may want to put your hazards on to allow you to drive out of harm's way.

So I chose to run this vehicle midday on a long stretch of our Garden State Parkway in the right lane. I had the owner of the vehicle come with me to drive the vehicle while I watched the driving conditions on the laptop. This type of job is a two-person procedure because you don't want to be glancing at a screen while driving, putting yourself in danger of getting into an accident. As the car was driven, the scan tool was counting down the percentage in a non-time-based procedure that would only advance as the radar unit was seeing the correct roadside objects. After driving almost 25 minutes and going through a few tolls, the scan tool finally finished to the count of 100 percent.

A message came up on the scan tool stating that the auto alignment procedure successfully completed and the radar unit was no longer in "Plant Mode." As I read the message further, it stated that the auto alignment procedure had determined that the radar sensor was horizontally misaligned and was in need of adjustment. There was now a new code — C14A4-00 — stored for "Sensor Adjustment Required." The scan tool instructed us to park the vehicle and go out in front of the vehicle facing the sensor housing. I was to turn the upper right hand Torx screw with the tool I left back at the shop. The owner of the car was NOT a happy camper. I apologized for the circumstances and explained to her that I was crash coursing this procedure and did not expect what was next to come. I told her that I was learning as I went and that the next one would be easier to do.

So now I had to drive all the way back to the shop to get this special female Torx tool. The scan tool specifically instructed me to turn the upper right-hand horizontal adjustment screw 3 1/4 turns counter clockwise. This would be followed by another auto alignment drive procedure, so it was back on the road again with a not-so-happy customer. I did not mention to her that the scan tool indicated additional screw adjustments may be needed if the horizontal alignment was still off. My hope was that this would be my last trip down the road.

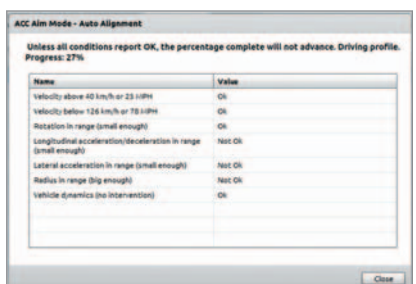
As we continued to drive, the scan tool was counting up percentage as usual. Finally it reached its 100 percent count, and to my surprise the second road trip did the job. The scan tool stated that the sensor was now horizontally correct. The vehicle owner was pleased to have her cruise control now working properly, but she wanted to be compensated for her gas

During the vertical calibration procedure, this tool levels the radar head to the surface.

and all the tolls she had to drive through. The owner of the shop reached into his pocket and compensated her for financial loss in tolls and gas. In business, it's all about customer satisfaction, and we all want happy customers and return business, so I applaud the shop owner for keeping the customer happy.

I made an investment in a new tool, and I also spent probably about 4-5 hours researching and working on this vehicle to learn about this radar cruise control system. I am sure there are many similar radar cruise control systems on other makes and models in the auto industry. I am also sure they may all have their own specific calibrating tool or procedure, so the learning curve is endless. What you learn on one system may not necessarily apply to another vehicle and these systems will become more common as we move closer to the autonomous vehicle of the future, which relies on radar systems. These long-range systems will be working in conjunction with collision avoidance systems that will network with onboard control modules such as ABS to stop the vehicle prior to a collision when not being used for cruise control.

There are also short-range radar systems that aid in detecting close encounters with vehicles in your blind spot or from cross traffic behind your vehicle while backing up. These systems will require programming or calibrating as well once a vehicle is involved in an accident. It is critical to make sure the body of the vehicle or the radar bracket is restored to original specification or the radar unit will never sit properly. This could cause a problem with the radar system not calibrating properly.


ACC Aim Mode - Auto Alignment

Unless all conditions report OK, the percentage complete will not advance. Driving profile.
Progress: 27%

Name	Value
Velocity above 40 km/h or 25 MPH	Ok
Velocity below 126 km/h or 78 MPH	Ok
Rotation in range (small enough)	Ok
Longitudinal acceleration/deceleration in range (small enough)	Not Ok
Lateral acceleration in range (small enough)	Not Ok
Radius in range (big enough)	Not Ok
Vehicle dynamics (no intervention)	Ok

Close

With one axis taken care of, it's time to take care of the other. And that means taking the car out for a drive while meeting very specific conditions.

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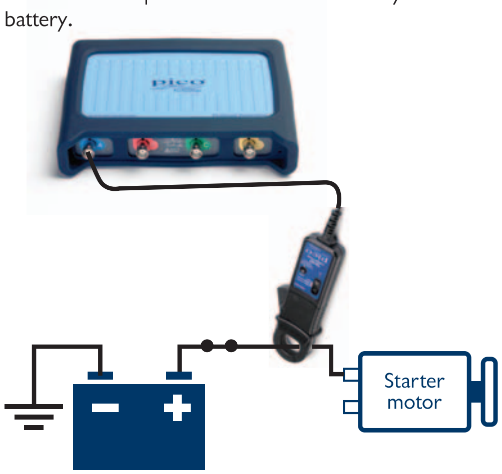
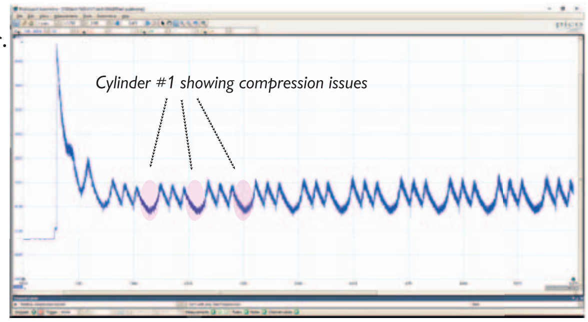


2. Run Timebase should be set at 200 ms per division and the scope started.

3. Read The waveform shows the amperage to crank the engine, usually between 80 and 200 amps. Once the engine has overcome the initial friction and inertia the waveform should settle down to a consistent 'sawtooth' pattern - zoom and rulers can help evaluate here, although a drop in cylinder compression is often quite obvious. If the waveform confirms a cylinder is losing compression, a sync trigger with a low amp current clamp connected to an injector or ignition coil will help to identify the offending cylinder. Using our WPS500X pressure transducer will highlight any mechanical issues requiring further attention.



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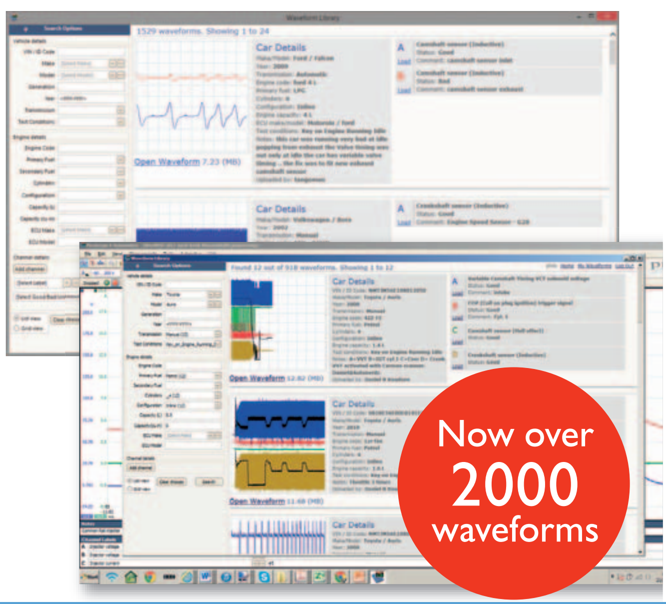

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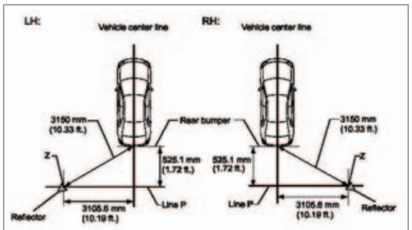
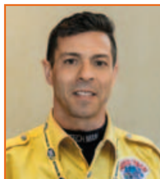
These short-range radar systems usually are calibrated statically with a road test, but they will require target boards or devices to be placed at certain locations near the vehicle prior to commanding the scan tool to put the radar unit in learn mode. There is no one tool or one procedure that is the same for all year, make and model vehicles. It's an unregulated field, so you may be required to have a collection of target boards and devices that could get costly if you are not performing these radar calibrations on a weekly basis. The documentation to perform these procedures is not always found in the scan tool or in your aftermarket repair information systems. The manufacturers will use different size target boards with different height and distance placement of these boards and target devices.



Short-range systems typically use "targets" for calibration that must be placed in precise locations relative to the vehicle.

Placement of these target boards and devices may require you to be a mathematician using a plumb bob to find the center line of the vehicle front to rear using the vehicle emblems that are usually located in the center of the front and rear bumpers. Then after marking the centerline of the vehicle on a shop floor, you then have to make further measurements from the marked centerline at certain distances away from the vehicle. The final measurements will give you precise locations to place your target of choice.

I can only imagine what the dealer tech has to go through to deal with these radar calibrations. It is so time consuming, but you need to be very critical in doing the job correctly or you will have a customer come back complaining that the system is not working correctly. What I can't understand is if you do some research on autonomous vehicles, on the internet they have self-calibrating systems that learn as you drive. So I don't fully understand the whole radar target situation. I'm hoping that some time in the near future all radar systems will be more universal by placing universal radar units in the front and rear windshields out of harm's way that are all self learning. I hope this story will hit home with some of you technicians out there and inspire you to keep up on technology as it drives into your bay. MA



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

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LOOK TO MOTORSPORTS FOR CLUES ABOUT TECHNOLOGIES YOU WILL FACE IN YOUR SERVICE BAY TOMORROW

BY **CHRIS CHESNEY**

It's kind of fun to look back on this industry and see how racing has influenced the vehicles we work on every day. While there are many who don't like to watch racing on TV or even live, these same people purchase vehicles equipped with technologies that were designed to win races. The engineers and "racers" who create innovations that win at the track are typically the best of the best. Most manufacturers put their best and brightest through their motorsports channel, allowing them to hone their creative skills by solving the problem of winning within the rules. If you follow motorsports you will quickly recognize the changes over the last few years as the sport seeks to be greener and more relevant to the world economy. Changes in fuels and mandatory alternative technologies such as electric drive systems have created an amazing environment filled with challenges for the engineers, resulting in an exciting future for our industry.

So how does racing influence the vehicle in your bay? They don't really look like what we drive or buy from the dealer. They get horrible fuel mileage and put out massive amounts of emissions; so how can we say they influence the vehicles we service? Consider the limitations of the rules they are given. For example, Formula 1 cars in 2016 are limited to 100kg of fuel for the entire race. This means in a typical 185-mile race they use about 26.4 gallons of fuel resulting in about 7 miles per gallon. Still not what your customer's cars should get but probably better than you thought. Now consider they get this mileage while driving to win a race and are breaking track records set by cars equipped with 1,000 horsepower engines. In this light, the achievements are amazing. Even more so is the fact that teams accomplish this with only two monitored testing sessions prior to the first race. There is no testing allowed during the season.

But what technologies does this bring to your bays? The engines used in Formula 1 today are 1.6L turbocharged gas direct-injected V6 systems that rev to 15,000 RPM, producing over 550 horsepower and are designed to last for four races, including practice. This means a typical engine will last upwards of 1,500 to 2,000 miles running at maximum power and efficiency. Also, the vehicles are equipped with a Kinetic Energy Recovery System (KERS), which recovers energy during braking and provides a boost using electricity during acceleration, much like a Hybrid Electric Vehicle such as a Toyota Prius. The technologies that you need to be ready to service include: Gas Direct Injection (GDI) systems; Variable Valve Timing; robust data networking systems that manage the fuel and ignition systems; electric drive systems; high voltage batteries; and the list goes on. You will also see the materials used in racing find their way to our bays such as titanium alloys, carbon fiber, magnesium alloys and metals treated with technologies such as cryogenics.

All of these technologies and many more are in your bay today and create a challenge for you and your team to be ready to serve your customer prior to their arrival. To recognize what is on its way in the future, just take a look at motorsports, and you will see the amazing people — challenged with winning — creating your future opportunities.

To learn more about these new technologies and training available from CARQUEST Technical Institute, visit CTIonline.com or contact your local Advance or Carquest delivery location.

CHRIS CHESNEY
CONTRIBUTING EDITOR

Chris Chesney has more than 40 years of technical training experience in the automotive aftermarket and currently serves as Senior Director of Customer Training for CARQUEST Technical Institute (CTI) and Advance Professional. Chesney received his ASE certifications in 1972 and has led thousands of technician trainings across North America.

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BIMMERWORLD RACING TEAMS UP WITH QUICKJACK

QuickJack is pleased to announce the recent partnership with BimmerWorld Racing to help promote their QuickJack portable vehicle jack system. The QuickJack is a lightweight, fully portable low-rise car jacking system that professional motorsports teams can use to get their cars in the air quickly.

Commented Andrie Hartanto, a world class BimmerWorld driver and QuickJack spokesperson; "We're always looking for products to help our crew work faster and perform better. In the past we were always forced to use floor jacks and jack stands after every track run. The QuickJack allows us to put the floor jacks and jack stands away and get the car off the ground in less than a minute. My crew can't live without the QuickJack."

About BimmerWorld

Founded in 1997 by James Clay, BimmerWorld began as a supplier of used BMW parts and quickly grew to offer replacement parts, performance parts and race parts for BMW enthusiasts. Located in southwest Virginia, BimmerWorld is a leading BMW parts supplier with customers spanning the globe. From OEM products to performance and racing parts, BimmerWorld can help customers find what they're looking for to get the most performance out of their BMW.

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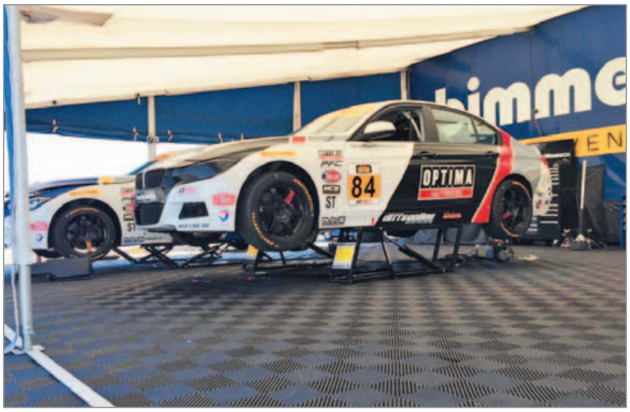

TAKING EVERYONE'S BEST SHOT

MOOG® parts are built to endure the demands of every NASCAR® team

At 200 miles per hour, even brushing up against a concrete wall is serious business. That's why every NASCAR® Sprint Cup car is equipped with MOOG® ball joints and tie rod ends, which are specifically engineered and manufactured to endure the abuse encountered each weekend on North America's most demanding racetracks.

"When you inspect any Sprint Cup Series car after a race, it typically looks like it has been through a war," explains Tim Nelson, director of Motorsports for Federal-Mogul Motorparts, the manufacturer of MOOG chassis components. "Some drivers are scraping the wall and making contact with other cars dozens of times throughout a race, exerting enormous mechanical loads on the ball joints, tie rods and other components."

MOOG, the Official Steering and Suspension of NASCAR, has been helping Cup drivers and crew chiefs maintain race-winning performance for more than 50 years. In fact, every Cup Series champion since 1966 has driven to victory with MOOG technology. Why this exceptional loyalty among racing's most demanding professionals? Three key reasons: durability, performance and consistency.

Bend, don't break

What happens to a NASCAR ball joint or tie rod after hard physical contact with the wall or another race car? That's a good question. Many wrecks in racing result in the destruction of just about everything on the cars involved. But in the case of MOOG steering and suspension parts, the answer to that question may surprise you.

"We've had several cases in just the past few years where crew chiefs were amazed to discover that our parts were still intact after serious impacts," Nelson explains. "That added layer of safety is critical in professional racing."

The ductility, or deformability, of the internal stud is one of the key product characteristics that helps keep a MOOG ball joint intact under severe stress. These NASCAR competition ball joints feature premium-steel studs that are precisely heat treated to a predetermined depth to provide extreme hardness in the outer margins for enhanced strength and wear resistance while maintaining exceptional ductility. This feature is invisible to the naked eye, yet plays a vital role in helping keep NASCAR drivers safe behind the wheel.

MOOG parts used in NASCAR competition also are equipped with innovative Belleville washer technology. This safety feature provides the precise ball-socket preload specified by the MOOG engineering team for precise operation. This washer also acts as a spring that absorbs energy from an impact, further reducing the chances of a catastrophic failure.

Maximizing driver control

Steering precision and consistency are critical in every driving situation, but they're huge considerations for NASCAR drivers and crew chiefs. MOOG engineers work hand-in-hand with NASCAR teams to develop and validate the latest ball joint and tie rod designs, with steering feel and precision being key factors in this process. And these parts — like every part carrying the MOOG brand — are manufactured to our exacting tolerances to provide the exceptional steering feel and performance expected by the crew chief, technician and driver…right out of the box.

"Our partnership with NASCAR teams is similar in many ways to our partnership with every customer who relies on MOOG," Nelson says. "We invest the same vigorous dedication to durability, performance and consistency in the design of our NASCAR parts as we do in our consumer parts."

Visit **www.moogparts.com** for more information.

MOOG® / NASCAR®

OFFICIAL STEERING & SUSPENSION OF NASCAR®

WINNERS DON'T LOOK FOR EXCUSES. THEY LOOK FOR A COMPETITIVE EDGE.

Professional drivers — at least the ones standing at the top of the podium — don't put much faith in marketing slogans or fancy packaging. They believe in numbers. In science. In objective facts.

Science is what separates Gumout® performance additives from competitors. In turn, that advantage ends up separating the pros from their competitors.

Formula DRIFT Series driver Ryan Tuerck is a big believer in the facts and numbers. One of the top young drivers in the Series, Tuerck was first attracted to Gumout® by the performance advantages their products offer. They have been proven in the lab, on the street and on the track. "I only use premium parts and products," he said. "Second-best doesn't win."

This season, with the help of Gumout® performance additives, Tuerck and his Gumout® Scion by Toyota FRS will be pushing the limits in high-RPM horsepower. While other racers may sacrifice engine efficiency to the heat and friction of redline racing, Tuerck will rely on Gumout's friction modifiers to help get the most out of his engine. These active ingredients lubricate fuel system components to preserve top-end horsepower in the face of extreme conditions.

The technology isn't only useful for professional drivers like Tuerck, though. Engineered to maximize performance, Gumout® is even more effective in the average garage, and in all types of engines, from daily drivers to lawnmowers.

Gumout® performance additives utilize advanced chemistry and the highest quality formulations. When corrosion and carbon deposits from fuel reduce a fuel system's efficiency, Gumout® uses unique detergent compounds like P.E.A. (polyetheramine) in their top-end products to clean existing deposits, and prevent future carbon build-up for up to 3,000 miles. In addition other additives in their formulations help condition parts against future damage. The result is peak performance and enhanced engine life.

Drifting offers an extreme proving ground for performance additives where many of the performance results can be transferred down to a street car level. Tuerck's highly modified, yet street-legal vehicle, will also test the limits of how much punishment a gasoline-powered engine can endure under harsh conditions of daily driving and occasional hooning.

Regular use of Gumout® performance additives is crucial to the performance of daily drivers even if they aren't heavily modified. When optimum performance depends on all engine components working in harmony, carbon buildup and water and ethanol corrosion lead to inefficiency. These inefficiencies can get expensive for car owners, leading to problems like decreased horsepower, fuel economy, and engine life.

Ryan will be putting Gumout to the test on and off the track this year. Coming off a fourth-place finish in the 2015 Formula DRIFT season, Tuerck is one of the early favorites this year, and don't be surprised to see him on top of the podium celebrating victories.

The 2016 Formula DRIFT Series features eight tour stops at the Pro level, starting in Long Beach, California on April 8. The Series will crown its champion in October, following the final event at "The House of DRIFT" in Irwindale, California.

GUMOUT PERFORMANCE ADDITIVES

SECTION 5A

RESTORING YOUR CAR'S PERFORMANCE ISN'T ROCKET SCIENCE. IT'S ORGANIC CHEMISTRY.

Cleaner engine parts mean better performance. Gumout cleans and conditions more engine parts than any other additive – including piston tops, cylinder heads, GDI injectors and the combustion chamber.

Fig. 1–Piston and Connecting Rod

The heat of the combustion chamber bonds carbon deposits to piston tops, creating hot spots that can lead to pre-ignition and reduced performance.

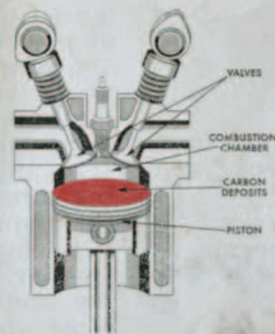

Fig. 2–Combustion Chamber

The intense 495º temperatures destroy most fuel additives before they can clean piston tops and cylinder heads. But the nitrogen-based PEA (polyetheramine) in Gumout® remains stable, easily withstanding the heat and pressure.

PEA breaks the bonds between carbon deposits and engine parts, removing them for restored horsepower and better fuel economy.

Gumout is scientifically proven in the lab, on the track and on the street. See all the ways it can improve your performance at gumout.com.

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GUMOUT
PERFORMANCE ADDITIVES

JIFFY-TITE KEEPS FLUIDS FLOWING

Jiffy-tite has been the preferred manufacturer of fluid connectors for the industrial and original equipment manufacturer sector of the automotive industry since 1963.

There are over 450 million Jiffy-tite devices in service on over 20 different brands of vehicles worldwide including Chevrolet, Ford, Cadillac, Dodge, Mercedes Benz.

With a proven track record in OE and aftermarket applications, as well as years of research and development in the lab, on the track, and on the dyno, Jiffy-tite has developed a full line of motorsports quick-connect fluid fittings that are second to none and offer the quickest connection in the industry.

FLUOROCARBON (FKM) SEAL	Oil	Transmission Fluid
	Water	E85 (Ethanol Fuel Blend)
	Fuel	Diesel
NITRILE (NBR) SEAL	Alcohol (Fuel)	
		
ETHYLENE PROPYLENE (EPDM) SEAL	Nitromethane	Brake Fluid
	Methanol (Methyl Alcohol)	Ethanol (Ethyl Alcohol)

***Note: these fittings should not be used on brake lines.**

Designed for racers by racers, these revolutionary quick-connect fluid fittings are engineered to perform and provide unsurpassed performance under extreme racing conditions. Jiffy-tite's quick-connect fluid fittings can replace nearly any fitting in any location (ranging in sizes -3AN through -12AN.) These fittings are made of lightweight, high quality aircraft aluminum with brass valves and stainless steel ball bearings. Jiffy-tite fittings are lightweight and corrosion resistant offering a long life span. Quickly connecting and disconnecting in seconds by hand, no tools are required, making them ideal for high performance applications; including drag racing, circle track and off-road, plus many other forms of motorsports and fluid applications.

Recently, Jiffy-tite added a new series to their line-up: the Pro-Compact series. Ideal for more compact applications, the new Pro-Compact series is perfect for applications that ***don't*** require valve technology, but ***do*** benefit from the no-tools technology behind Jiffy-tite's signature quick-connect fluid fittings.

Comparable in size to AN sized fittings on the market today, Jiffy-tite's Pro-Compact series is the perfect choice for anywhere valved technology is not a requirement. The reduced size is paramount to bringing Jiffy-tite's revolutionary quick-connect technology to smaller spaces, available in a variety of options ranging from -4AN through -20AN.

All Jiffy-tite fittings, including the new Pro-Compact series, are compatible with virtually any fuel, oil, water and transmission applications. There are seal compatibility issues customers should be aware of before selecting the right seal for their fitting's application.

Racers rely on Jiffy-tite's quick-connect fittings for minimum flow restriction and maximum safety. With Jiffy-tite you can have the advantage of high flow, minimum restriction, easy connect and disconnect in seconds by hand, no tools needed, 100% leak proof when valved fittings are disconnected-giving that added safety feature.

Manufactured in Lancaster, New York, all of Jiffy-tite's fittings, including the new Pro-Compact series, are compatible with virtually any fuel, oil, water and transmission applications given the option of Fluorocarbon (FKM), Nitrile (NBR), or Ethylene Propylene (EPDM) seals and they are available in black and gold anodized finish or all black.

Additionally, with Jiffy-tite's quick-connect fluid fittings, racers can avoid common problems associated with traditional threaded fittings such as stripping, cross-threading, over-tightening, forgetting to tighten, stripping the hex by using the incorrect tool or scratching the fitting by frequent wrenching.

For more information on Jiffy-tite's quick-connect fluid fittings for motorsports applications, visit www.jiffy-tite-motorsports.com or call 888-605-7788.

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NO Over-tightening
Made in America

THE ULTIMATE TEST: LIQUI MOLY ALSO USES MOTOR SPORTS AS TESTING GROUNDS FOR ITS OWN PRODUCTS

Naturally motor sports also attract a great deal of attention for LIQUI MOLY. The objective is ensure that spectators at race tracks and above all television viewers are familiar with our brand and will hopefully try it out some time in the future. But in addition to all the marketing aspects, LIQUI MOLY's participation in motor sports also has a technical background: This is the ultimate test for our products.

The oil in a racing engine is subject to stresses going far beyond normal operation. Extremely high temperatures, extremely high pressures, extremely high speeds. Under such circumstances weaknesses in an oil show up quickly. Here only oils with perfect performance are acceptable. Any flaw, any defect mercilessly reeks havoc with lap times and engine condition.

In everyday situations on the road, the stresses acting on the motor oil are quite different. Here the oil requires the qualities of a Marathon runner, rather than those of a sprinter on a race course. The oil change intervals are longer, making properties such as protection against corrosion and wear as well as the cleaning effect more important.

Nevertheless, these tests provide important insights as to how the oil behaves in extreme situations. The better it is in these situations, the greater its performance reserves in everyday use. And they very well may be required, whether due to ambient conditions (extreme heat, steep grades, heavy loads), or because of problems (oil loss, mechanical defects). Oils, which have proven themselves on the race track, also offer the greatest possible protection on the road.

LIQUI MOLY is involved in a variety of motor sports events.

The best known are Sandro Cortese in the Moto2 Motorcycle World Championship and the LIQUI MOLY Engstler Team at the TCR Touring Car Racing Championship. And the outstanding factor is that LIQUI MOLY does not use motor oils developed specially for racing - the oils all originate from our standard sales line. This ensures that every car owner can profit from the experience gained in motor sports.

The Motorcycle World Championship proves just how good these high performance motor oils are. As of this year all teams in the Moto2 and Moto3 races will be using oil from LIQUI MOLY.

LIQUI MOLY offers more than just motor oil. The company has over 50 years of experience in the production of additives. These additives ensure that all engine performance reserves are utilized to the optimum. They do this by removing damaging deposits from the injection system, the combustion chambers and the oil circuit and by reducing friction in the engine.

What does this mean for workshops? With LIQUI MOLY you get a strong brand and premium quality made in Germany. Every quart is filled up in Germany. This makes LIQUI MOLY the perfect brand for all car owners who want higher performance and greater security. Because motor oil is not just motor oil, but rather a virtually integral part which must match each individual engine precisely, we provide a free oil guide at www.liqui-moly.us to tell you which oil is right for which engine.

TIPS TO BEAT REPAIR INFORMATION OVERLOAD

With so many high-tech vehicles on the road today, searching for data to diagnose and repair them can lead to information overload. Vehicles just keep getting more complex and auto repair technicians have to keep up.

All of this technology comes with masses of documentation and information needed to diagnose, repair and maintain the advanced systems now driving our vehicles. And OEM information alone is often not enough to get to the root cause of an issue. Real-world experience from other techs who have solved the same issue can provide valuable insight that will direct you to the correct diagnosis and help you stay on schedule with the repair.

But too much data can lead to information overload — a common condition facing techs today. Symptoms of information overload include feeling overwhelmed and spending too much time researching. But if technology is part of the challenge, it also provides a cure: advanced software like ProDemand® from Mitchell 1 simplifies the search process and quickly delivers the nugget needed to repair the vehicle.

Selecting the right repair information system is critical to beating information overload. Here are some of the main things to look for:

1. **Complete OEM + Real-World Content Together** – Having real-world "silver bullets" delivered with the OEM information for the vehicle is the best way to beat information overload. Once the vehicle is selected, you should have all you need to start the diagnosis and repair, including TSBs retrieved with every search.

2. **Advanced Search Capability** – A single lookup that brings back complete information can be a real time-saver. ProDemand groups search results by "probable component," allowing you to see the list of components associated with the code or symptom, ranked in order from the most likely to the least likely component at fault.

3. **Standardized Formatting of Content** – Using a system that has a consistent style across all OEMs makes it quick and easy to look up information and read wiring diagrams for any vehicle in the database.

4. **Shortcuts** – Most of the time, techs need to look up things like torque specs, fluid specs, reset procedures, wiring diagrams, TSBs, etc. So ProDemand provides a convenient Quick Links bar on every page and gives you immediate access to the information you use the most.

5. **Jump Start to Diagnostic Information** – Insight into the most common fixes for the vehicle can help you reach an accurate diagnosis faster. In ProDemand, the Top 10 Repairs feature puts this collective knowledge right at your fingertips.

There is no shortage of information available to techs. For instance, ProDemand now hosts over 23 million pages of content, along with nearly 19 million "Real Fixes" – actual repair solutions from professional techs across the U.S. In addition to collecting the data, Mitchell 1 also makes it quick and easy to find the precise information needed to fix the vehicle. You don't need a doctor, just the right information tools to cure that case of information overload.

Mitchell1®

In your shop, at your side

WHY DO TOP RACE TEAMS, CUSTOM BUILDERS, MECHANICS AND EVEN MAJOR AUTOMAKERS INSIST ON RED KAP UNIFORMS?

The automotive workwear giant offers clear business advantages, pure and simple. Only Red Kap draws on expertise and insights from some of the industry's brightest stars. It is committed to bringing the latest high-performance designs, purpose-built just for the auto world. And, only Red Kap has a long and successful OEM heritage that spans more than three decades.

Proven by pros

Welcome to the fierce world of professional racing. Here the competition and terrain is at its highest. For the vehicles, teams and their tools, these are the real proving grounds. This is where Red Kap challenges top champions to put their workwear to the test. Guys like "Ballistic" BJ Baldwin who have conquered the Baja 1000 multiple times and NASCAR's Richard Childress Racing team and Greg Adler of 4 Wheel Parts in the Lucas Off-Road series. All these teams not only test our products but utilize our gear for their businesses off the track.

Geared for the garage

Red Kap has created serious workwear, purpose-built for the auto industry, for decades. Since 1923 to be exact. Our team spends lots of time in garages — places where it's easy to see what works, and what really works. If anything about our uniforms is distracting, the pros let us know. These guys love features like covered buttons and hidden zippers to protect expensive mirror finishes. Pockets that practically hand you the right tool just when you need it. And high-performance fabrics that keep them cool and dry, even when they're seriously sweating the details.

Designed with pride

To create great workwear, you have to listen to the people who wear it day in and out. So that's exactly what Red Kap does. It's how the design process gets started. And then the magic happens. We put pen to paper, build prototypes and put them to work. We test, evaluate, tweak and repeat. The result has to be more than comfortable — it's gotta be strong enough to stand up to daily punishment in the harshest conditions. We've been designing quality workwear since 1923. Adding innovations that help people do their jobs better, and more comfortably.

Crafted for the carmakers

Red Kap has built uniforms for just about every major carmaker for more than three decades, making us the largest manufacturer of workwear for the automotive industry. OEM's rely on Red Kap to provide quality garments that help convey professionalism and reinforce their brand image while providing their employees with comfortable, reliable apparel that works with them on the job.

This all adds up to a clear advantage — The RK Advantage. To learn more visit www.redkapauto.com/RedKapAdvantage.

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7.30 a.m - 4.30 p.m

FEATURING:

MIKE ANDERSON

FINANCIAL BEST PRACTICES

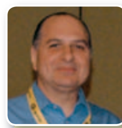
Learn how to read and understand your Profit & Loss Statement and Balance Sheet. Discuss your financial role and what you can audit to ensure your accountant or bookkeeper is keeping accurate accounting records.

PETE MEIER

PRACTICAL ELECTRICAL SCOPE TECHNIQUES

Learn often misunderstood electrical testing methods that help quickly isolate pesky electrical gremlins with ease.

Techniques covered include: finding parasitic battery drains; using current for more than electrical testing; multiple ways to use your scope for troubleshooting complaints on every system on the car.



"G" JERRY TRUGLIA

HOW TO DIAGNOSE P0420S & P0430S (CATALYST BELOW THRESHOLD) DTCS

Tired of dealing with catalytic converter problems? This course will help you address common problem components and systems including proper diagnosis.

KEYNOTE SPEECH By **Mike Anderson** of Collision Advice

Enjoy a catered breakfast, lunch and refreshments thanks to our sponsors:

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GO TO WWW.MOTORAGE.COM/WTE FOR DETAILS!

NEW AFTERMARKET PARTS LINE

Jiffy-tite, the leading OEM supplier of fluid connection systems for the automotive industry, has introduced an aftermarket line featuring 41 part numbers as well as caps, plugs and bus kits. With more than 450 million Jiffy-tite devices in service worldwide, Jiffy-tite's state-of-the-art products are known for their technology and performance.

Jiffy-tite

HEAVY-DUTY TWO-POST LIFTS

Forward Lift introduces its F-Series heavy-duty two-post lifts, the F-10 and F-12. Both lifts have been third-party tested and ALI certified to meet industry safety and performance standards. The F-10 is rated to 10,000 lbs. and features three-stage front and two-stage rear arms. The F-12 has a 12,000 lb. capacity, with two-stage front and rear arms.

Forward Lift

LATEX POWDER-FREE GLOVES

The Adenna Phantom latex powder-free gloves have a textured surface to enhance grip performance in both wet and dry applications. The black color of the Phantom glove masks stains, oil, grease and paints. The Phantom has an above average latex glove finger thickness at 6-mil. For more information, visit www.adenna.com.

Adenna

MULTI-SYSTEM TUNE-UP

The most advanced treatment for all types of engines, Gumout® Multi-System Tune-Up performance additive is the scientifically verified leader in removing and preventing gummy deposits from building up on fuel system components. Its unique chemistry stabilizes gasoline, ethanol and diesel fuels, fighting the corrosive elements that can prematurely age an engine. Visit Gumout.com.

Gumout

ENGINE, TRANSMISSION MOUNTS

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

NAPA AUTO PARTS

UNIVERSAL COOLANT DYE

Tracerline® Rite-Blend™ is a concentrated, universal trace dye that makes finding engine coolant leaks fast and simple. The GM-approved formula works with both conventional and extended-life coolants, won't change the color of the host fluid and fluoresces brilliantly using any leak detection lamp. It's available in one ounce, eight ounce and larger size bottles.

TRACER PRODUCTS

FUEL SYSTEM SERVICE

Valvoline™ engineers have developed a groundbreaking solution for treating and restoring gasoline direct-injection fuel systems with the EasyGDI™ Fuel System Service featuring Power Dispersal Technology™. The first-of-its-kind fuel system service removes carbon deposits from hard-to-reach intake valves, piston tops, cylinder heads and fuel injectors in gasoline direct-injection (GDI) engines in just over one hour using basic tools, a simple canister apparatus and shop air.

Valvoline

PERFORMANCE BRAKE UPGRADE KITS

CARDONE Industries announced the release of A1 CARDONE Performance Brake Upgrade Kits. The growing popularity of automotive customization is a clear sign that drivers take pride in how their vehicles look and perform, and the braking system lends itself to many options for performance and aesthetics.

CARDONE Industries

MOOG FROM ADVANCE PROFESSIONAL

Advance Professional is one of the leading providers of MOOG parts. MOOG is the official steering and suspension for NASCAR. Since 1966, every NASCAR Sprint Cup champion has won on MOOG. With 28 dedicated MOOG engineers in North America and 45 patents, MOOG offers best-in-class engineering, research and development, and coverage. For more information about MOOG parts, visit advancecommercial.com or contact your local delivery location.

Advance Professional

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

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

BendPak

TEXTAR HIGH CARBON BRAKE DISCS

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

WORLDPAC

AUTO REPAIR SHOP SOLUTIONS LINE

Mitchell1
In your shop, at your side

Mitchell 1 offers an industry-leading family of products for the automotive and commercial trucking industries. Mitchell 1's comprehensive line of auto repair shop solutions includes complete OEM and real-world repair information, diagnostic, estimating and shop management software, and marketing services to help automotive service professionals simplify everyday tasks and increase efficiency, productivity and profitability.

Mitchell 1

POWER STEERING FLUID

Synthetic Power Steering Fluid by BlueDevil Products is formulated with conditioners to rejuvenate seals and repair leak points and meet service requirements for all domestic and foreign manufacturers. It is an excellent substitute for any normal power steering fluid and maintains optimal power steering system conditions, along with preventing future common wear problems.

BlueDevil Products

STRETCH FIT INSTALLATION TOOL

Gates introduces a new Stretch Fit installation tool to help technicians do the job right the first time. This tool is for the proper installation of the belt on 2011-2016 Ford Fiestas with 1.6L engines that utilize Stretch Fit belt technology on the A/C compressor drives. Part No. 91032 is sold separately.

Gates

ENGINE IGNITION ANALYZER

The GTC505 is a complete ignition system analyzer, compatible with all common types of spark ignition systems. The GTC505 can display waveforms in real time; compare readings between cylinders; detect and display dwell angle and primary current ramp time; chart burn time, spark plug voltage, dwell/ramp time, and RPM for each spark, allowing for detection of misfires; display all this data on its 3.5” color TFT LCD screen; survive and pass the rigorous “MIL-STD-810” drop test and more!

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Coxreels’ Switch Box, available in open and closed variations, contains all of the necessary parts and components to make the motorized reel function in most service truck or trailer installations. The Switch Box mounts to the motor and contains a relay, circuit breaker and switch. The relay activates the motor and the circuit breaker protects the vehicle from overload.

Coxreels

AD INDEX

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HANDLING A HOT CUSTOMER

CORRECTLY ASSESSING THE CONDITION OF A CONSTANTLY EVOLVING A/C SYSTEM WILL HELP YOUR CUSTOMER TO "CHILL"

BY **PETE MEIER**
Director of Training

It's getting close to that time of year again — the time of year when your customers quit complaining about being too cold in their car and start complaining that it's too hot. As professionals, we can head off those complaints by offering to inspect their air conditioning systems at the first sign of a break in Old Man Winter's reign.

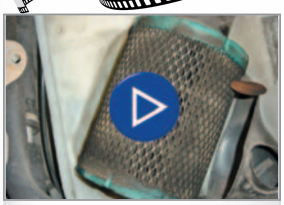
And as is true with every other system on the car, the air conditioning system is constantly evolving — meaning your service and inspection procedures should be as well.

Some of the steps you need to take while performing a professional A/C system inspection that we'll share in this month's edition of The Trainer are not new. For example, one of the first steps you should take before connecting your gauges or service equipment is to sample the refrigerant in the car you are working on to make sure it's correct and not contaminated. We've been repeating this message for years, yet many shops still fail to perform this simple step. The end result is a contamination of the vehicle's charge and of the shop's refrigerant supply. Depending on the type of contamination, personal injury could also result from servicing a "dirty" car.

Checking for the presence of sealants is another industry-recommended procedure that is often overlooked. When introduced into your service equipment, it can result in costly downtime and repairs. If your A/C service season is short, do you really want to lose revenue while waiting for a part?

These steps and a lot more are all included in this month's video, as I walk you through a routine A/C system performance inspection. MA

[VIDEOS]



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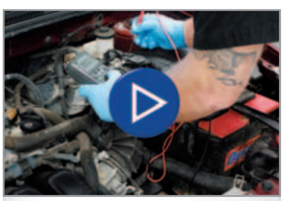

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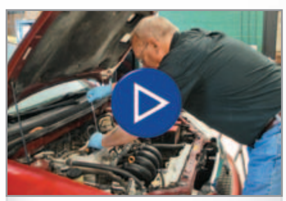

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