

PTEN

PROFESSIONAL TOOL & EQUIPMENT NEWS

\$15.00 - December 2023
Volume 34, Number 10

ENDEAVOR
BUSINESS MEDIA



MAXIMUS 5.0

REDEFINING DIAGNOSTICS
FOR MASTER TECHNICIANS
BY MATCO TOOLS

DETAILS ON THE COVER PRODUCTS
AND OTHER NEW TOOLS **PAGE 10**

AAPEX/SEMA
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TOP PICKS
FROM VEGAS
PAGE 20

TOP 100
OUR MOST
REQUESTED
PRODUCTS
OF 2023
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▲ Patented micro
diamond grip
surface



▲ Easy push-on/
pull-off operation

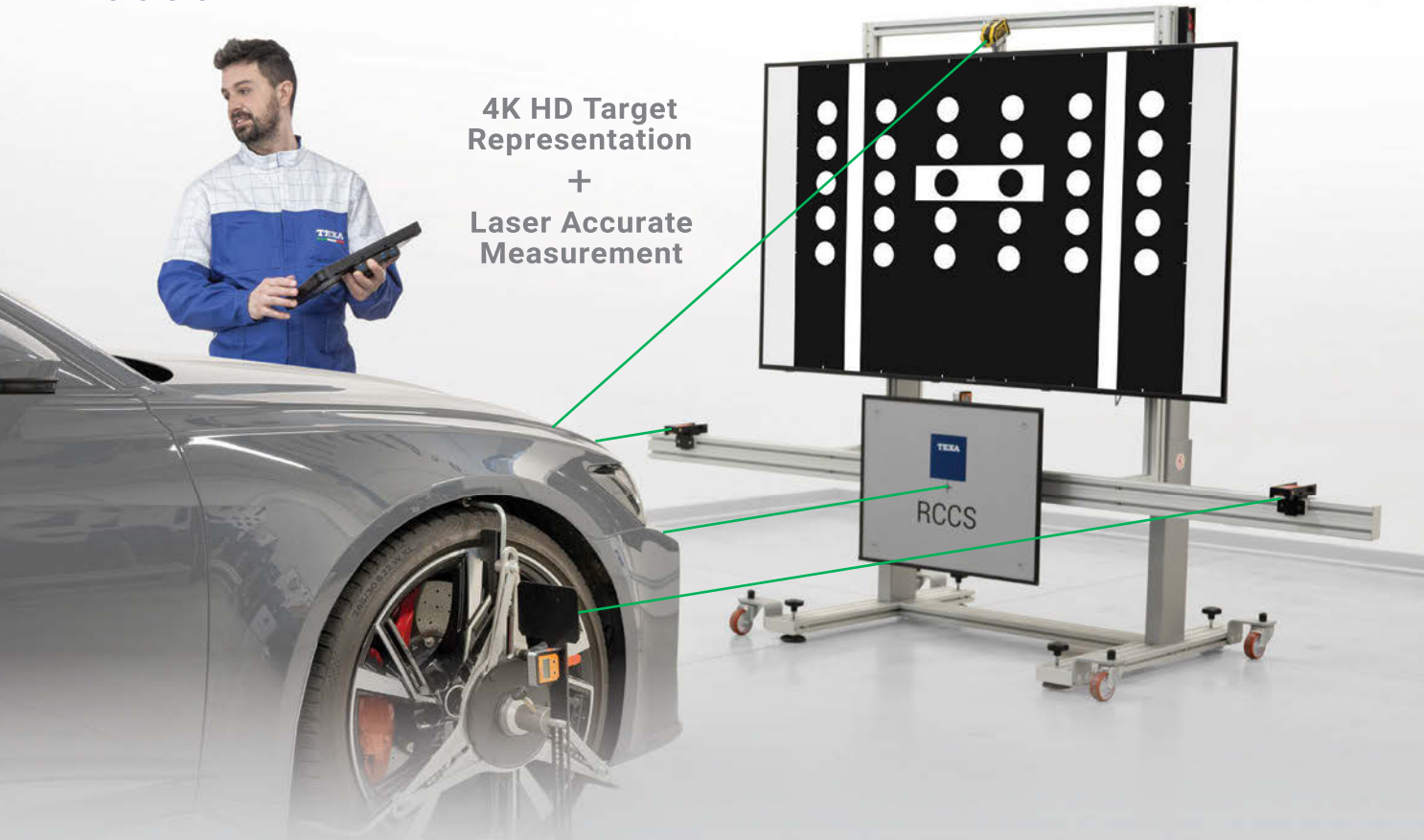


▲ Quickly checks
torque wrenches



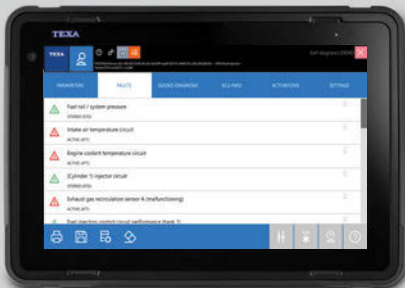
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DIAGNOSTICS



ADVANCED COVERAGE

AUTO SCAN ALL VEHICLE SYSTEMS
ADVANCED COMPONENT HEALTH CHECK
ADAS MODULE CONFIRMATION

VIRTUAL POSITIONING



GUIDED PROCEDURES

STEP-BY-STEP ILLUSTRATED INSTRUCTION
BLUETOOTH LASER DISTANCE MEASURE
CALIBRATION FRAME MICRO ADJUSTMENT

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AWARDS



PTEN held its annual Innovation Awards ceremony at AAPEX on Oct. 31.
[VehicleServicePros.com/53076655](https://www.vehicleservicepros.com/53076655)

PHOTO GALLERY



The AAPEX show wrapped up the first week of November in Las Vegas, in case you missed it, here are some scenes from the show floor.

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TOOL REVIEW



The Lisle Corporation Magnetic Funnel Holder, No. 50240, reviewed by Brin Kline, owner and technician at Assured Auto Works in Melbourne, Florida.

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TECH PROFILE



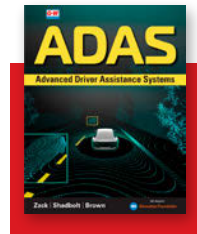
Long before she became the controller at White's Canyon Motors, a Ford dealership, Sidney Olson started out as an apprentice at White's Queen City Motors, a Chevy dealership, where she would climb the ranks and become parts manager.

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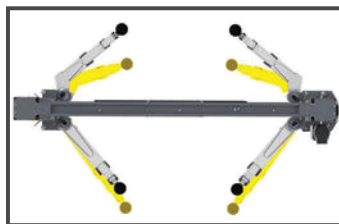
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The start of something new

Come 2024 we've got some new opportunities we'll be exploring with all of you!

By Emily Markham, Editor
Emily@VehicleServicesPros.com

It's just about a wrap on 2023, but what a wonderful year it's been! I know I'm grateful for all the opportunities and growth this year has afforded me, and I hope 2023 has been just as kind to all of you.

I've learned a lot this year. Becoming the editor for *PTEN* and *Professional Distributor*, I learned how to be a manager – looking after not only myself but my team as well. I found I really had to hone in on my time management skills, become better at delegating tasks where I could (still working on this one!), and put in extra work on nights and weekends.

Whether you're a new technician or have been at this for years, whether you're a shop of one or a shop of many, I know all of you have been doing much the same as I have throughout this year. I know it's not easy being in the business of automotive repair and fighting battles you have little to no control over – the technician shortage, the supply chain, data for repairs, etc. But I'm always so impressed by the passion and resilience of this industry, and I'm so proud to be able to offer some guidance to all of you within the pages of *PTEN*.

Though we won't be ringing in the new year together, I'd like to raise a glass to all of you for all the hard work you've put in

this year. The *PTEN* team wishes you all a happy and prosperous new year. Cheers!

UPDATES FOR 2024

Looking forward, I have a few updates to share with you as we move into the new year. The first being that VehicleServicePros.com is getting an update. As you may know, back in June of 2022 Endeavor Business Media joined forces with 10 Missions Media creating a stronger-than-ever Vehicle Repair Group. (Learn more about the acquisition here: VehicleServicePros.com/21269661.)

So, after adding five new publications to the group, we've spent the last year and a half learning about each other's publications and figuring out the best ways to serve you, our readers. Long story short, in 2024, VehicleServicePros.com will be merging *Auto Service Professional* with *Motor Age* to continue providing technical content on the website. Additionally, *ABRN* will no longer be a part of VehicleServicePros.com as it will be integrated with the *FenderBender* website.

We believe this transition will provide readers with a more satisfying website experience. With content geared toward the same parts of the industry being grouped together, users will have an easier

time finding exactly the content they are searching for.

The website update is set to launch in early 2024 and will continue to provide information, insight, and intelligence on industry trends and technology so you can stay engaged and well-informed.

In other news, starting in 2024, *PTEN* will be running eight print issues a year instead of 10. The February and August issues are being dropped, but don't worry! We've been cooking up lots of new ideas to up our digital content game and provide you with more articles, case studies, and videos than ever. See you in the new year! ✖

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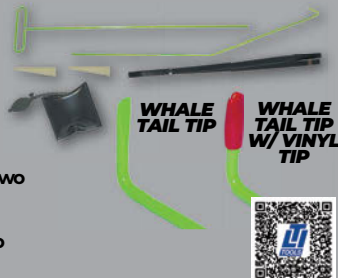
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The gloves are commercial grade, 7-mil thickness, powder-free, and latex-free. The Grease Bully MDT Nitrile Gloves come in safety red and are available in sizes medium through XXL.

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PUSH-ON/PULL-OFF FEATURE

The **Strategic Tools & Equipment LOCKJAW Ratcheting Flare Nut Wrench** is a patented, ratcheting open-ended flare nut wrench that works on metric and SAE nuts, including damaged nuts. Its push-on/pull-off feature allows the tool to be used with one hand while its ratcheting design allows users to ratchet around the nut without removing the tool from the nut. The flare nut wrench also offers ideal gripping strength. The more leverage exerted on the tool, the tighter the grip on the nut, the company says. Sizes include 8-9mm, 10-11mm, 12-13mm, and 14-15mm as well as SAE sizes: 5/16" by 11/32", 3/8" by 7/16", 15/32" by 1/2", and 9/16" by 19/32".

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QUICKLY CHECKS TORQUE WRENCHES

The **Hazet Torque Testers**, Nos. 7901E, 7902E, and 7903E, are designed to offer a reliable control aid for torque wrenches. The 7901E has a fixed internal 1/2" square socket and can measure torques between 7.37 to 258.15 ft-lbs. The 7902E has a fixed 27mm hexagon socket and measures from 36.88 up to 811.30 ft-lbs. The 7903E has a fixed 10mm external hexagon socket for smaller torque wrenches and comes with additional 1/4" and 3/8" adapters. It can measure 1.10 to 22.18 ft-lbs with a maximum tolerance of +/- 1 percent. The torque testers feature a large, easy-to-read LCD display with backlighting, a quick test function, an IP40 protection rating, and three measurement readouts.



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REDEFINING THE DIAGNOSTIC EXPERIENCE

The **Matco Tools Maximus 5.0** diagnostic scan tool is ideal for master technicians. Engineered with advanced technology, the Maximus 5.0 is designed to deliver a combination of automotive intelligence, quick navigation, and ergonomic handling for optimal efficiency. Offering a new intuitive user interface, a larger touchscreen, increased memory, and extended battery life, the Maximus 5.0 comes fully equipped and is available with carline (No. MDMAX5CL) or carline and heavy duty software (No. MDMAX5CLHD).

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NEW PRODUCTS 



OFFERS THREE TORQUE SETTINGS

The **Snap-on 18V 3/8" Drive Monster Lithium Stubby Cordless Impact Wrench**, No. CT9038, delivers 525 ft-lbs of breakaway torque and 275 ft-lb of working torque in a compact size for greater access in tight spaces. Users can dial in the proper torque with three settings: 25 percent, 50 percent, and full torque. With an ergonomic design and low vibration, the impact wrench allows users to work longer with less fatigue. It also features a cushioned grip handle for positive tool control, an integrated 100 lm LED to illuminate the work area, a built-in brake to prevent the tool from throwing sockets and fasteners, and a variable speed trigger for precise control.

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OFFERS TOUCHSCREEN COMPATIBILITY

The **Magid 21G ANSI A4 Work Glove** is engineered specifically for dexterity and comfort. The glove's 21-gauge ultra-thin specialty fiber blend shell allows for a bare-hand feel and its polyurethane palm coating gives users increased grip and touchscreen compatibility. These gloves are intended for jobs that require the handling of small parts.

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MODULAR DESIGN FOR OPTIMAL ORGANIZATION

The **Ascot Supply 32-Bin Metal Storage Cabinet** features a modular design for optimal organization, mounting holes located at the top and bottom, and hemmed bin fronts for retain parts. Additionally, the cabinet is constructed with heavy duty steel that provides strength and stability. The cabinet comes fully assembled and ready to use. The cabinet is 33-3/4" wide by 8-1/2" deep by 19-14" high. The bin sizes are 4" wide by 8-3/8" deep by 4-1/2" high.

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FEATURES THREE BOOST MODES

The **Schumacher Electric 6V/12V 250A Manual Timer-Controlled Battery Charger and Jump Starter**, No. SC1667, is a manual charger that gives users complete control over the battery charging process. Some of the benefits included in this tool are three boost modes for quickly and efficiently adding charge to deeply discharged batteries, a heavy duty metal case with an easy-to-read meter, a 135-minute manual timer, six-gauge booster cables, and a rate selection dial. The battery charger can reach up to 12' with a 6' power cord.

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BEVEL GEARS PREVENT STALLS

The **AIRCAT 1/4" Mini Angle Die Grinder**, No. 6250, features a .3hp motor that produces 18,000 rpm free speed. Weighing just 1lb and measuring 5" in length, the 6250 provides added control and maneuverability while allowing access into tight spaces. It also offers heavy duty bevel gears that prevent stalls, a variable speed trigger that allows users to control the tool speed, an over-mold grip for added user comfort, safety lock-off throttle levers to prevent accidental start-ups, and a rear exhaust with AIRCAT's silencing system to reduce noise levels to 81.5 dBA without reducing the tool performance.

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PREVENTS ROUNDING OF HEX FASTENERS

The **GripEdge Tools RPT Hex Bit Sockets** are designed to prevent the rounding of good hex fasteners while being able to remove damaged ones. Featuring patented RPT (rounding prevention technology), the sockets deliver up to 50 percent more torque on good hex fasteners, and up to 400 percent more on damaged ones, according to the company. Available in sizes ranging from 1.5mm to 10mm and 1/16" to 3/8".

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Unlock the power of your diagnostic tools:

A guide to performance and driveability analysis

In this article, we'll discuss using PIDs to quickly assess engine performance operation and how to effectively gather data during a road test.

By **Scott Brown**, Technical Editor



▲ **Figure 5** — Adjusting y-axes to reveal TCC slip
Photo courtesy of Scott Brown

Today's powertrain systems have grown quite complex and demand a certain skill set when it comes to addressing engine performance and driveability challenges. In fact, many of the skills needed to successfully resolve the wide range of issues presenting operational problems on these vehicles demand sim-

ilar skills one is required to obtain in pursuit of an electrical engineering (EE) degree. Now of course the EE degree is great for the design side and most certainly dives much deeper into various subjects. However, we as diagnosticians are dealing with the real-world results of these systems and as we all know, things don't always work out as planned. This is why we need to possess an eclectic skill

set to help us better understand and conquer vehicle performance problems.

For review, here's a list of the core areas of study for an EE:

- Circuit theory
- Digital logic
- Signal processing
- Control systems
- Electronics
- Electromagnetics

* Scan Tool Results *

- ENGINE
 - CURRENT|Fail Since Clear:
 - **P0016-00** - Crankshaft Position - Intake Camshaft Position Not Plausible
 - Fail Since Clear:
 - **P0017-00** - Crankshaft Position - Exhaust Camshaft Position Not Plausible
 - **P0300-00** - Engine Misfire Detected
 - Fail Since Clear|HISTORY:
 - **P0128-00** - Engine Coolant Temperature (ECT) Below Thermostat Regulating Temperature
- BODY CONTROL (TPMS)
 - Fail Since Clear|HISTORY:
 - **B1517-5A** - Battery Voltage
 - **B2699-01** - Right Headlamp Control Circuit
 - **B2699-04** - Right Headlamp Control Circuit
 - **B3806-00** - High Beam And Headlamp Flash Select Circuit
 - **U0151-00** - Lost Communication With Inflatable Restraint Sensing And Diagnostic Module
 - **U0164-00** - Lost Communication With HVAC Control Module
 - CURRENT|Fail Since Clear|HISTORY:
 - **B2575-01** - Headlamps Control Circuit
 - **B2575-04** - Headlamps Control Circuit
- AIRBAG
 - HISTORY:
 - **B1325-03** - Control Module Power Circuit
- INSTRUMENT PANEL
 - Fail Since Clear:
 - **B1325-03** - Control Module Power Circuit
- TRANSMISSION
 - Scanned No Errors
- ELECTRONIC BRAKE CONTROL
 - Scanned No Errors

▲ **Figure 1** — *Bosch Scan Shop Ware*
Photo courtesy of Scott Brown

- Power systems
- Statistics and probabilities
- Microcontrollers
- Communication systems
- Calculus and differential equations
- Physics
- Programming languages

While that list is quite extensive, in my opinion, many of these areas align with the competencies today's diagnostician needs to possess. So, the next time you hear someone refer to

diagnostics as just connecting it to the "machine" feel free to remind them of the knowledge and skills needed to properly address today's automobiles.

My recommendations are that when you're seeking training to better yourself as a diagnostician, review the areas listed above to better understand your strengths and weaknesses. Overcoming deficiencies in certain areas can aid in performing diagnostics well into the future! Now, let's dive in and have a look at modern vehicle performance and analysis troubleshooting.

Modern internal combustion engine (ICE) vehicles are equipped with sensor data that quite simply has made the driveability technician's life a lot better. In fact, due to the evolution of OBD-II Parameter Identifiers (PIDs), we are blessed to have access to some very valuable information we can leverage. In this article, we'll discuss using these PIDs to help us quickly assess engine performance operation and how to effectively gather data during a road test. We'll also discuss how to leverage some of the OEM's diagnostic routines that can be called up in the scan tool as well.

TOOLING – SCAN TOOLS

Having a good understanding of the tool's strengths and weaknesses is a priority. I use a variety of scan tools and my selection is dependent on the tasks ahead.

Here are a few areas of focus:

DOCUMENTATION

Initially, I usually like to gather all the evidence and document it before carrying out any testing. I'm sure by now you've heard the term "pre-scan" and it's a great best practice. In fact, we have a tool we use that streamlines this process by performing a full vehicle scan that will then insert the results right into the work order within our SMS (**Figure 1**). From there, the technician may want to gather the freeze-frame data from DTCs and record them as this may provide further guidance. Secondly, it might make sense to gather module part numbers along with their software versions. The Ford IDS does a great job of logging all this information during a diagnostic session and we'll talk more about this later in this article.

SAMPLE RATE

When monitoring/recording vehicle performance data, you need to be aware of the update rate of the scan tool which is also dependent on the vehicle under test. Some PIDs are being broadcasted from a module at a fixed rate and some PIDs may be polled (requested) by the scan tool at a selectable rate.

PID RELIABILITY

Keep in mind that the data you see has been converted from binary serial data which is highly dependent on the accuracy of the tool's CAN database libraries and its ability to properly

translate. Additionally, OBD-II regulations require that the data reported must be accurate and reflect real-time conditions of the vehicle. However, there are exceptions where there is an allowance for some modules to substitute data under specific fault conditions to prevent damage due to other systems relying on this data to perform functions and or allow limp-home modes.

DATA PRESENTATION

Possessing the power to display the data in certain ways can be highly beneficial to the diagnostician in navigating this complicated matrix. For example, having the ability to overlay data on one timeline with controllable Y-axes in my opinion is extremely powerful as I will demonstrate later in this article in some real-world examples. In other cases, one might benefit from being able to display a 3-D graph of data when addressing certain problems as shown in **Figure 2**.

OBD-II MONITORS

In many states, motor vehicles are subject to periodic inspection and maintenance programs (I&M) which include an OBD-II system interrogation. For the most part, the vehicle shouldn't have any DTCs set or monitors in a non-completed state. However, there are some exceptions. Following a repair

		Desired Boost (kPa)									
		A	L	C	M	N					
+	-	100	120	140	160	170	180	190	200	210	220
line Speed (rpm)	[Sensc]										
	1000	0									
	1500	-2	6	20	29	38					
	2000	-6	0	9	18	31	26	20			
	2500	-8	-6	4	3	16	28	14			
	3000	-9	-9	0	-5			4	3		
	3500	-10	-6				50	8	6		
	4000	-5	-6					17	1		
	4500	-12	-6					3	3		
	5000	-37	-14						5		
	6000					2	2	4			

▲ **Figure 2 — Turbo boost error graph**
Photo courtesy of Scott Brown

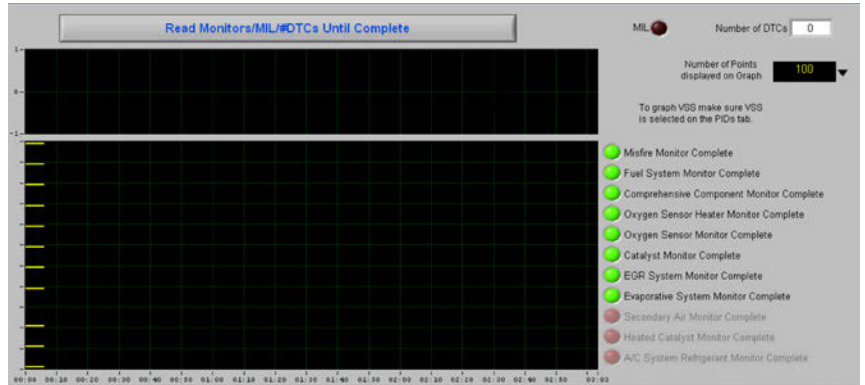
and a code clear will result in the monitors being cleared. Usually, the technician will want to execute proper drive cycles so that the vehicle will run and complete the OBD-II. However, there may be conditional prerequisites the vehicle needs to be within for a monitor to be enabled to run. I'm sure that you would agree that it is extremely important to know if the monitor you're trying to run is currently enabled or not. PID \$41 shown in **Figure 3** will let the technician know whether a particular monitor is enabled for the current drive cycle. Knowing where to obtain that information is extremely critical. Some tools also do a good job of displaying monitor status graphically such as the eScan from Automotive Test Solutions (**Figure 4**).

J1979 J1939/ISO27145			
E8 ECM-EngineControl		EA TCM-TransmisCtrl	
PID	Value	Unit	Comment
0C	827	1/min	Engine RPM
2F	26.7	%	Fuel level input
41	0000 0000	Bit	Monitor status this driving cycle
	0000 1111		• Misfire monitoring enabled and complete
	1100 1010		• Fuel system monitoring enabled and complete
	1110 0001		• Comprehensive component monitoring enabled and complete
			• NOx aftertreatment monitoring enabled and complete
			• Boost pressure system monitoring enabled and complete
			• PM filter monitoring enabled
			• EGR and/or VVT system monitoring enabled
46	26	°C	Ambient air temperature

▲ **Figure 3 — Silver scan tool PID \$41 monitor data**
Photo courtesy of Scott Brown

MODE \$06

As you're likely aware, the data reported here can be useful if clearly understood. For example, test IDs (TID) will display the MIN/MAX and test results for tests the system performs. Now it's likely that you've heard that test results that are near the maximum are an indication of a pending failure. This is what I was led to believe until I attended the 2022 SAE OBD-II symposium in Anaheim, California. At this event I also attended an all-day training session titled "Emissions-Related OBD Systems: A Design Overview." Now while this session was designed for calibration engineers, I learned a lot and gained a higher level of respect for the operations these on-board systems are running on the very machines we are tasked with diagnosing and maintaining. I learned two significant terms that the engineers focus a great deal of attention on. Best performing unacceptable (BPA) and worst performing acceptable (WPA). These are the two targets (slopes) the engineering teams work with to design their OBD systems which in turn, drive the quality



▲ **Figure 4 — ATS eScan monitor data**
Photo courtesy of Scott Brown

of the parts equipped on the vehicle and the software running these systems. Anyhow, later that week, I attended a General Motors presentation on exhaust gas monitoring which is slated for the future where NOx and other gasses are planned for future direct on-board monitoring. The presentation started off with talking about Mode\$06 and how it has been found to be misused in service. Specifically, the presenter went on to state that technicians were performing service part replace-

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ments based on Mode \$06 test results that were landing near the maximum limits. The facts are that if you see certain test results near the maximum limits, it doesn't necessarily mean that there is a failure. However, there are certain Mode \$06 TIDs that can be helpful such as misfire. For a vehicle that arrives with a P0300, the technician can scan the Mode \$06 data and look to see which cylinder is showing the most misfire activity.

MODE \$09

The data reported in this area is known as in-use performance monitoring (IUPM) and can be very useful for discovering how often monitoring conditions are met and how often they have been completed. This information can be leveraged in cases where you're trying to understand why a monitor is difficult to complete. If you're unfamiliar with this area, you may want to begin gathering data from this area as it can be quite revealing, especially with new propulsion systems since the California Air Resources Board has mandated certain propulsion performance statistics be reported here as they pertain to hybrid and battery electric vehicles.

DATA PIDS

After collecting DTCs, freeze frame, and Mode \$06/\$09 you will likely move to Mode \$01 which of course is live data. Whether you're looking at generic or manufacturer-specific information, as mentioned earlier, you need to know how to leverage such data.

RELATED PRODUCTS



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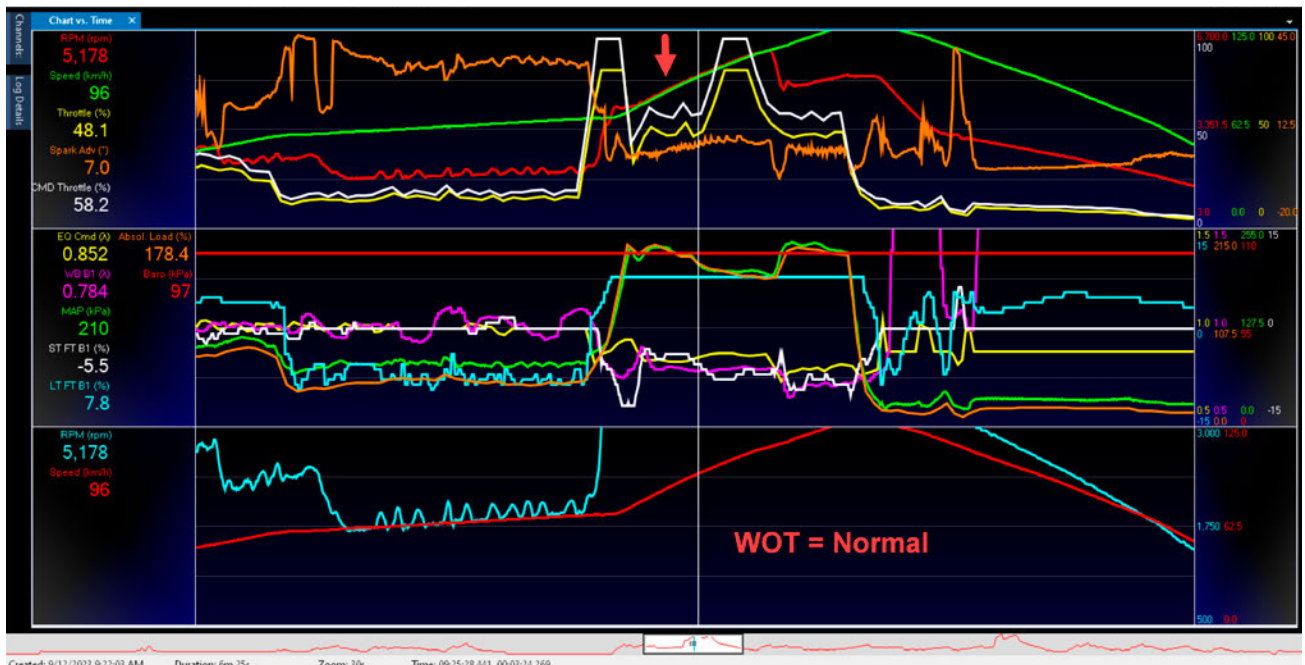
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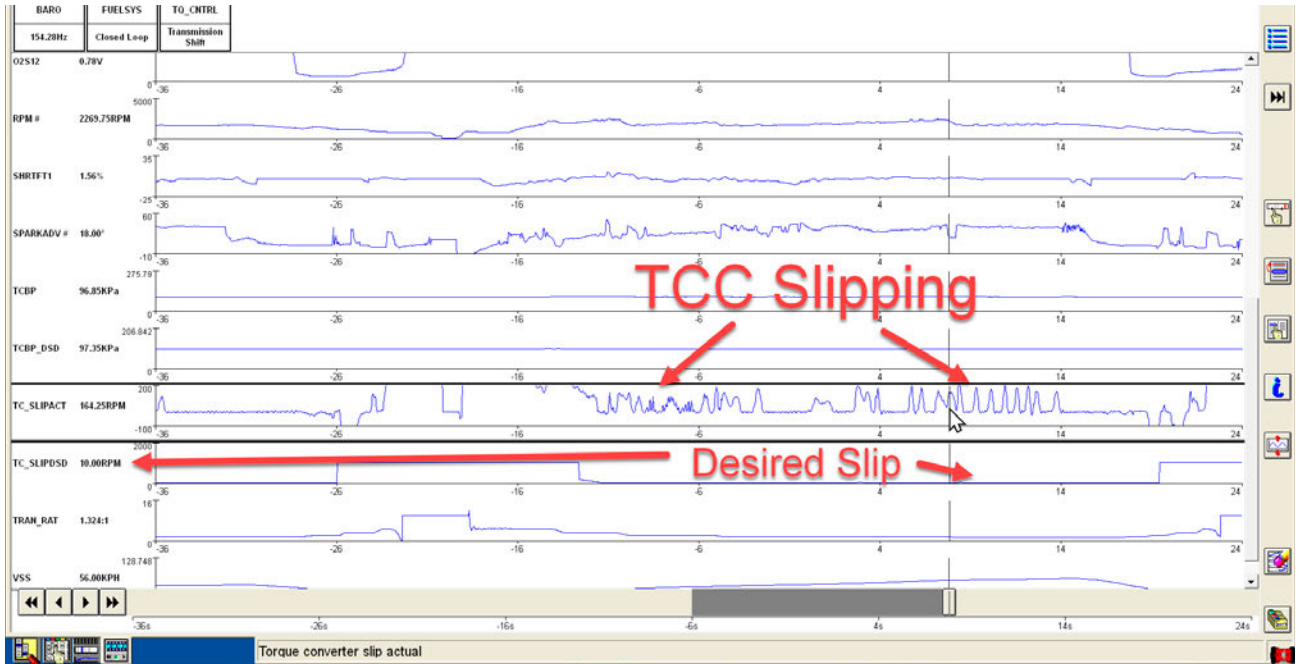
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▲ **Figure 6 — WOT no TCC slip**
Photo courtesy of Scott Brown



▲ **Figure 7 — Ford IDS TCC slip**
Photo courtesy of Scott Brown

CASE STUDIES

CASE STUDY #1:

POOR PERFORMING FORD EDGE

Recently one of my technicians asked me for a second opinion on a 2019 Ford Edge 2.0L he was addressing for a complaint about poor performance. This was a new client and they stated that the vehicle seemed to be misfiring and lacked smooth acceleration. My tech stated that the only DTC stored in the vehicle was related to the front shutters which he didn't think were related to the performance problem. He also stated that there was no misfire history statistical data reported in Mode \$06. So, I decided to grab one of my go-to devices and record some data while performing a road test. Sure enough, I felt the condition and it sure felt as if the engine was misfiring under light load conditions. During the road test and while I was recording, I proceeded to perform a wide-open throttle (WOT) sweep up through a shift point. I normally do this for most driveability analysis events so I can gauge the performance of certain systems. What I noticed is that during the WOT event, the vehicle performed properly with great acceleration.

When I returned to the shop, I proceeded to perform a data review. The first thing I noticed was that the normal data metrics such as fuel trim, spark advance, and temperatures, looked very

normal and that I could see a distinctive change in engine speed during the light load misfire symptom. While reviewing the recorded data, I decided to match up the vehicle speed sensor (VSS) signal with the engine speed (RPM) by adjusting the MIN/MAX ranges of their respective axes to see if I could visualize what I suspected.

As you can see in **Figure 5**, the RPM trace is unsteady as opposed to the VSS signal which is indicative of torque converter clutch slippage since the RPM signal isn't dropping significantly below the vehicle speed slope.

Looking further, you can see in the recording, that during the first and second gear operation, each RPM slope was smooth. When I entered the third and fourth gear, the vehicle exhibited the symptoms the client was complaining about.



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Looking at **Figure 6**, you can see in the top row (green and red traces), that I adjusted the RPM and VSS Y-axes so that the WOT segments paralleled each other demonstrating the lack of torque converter slippage.

Since I was preparing for this article, I decided to connect the Ford factory tool (IDS) to have a look at what their scan tool offered to confirm my suspicions that the torque converter clutch (TCC) was slipping. **Figure 7** shows us that indeed the TCC is slipping.

In conclusion, the Ford Edge with only 44,000 miles will be visiting the dealer for warranty work. The scan tool provided us enough information with generic data to conclude that the engine performance was nominal, and the symptoms were caused by a slipping torque converter clutch. Additionally, if you look at the middle traces in **Figure 6**, you can see the wide band sensor is reporting lambda (Wide Band Bank 1) closely following the equivalence ratio command (EQ) during a WOT event in power enrichment (PE) mode. These numbers are indicative of a healthy system and validate that several systems are operating properly such as:

- Low-pressure fuel delivery
- High-pressure gasoline direct injection
- Turbo operation
- Proper cylinder air flow estimation (airmass)

CASE STUDY #2:

COMEBACK - 2006 TOYOTA TACOMA V6 – P0171 P0174

We recently had a vehicle come in for multiple misfire DTC which ended up needing coils and plugs to rectify. The technician performed a road test and found that the vehicle's performance was nominal. The problem is that a proper road test with data analysis was not performed. The vehicle returned a week or so later with a complaint that the MIL was on and that there was some "pinging" that could be heard coming from the engine under light load operation. However, the client did state that the vehicle was no longer misfiring.

I proceeded to acquire some of the key performance data parameters I typically record during a road test after seeing that DTCs P0171 and P0174 were set. During my road test, I observed light detonation occurring while driving. Then as part of my normal road test procedure, I performed a WOT pull making sure that I was able to sweep from 3,000 to 5,000



▲ **Figure 8 — 2006 Tacoma poor performance: P0171, P0174**
Photo courtesy of Scott Brow



▲ **Figure 9 — 2006 Tacoma after MAF sensor cleaning**
Photo courtesy of Scott Brow

RPM noting that this engine produces maximum torque at approximately 4,000 RPM. The significance of this RPM point is that this is where the engine will achieve maximum volumetric efficiency.

After returning to the shop, it was time again to analyze the data. The data displayed in **Figure 8** is very telling.

At 4,038 RPM, you can see the absolute load is at 60.4 percent which isn't good in my book. Additionally, since this engine is equipped with two wide-band sensors, they are reporting a lean condition across the entire WOT pull. Looking at the MAF data along with my MAF Cyl Air6 math PID, I can conclude that the air mass numbers are underreporting. See my article titled "Solve driveability issues, emissions-related failures with fuel trim diagnostics" from 2021 for more information (VehicleServicePros.com/21241453).

The next step was to inspect the air flow tract to see if there was anything that could be upsetting the MAF signal. Seeing that there was none, we removed the sensor for inspection. We could see clearly that the sensor was quite dirty, so we attempted to clean it which on this vehicle isn't very feasible.

After our attempt, we took the vehicle back out on the road for a repeat test and **Figure 9** shows our results.

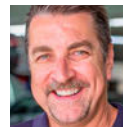
As you can see, the numbers have greatly improved. The absolute load is now at 77.2 percent which aligns with our quick math on the cylinder air equation. We sold a new MAF sensor, cleared all adaptive memory, and placed the vehicle back into service where it is currently operating properly. What we learned here is that although you may have a gross error (multiple defective coils), a diagnostic technician should always remain curious and perform a final road test evaluation while recording the proper key performance indicators. Now if we had good airflow numbers with a lean exhaust, then we would proceed to investigate the fuel supply side of the vehicle.

Looking back on my two images (**Figures 8 & 9**) you can see the 3-dimensional graph in the lower right of the screen. This graph is configured to show an averaged value of long-term fuel trim (LTFT) over an RPM/cylinder airmass table. Some scan tools allow you to configure tables like this which can be useful for visualizing data. In fact, looking back on **Figure 2**, this table was used to monitor boost on a turbocharged vehicle that was suspected of having an intermittent leaking wastegate

valve. This chart takes advantage of a math PID that automatically finds the difference between actual and desired boost.

CONCLUSION

Modern driveability diagnosticians not only rely heavily on scan tools and OBD-II data to troubleshoot performance issues effectively, but they must also possess the inquisitiveness necessary to properly analyze and diagnose these systems. They also need to have a heightened level of situational awareness of the tools and equipment available to take on these demanding tasks. ❌



SCOTT BROWN is an ASE Master Certified L1 Technician and has over 37 years of professional service industry experience. He is an independent shop owner in Southern California and is engaged at various levels within the industry. He has a deep understanding of the challenges technicians experience at the service level and is continuously striving to move the industry forward through education and networking. Brown founded Diagnostic Network (diag.net) after 22 years of service at iATN, where he retired as company president in 2018.

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We saw a number of products introduced at the AAPEX and SEMA shows again this year. Here are some new tools and equipment selected by our editorial staff that piqued our interest.



Hofmann
Armored Series 2400P
Wheel Balancer

The **Hofmann Armored Series 2400P Wheel Balancer** is designed for high-volume shops. Developed using forged steel, the wheel balancer offers resilience, even in tough environments. It features a large, high-resolution touchscreen display with easy-to-read large digits, a compact framework, a laser scanner that automatically detects the number and position of rim spokes, and it incorporates a power clamping device that secures the wheel with a constant force. The unit also automatically detects wheel dimensions and selects the appropriate balancing mode, weight type, and weight position, and automatically detects the rim width by utilizing sonar sensors.

Editor's Note: The Hofmann 2400P is ideal for both standard and EV wheels. It not only automatically detects wheel dimensions but also automatically detects the rim width by utilizing sonar sensors. Both features eliminate the need for manual input, reducing the possibility of errors.

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JohnDow Industries
Vehicle Fire Blanket,
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The **JohnDow Industries Vehicle Fire Blanket**, No. JDI-VFB1, is designed to suppress EV, hybrid, and internal combustion engine vehicle fire flames and fumes. The high temperature-resistant material prevents the fire from spreading and damaging surrounding vehicles and property in the shop. It also deprives vehicle fires of oxygen and minimizes the potential combustion reducing the fire temperature. The blanket measures 19.5" by 29.5" (575 sq. ft.) and weighs 61.7 lbs. It's made from fiberglass with flame-resistant coating material and includes large deployment handle straps and a storage bag for easy portability. An optional wall rack is available (No. JDI-WRFB).



Editor's Note: This fire blanket enables techs to isolate a Li-ion battery fire, preventing it from spreading and ultimately keeping it from damaging surrounding vehicles and the shop. Although it may not put out the fire, it will contain it until the fire department arrives. Safety is always a No. 1 priority.

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KNIPEX
9" Crimping Pliers -
Four-Mandrel DT Contacts

The **KNIPEX 9" Crimping Pliers - Four-Mandrel DT Contacts**, No. 97 52 67 DT, are



designed to crimp all turned male and female contacts for the DT, DTM, and DTP series (Deutsch series). The pliers have a crimping capacity from 22-12 AWG and their synchronous feed of the four mandrels achieves ideal crimping results with eight indentations (4/8-indent). Additionally, the tool features a crimp depth selector wheel with eight locking positions, a non-locking ratchet mechanism, comfortable multi-component grips, and the position settings for the crimp depth can be clearly read on the pliers.

Editor's Note: This crimper offers repetitive, high crimping quality thanks to its ratchet (unlockable) mechanism and features a universal positioning locator for flexible adjustment of all contact lengths.

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GEDORE
Thread Reset Tool,
No. KL-0173-602 KA

The **GEDORE Thread Reset Tool**, No. KL-0173-602 KA, repairs damaged threads



without compromising the wheel stud's strength. The tool offers chipless repair, uses roll-forming technology, and can service the wheel stud in just 30 seconds, says the company. All the user needs to do is attach the tool to the wheel stud, use their 41mm socket wrench, remove it, and the repair is finished. This kit covers all makes and models on the road.

Editor's Note: Updated from its predecessor, the Thread Reset Tool is able to repair damaged threads and retain the wheel stud's integrity. This kit covers all passenger vehicles in North America, making it a great addition to any toolbox.

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Take a look at our photo galleries from the shows at:
VehicleServicePros.com/53077686 and VehicleServicePros.com/53077134

Portacool Apex Series

The **Portacool Apex Series** comprises six different models that cool areas from 500 to over 6,500 sq. ft., cooling with amplified air velocity across the entire line. The cooler's design features optimized airflow patterns that are intended to enhance the evaporative cooling experience. Additionally, this series includes the CoolSync technology platform which allows control over the fan's speed, the water distribution system, and more via the Portacool app.

Editor's Note: This updated line from Portacool offers so much with the touch of a button in the new CoolSync app; not only can users control fan speed, they can also direct the air flow and monitor the water-level while receiving real-time updates. The redesign also offers reduced noise levels.



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Hunter Engineering Ultimate ADAS

Hunter Engineering's **Ultimate ADAS** system is designed to eliminate error-prone manual layouts common to static ADAS calibrations. Ultimate ADAS combines Hunter's standard-setting alignment technology with a guided target placement system for around-the-vehicle coverage. Gimbal-mounted lasers are the key component, replacing the inexact guesswork for strings, plumb bobs, and tape measures to cut setup time by 70 percent for certain procedures. The gimbals' onscreen guidance provided by Hunter's WinAlign software increases target placement precision by automatically compensating for non-level floors, monitoring for placement errors, and confirming accuracy with laser measurements each step of the way. Ultimate ADAS is currently exclusively available to Honda and Acura dealers, with availability set to expand in 2024.

Editor's Note: After watching a live demo of this system, it's safe to say that the claim of cutting setup time by 70 percent is no exaggeration. A normally 15-minute, 21-step OEM procedure was done in less than two minutes.

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Philips Xperion 3000 Pocket LED Lamp

The **Lumileds Philips Pocket LED Lamp** delivers a 300 lm white beam and has a battery life of three hours regularly or 10 hours in eco mode. The 180-degree pivoting base allows users to direct the light exactly where they need it to go. If users need to work handsfree, the Pocket Lamp has a 360-degree retractable rotating hook, as well as a magnet built into the base. With its robust housing, the light is able to withstand some rough treatment. The lamp comes with a USB-C charging cable.

Editor's Note: The professional-quality and affordably priced Xperion 3000 Pocket Lamp is part of Philips' new line of work lights. The Pocket Lamp has all the bells and whistles a tech could ask for — magnet-pivoting base, rotating hook, water-, impact-, and solvent-resistance, and rechargeable lithium batteries.

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Rotary All-Vehicle Lift Arms

The **Rotary All-Vehicle (AV) Lift Arms** are designed to allow for maximum reach and retraction to properly lift all vehicles within the rated lift capacity using OEM-recommended pickup points. Whether utilizing the AV Lift Arms on an existing Rotary SPOA10 series lift or installing a next-generation lift system, shops of all sizes can easily lift nearly any vehicle make and model, including EVs, imports, and luxury vehicles, using a single lift. Notable key features include full clearance on EVs for easy battery removal and service, a larger pickup range for easier vehicle spotting, low-profile arms, and a shorter arm retraction.

Editor's Note: The AV lift arms make it easier for techs to pick up nearly any vehicle make and model, including EVs and very low-profile sports cars, using a single lift. The design eliminates the need to re-spot vehicles, maximizing labor time.

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PTEN TOP 100 PRODUCTS 2023



EACH YEAR, WE COMPILE A LIST OF the most inquired products found throughout the pages of PTEN over the year. We do this not only for us to see what products

our readers are interested in the most, but also to share with you, our readers, what products other technicians and shop owners are requesting more info about.

All inquiries were submitted via our reader service cards found in every issue and through our online e-inquiry system. Over the next couple of pages, you'll see the top 25 products of 2023. For the full top 100 list, please visit: VehicleServicePros.com/2023-top-100-products.

—Kayla Nadler, Associate Editor



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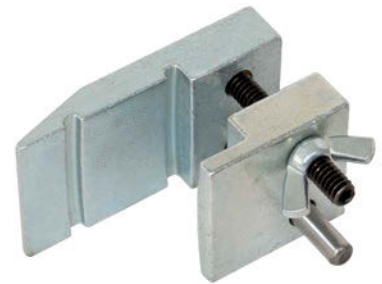


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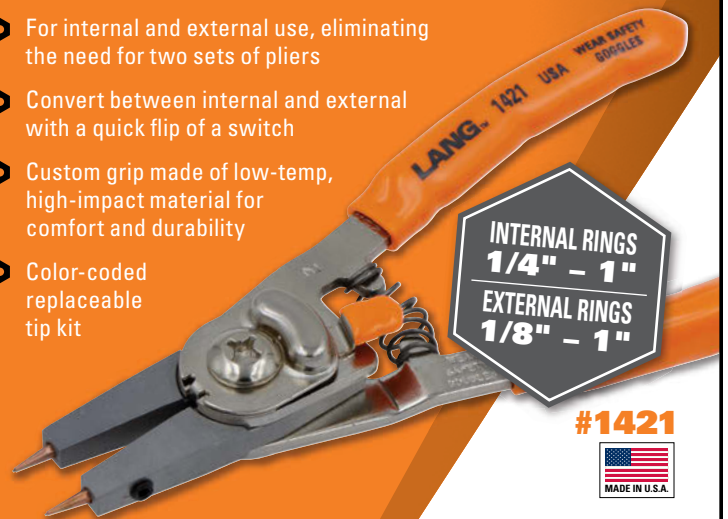
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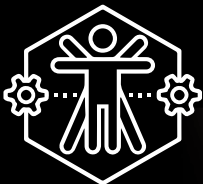
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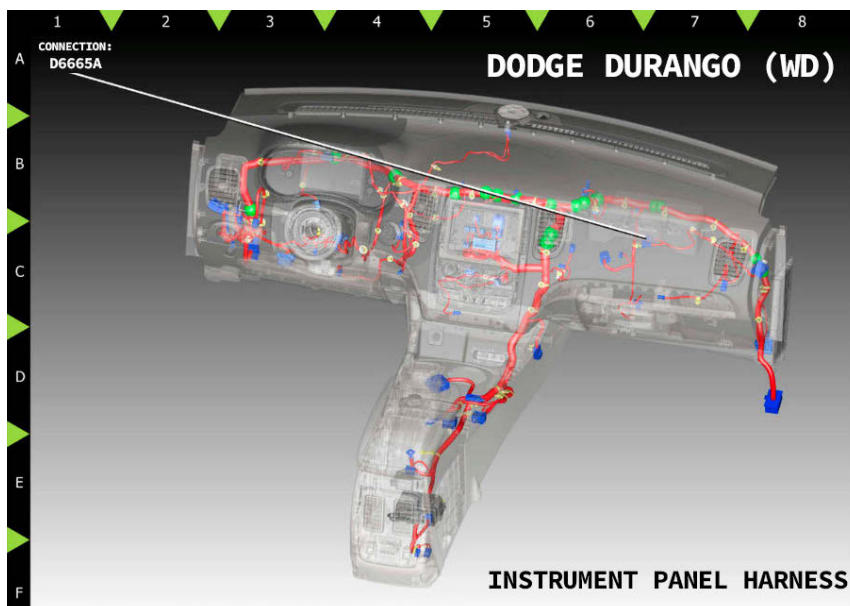
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Today's battery and electrical system service

Understand the proper procedures and tooling to repair automotive battery and electrical systems.

By **Ross Colket**, Contributing Editor



▲ *Chrysler dashboard illustrating the technology involved in today's vehicles.*
Photo from Mitchell 1

When it comes to today's vehicles, stable voltage is incredibly important.

On modern vehicles, just dirty battery terminals can cause drivability concerns. They can cause odd things with the vehicle's operation, from stalling just from poor contact at the battery terminals to communication issues and multiple trouble codes. When it comes to looking for this, a simple voltage drop test can be the best test to perform to find these types of problems. Due to the number of computers utilized in today's vehicles, it is increasingly important to ensure proper charging system operation as well.

DIAGNOSING ELECTRICAL CONCERNS

Now, when it comes to diagnosing an electrical concern you should always start with a complete battery and charging system test. I am going to show my age in my next statement. I started so long ago that I learned to test batteries with carbon pile testers. They would load test the battery and generate quite a bit of heat as part of the test, hence the nickname toaster. Today's battery testers (Figure 1) are conductance-type testers and do not load test the battery, instead, they test the internal resistance of the battery. The benefit of this type of tester is that the battery does not have to be fully charged

in order to perform an accurate test. I have had the occasional battery that if you load tested it, it would fail but it would pass the conductance test. Those batteries have been the exception rather than the rule though.

The next step is to check the charging system for proper operation and voltage. As part of my charging system testing, I will typically turn on all the major loads in the vehicle and see where the voltage rests. If I do find a problem, I will begin by voltage drop testing the charging system. This is the fastest way to locate any type of issue you may have in the charging circuit.

THE MODERN VEHICLE'S BATTERY

More and more vehicles are installing the battery in the trunk. The reason for this is to maintain the temperature of the battery more consistently. Being installed in the trunk, the battery is not exposed to the high underhood temperatures of the engine. But in doing so, the batteries have become more difficult to access and replace. Make sure to consult the labor guide for proper testing times on these applications.

Also, more and more vehicles are coming from the factory with AGM-style batteries. As you can see from Figure 2, the battery doesn't look any different from a normal flooded LED cell battery, but don't let this similarity make you forget to reset the battery life cycle in the PCM. The purpose of doing this is to ensure the proper charge rate for the new battery. An aged AGM battery is going to have a more aggressive charge rate to maintain the

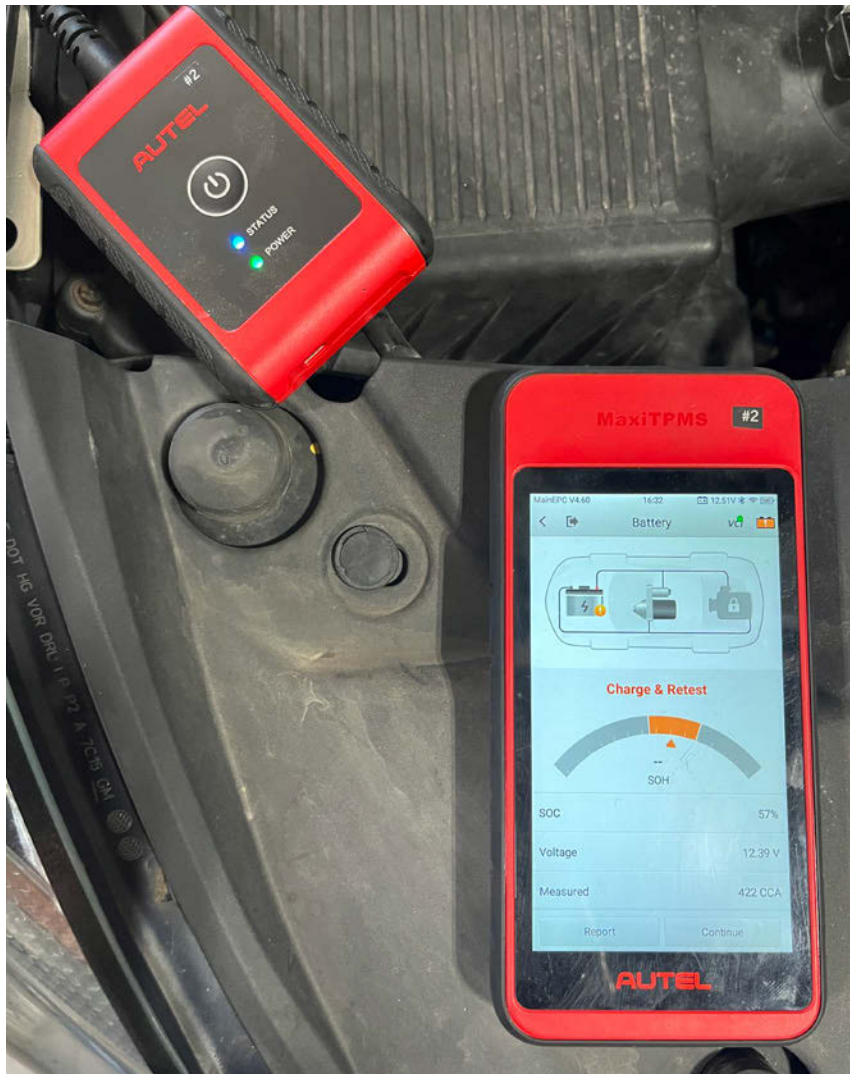
» TOOLS USED:

- AUTEL BATTERY TESTER
- BATTERY CHARGER
- CHARGING SYSTEM TESTER
- VOLTAGE TESTER
- DIAGNOSTIC SCAN TOOL

proper charge level of the battery. If you do not reset battery life with a new AGM battery, it will dramatically decrease the life of the new battery. I have personally seen a new AGM battery where the battery life wasn't reset, which caused the new battery to fail within two years.

WORKING WITH ALTERNATORS

When it comes to alternators, there are plenty of things that can go wrong. From broken sprag clutches to bearing failure to bad voltage regulators. Make sure you understand the proper operation of the alternator that you are working with. Remember when using remanufactured alternators there is approximately a 14 percent return rate for all rotating electrical in the industry (Figure 3). Also, be sure to do a proper diagnosis of the complete charging system before condemning the alternator. There is nothing more frustrating than replacing a second alternator only to ultimately find it was something you missed during your initial diagnosis — especially when it is a 3-plus hour job.



▲ Figure 1 — This battery tester is indicating a battery needs further testing.
Photo courtesy of Ross Colket

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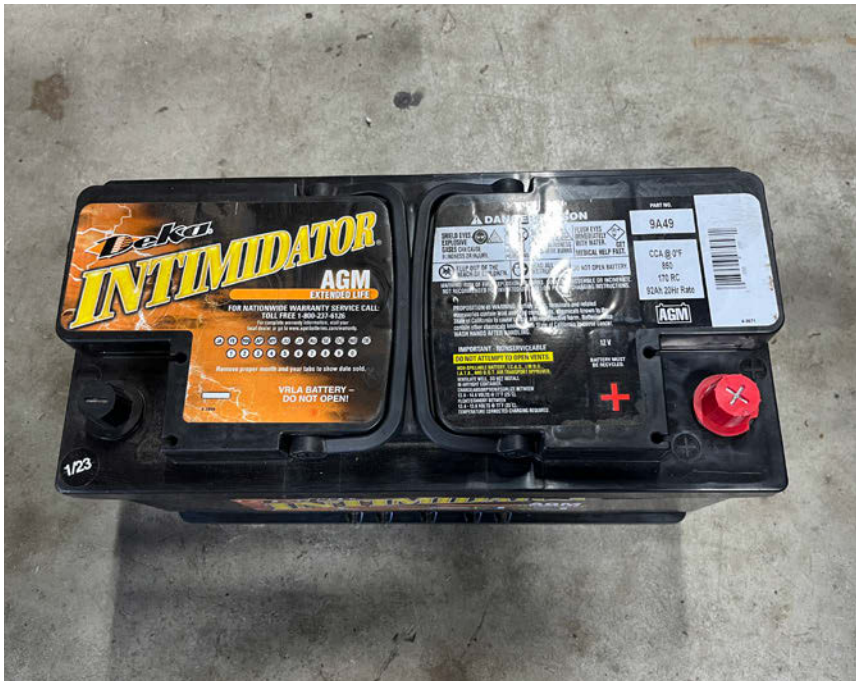
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▲ **Figure 2 — An AGM battery; notice its similarity to a traditional battery.**
Photo courtesy of Ross Colket

I personally will install the new alternator and verify proper operation. If it is not operating properly, I will begin my diagnosis from the beginning to verify it is truly the replacement part and not an issue in the wiring or the PCM. Doing this could save you the aggravation of replacing the alternator again.

VOLTAGE REGULATOR

There are many different strategies used to control the voltage regulator of the alternator. Ford for example, when first started and with low rpm, the voltage regulation is handled by the alternator's internal voltage regulator. Once the engine hits 1,400 rpm the system switches over to the PCM for voltage regulation. This is accomplished by a pulse width modulated signal. There is a control and feedback from the alternator to the PCM. If either one of the wires breaks, the alternator's internal voltage regulator will continue to handle the charging circuit, but you will have a red battery light on the dash. Keep in mind the red battery light will be off until you hit the 1400 rpm. Once you hit that rpm level the light will come on. The trick to repairing any of these charging systems is dependent on knowing the theory and operation of the system.

DIAGNOSING INTERMITTENT/ CONSTANT PROBLEMS

One of the first things I do when I am diagnosing a vehicle with either an intermittent or constant problem is to watch the voltage through the scanner as well as what the PCM is reporting. Obviously, if the concern is in another system look for the voltage PID in that module. You could have a voltage drop at a connector or even a damaged wire going to just that module. Do not forget when performing any testing to make sure that you have a good ground for accurate readings.

I try very hard not to use resistance tests unless I'm specifically testing a sensor. Think of a multi-strand wire connected to the headlight. If one strand is still making contact it will show good resistance readings. However, if you load test the circuit with the headlamp, the light will barely light,

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if at all. The wire simply cannot carry the amperage load through one strand. This is where voltage drop testing comes into play. You would pick up on that failure as soon as you tested that part of the circuit.

CASE STUDY 1: FORD F-550

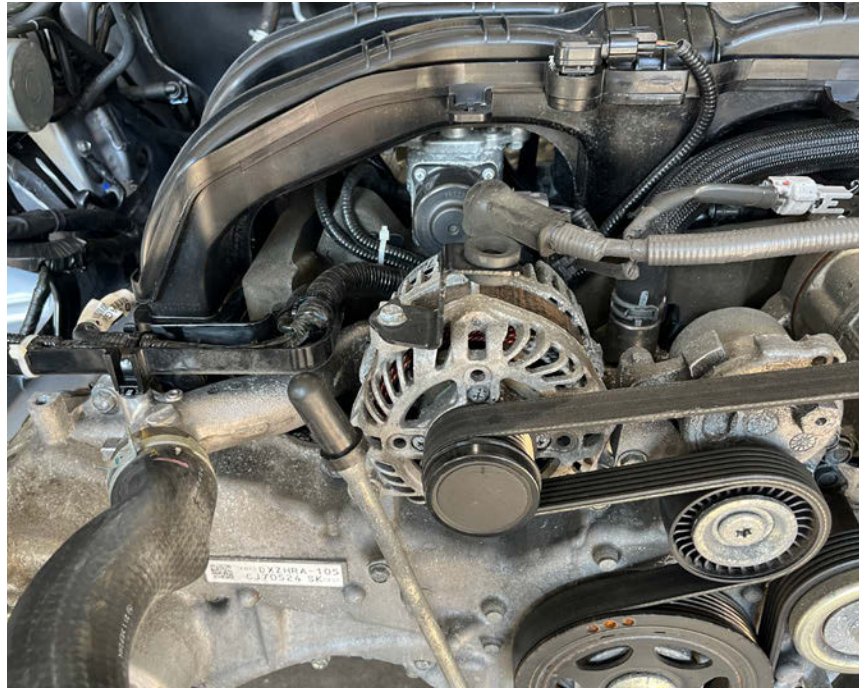
We recently had a client's vehicle in for an intermittent stalling concern on his Ford F-550. The complaint was described as he would be driving down the road and the truck would shut off for a split second and a few lights would come on, on the dashboard (**Figure 4**). The truck would slow down to approximately 35 mph and then restart, but the lights would remain on until the ignition was cycled.

Now, this client raced dirt track for years and recently performed a frame-off restoration on a Nova. He is very mechanically inclined but understood this was more than his capability. The very first thing we did was drive the vehicle, but we were unable to duplicate the problem. The next step was to perform a full vehicle scan to see what trouble codes popped up. The codes we found directly corresponded to a bulletin to replace the transmission wire harness for leaking into the external connector. Sure enough, we disconnected the connector and it was full of automatic transmission fluid.

We advised the client of our findings and actually showed him what we had found. He authorized the repair so we replaced the transmission internal wire harness and performed several long test drives to verify that that was the only problem. We logged over 50 miles on the vehicle with no problem. We contacted the client to let him know it was all set and he came and picked up the vehicle. Within half an hour the client texted me to let me know that the problem had reoccurred. That weekend he changed both batteries and he has logged over 1,400 miles on the truck since with no problems.

CASE STUDY 2: DODGE CHALLENGER

Electrical faults can be some of the most difficult to find. We had a Dodge Challenger that only under certain conditions would the network shut down. If



▲ **Figure 3** — A typical alternator illustrating proper physical condition.
Photo courtesy of Ross Colket



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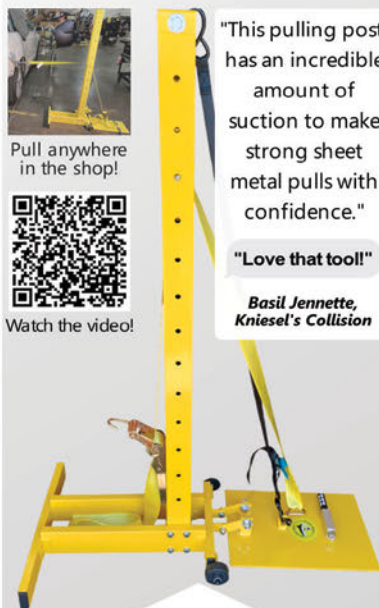


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TOOL BRIEFING



▲ **Figure 4 — Ford diesel engine and batteries showing that a bad battery or bad battery cable connections can cause strange problems.**

Photo courtesy of Ross Colket

you drove the car normally it was fine. The client had taken the vehicle to the dealer a total of six times with them being unable to duplicate the problem. The client finally brought the vehicle to us.

We found that if you put all the heavy loads on in the vehicle and let it just sit and idle. The voltage would drop down to 11.5V and the problem would occur. It was easy to see because the windshield wiper blades would turn on by themselves. The network would go down and everything would default to a safety mode. The Challenger's network is only CAN, there are no other networks on the vehicle, so the entire car would crash. On this vehicle, it ended up being the transmission control module. We determined this by connecting an oscilloscope to the network and began disconnecting modules from the bus bar until the network returned to normal.

THE RIGHT TOOLS FOR THE JOB

When performing electrical system diagnostics, know which tool is the right tool for the type of diagnostics that you are doing. A DVOM is not the right tool for

performing network diagnostics. The update rate is too slow for network diagnostics. For example, a DVOM's update rate is approximately 40 times a second or every 25 milliseconds (**Figure 5**). In the attached CAN signal, we can see we are looking at approximately 50 milliseconds. Our DVOM would sample that signal twice in that time frame. Most meters are average responding and will average the upper and lower voltage levels. If the meter samples CAN low both times at 2.5V it is going to read 2.5V on the display, but if samples CAN low at 2.5V and 1.25V it is going to display 1.987V. Make sure you choose the proper tool for the job that you are working on. ❌



ROSS COLKET is the owner of Colket Automotive Technical Services in Lansdale, Pennsylvania. He is an ASE Certified Master

Technician with over 30 years of experience as both a technician and educator. As a former CTI instructor, he believes in the importance of training and giving back to the industry. Ross fully supports and believes in Motor Age's mission to "advance the automotive professional."

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ProMAXX Ford 6.7L Power Stroke Fuel Injector Removal Kit

Reviewed by Randy Kaiser, service manager at Rost Motor, Inc. in Manson, Iowa.

Q: How did the tool function as far as saving you time?

A: This is a very unique tool, and a pretty good time saver. Instead of bolting down a traditional injector remover, you slip a button into the opening, position the remover, and snug it up to the injector. Then you slip the other part of the tool into your air hammer and let it do the work for you.

Q: How was its packaging? Did it come with any accessories?

A: The packaging is actually very nice. It comes in a very sturdy cardboard box that will easily fit into a toolbox drawer. There are no accessories included, just the components of the tool.



Q: What kind of setup was involved before using the product?

A: There is no setup involved. You simply take the tool out of the box and put it to work.

Q: How easy was it to use?

A: It's actually very easy to use. Once you position the button in the opening, you simply slide the injector remover into place and snug it up to the injector.

Q: What types of jobs/repairs did you use this tool for?

A: I used it to remove injectors on a Ford 6.7L diesel engine.

Q: Was there a manual included? If so, did you use the manual and was the manual easy to understand?

A: There was no manual included. There was a one-page instruction sheet with pictures that does a good job of explaining how to use the tool.

Q: What features did you like?

A: I like that you don't have to fasten it down to use it. You just slip it into place.

This makes it much quicker to use. Then after you have it in place, the air hammer does all of the work for you.

Q: Is there any way you could think to improve or add to this tool?

A: The button that you put in first is not overly big and sometimes gets a little slippery with oily hands. It could also possibly be dropped and lost. It might be a good idea to include a spare button with the kit.

Q: How does this tool compare to other tools you've worked with?

A: I have used other injector pullers, but never one that was designed to be used with an air hammer. This feature makes it much easier to remove the stuck injectors.

Q: On a scale of 1 to 10, how would you rate these tools overall? Why?

A: Probably a solid nine. It was very well made and fit well on the injectors so that it didn't slide off. It was quick and easy to install. The added advantage of using the power and vibration of the air hammer to remove stubborn injectors is a big plus. ✖



RANDY KAISER started working at Rost Motor, Inc. shortly after graduating high school, and he is still working there 48 years later. Through the years, he has been a lube tech, line tech, paint

and body tech, parts department head, service manager, and is currently in charge of the parts and service departments. Kaiser is ASE Master Certified and a Ford Master Certified Technician, as well as a Ford certified Service Manager and Service Advisor.

PRODUCT DESCRIPTION

The **ProMAXX Ford Power Stroke 6.7L Fuel Injector Seat Repair Service ProKit - Robby** enables technicians to quickly remove stuck fuel injectors and easily refurbish the fuel injector seat in the 6.7L cylinder head. The Robby tool restores the seat's seal in approximately 15 seconds, maintaining cylinder head compression and engine performance. The ProKit is designed to remove carbon deposits and restore the seat to factory new. It includes the company's PowerPull 6.7L Fuel Injector Removal Kit, which pops stuck fuel injectors quickly by not bolting/unbolting from the cylinder head. Engineered and American-made.

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Lisle Corporation 1/4" Pry Bar with Strike Cap

Reviewed Pete Rudloff owner of Pete's Garage Inc. in Newark, Delaware.

Q: How did the tool function as far as saving you time?

A: Sometimes you simply need a small pry bar that can take getting hit by a hammer.

Q: What kind of setup was involved before using the product?

A: Zero set up, just remove the packaging.

Q: Was there a manual included? If so, did you use the manual and was the manual easy to understand?

A: A manual of sorts is included, a single paragraph on the back of the card explaining the tool can be struck with a hammer.

Q: How easy was it to use?

A: The tool side of this is super simple, it is a pry bar, only smaller.



Q: How was its packaging? Did it come with any accessories?

A: Well packaged on a card with shrink wrap, traditional Lisle packaging.

Q: What features did you like?

A: The strike cap is critical, more pry bars come with this nowadays but that wasn't always the case. Technicians have been striking pry bars for a long time and not having a strike cap inevitably ends up in the handle getting damaged or sometimes completely breaking off.

Q: Is there any way you could think to improve or add to this tool?

A: Lose the shirt pocket clip, I don't see this as a tool that one would typically carry around all day. The clip makes handling the pry bar a little awkward, and it pops off very easily.

Q: What types of jobs/repairs did you use this tool for?

A: Seal removal and light duty prying, it is only limited by the user's creativity. It's not a tool for every job but most technicians will find a use for this small pry bar.

Q: How does this tool compare to other tools you've worked with?

A: I own many pry bars, none this size. I'm actually surprised by how often I use it now that I own one this size. It is going to save me from damaging many flat-bladed screwdrivers.

Q: Is there anything you had questions or concerns about in regard to the tool?

A: None, the tool is quite user-friendly and does exactly what it is designed to do.

Q: On a scale of 1 to 10, how would you rate this tool overall? Why?

A: An eight. I think its a great tool and has lots of practical purposes. ⓧ



PETE RUDLOFF is a nationally awarded technician, national automotive instructor/consultant, technical writer, software developer, automotive trade advocate, and owner of

Pete's Garage Inc. in Newark, Del. Rudloff has a national reputation as friend to the general auto repair shop and is known for fixing difficult to fix cars and facing challenging trade issues head-on. In 2016, Rudloff created FlexCheck Auto DVI in order to help independent auto repair shops nationwide increase their revenue.

This product was given to the reviewer free of charge from the manufacturer.

PRODUCT DESCRIPTION

The **1/4" Pry Bar with Strike Cap**, No. 35100, from **Lisle Corporation** is designed to remove seals, electrical connectors, O-rings, plastic caps, interior trim pieces, metal, and plastic retainers. The strike cap in the top of the handle can be tapped with a hammer, and the 1/4" square shaft pry bar has a pocket clip and measures 5" in length. In addition to these features, the tip design cradles the return spring to keep it from sliding off. The heat-treated material and extra-long shaft provides strength and stability, and an ergonomic handle gives users comfort as they work.

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Olsa Tools 3-Row Magnetic Socket Holder

Reviewed by Brin Kline, owner and technician at Assured Auto Works in Melbourne, Florida.



Q: How did the equipment function as far as saving you time?

A: Keeping sockets organized is a must for efficiency on any job. I have other socket organizers, but they require placing the socket on the square drive and turning the socket to lock it in. This takes a little additional time. With the Olsa Tools Socket Holder, the user simply places the socket into the holder. This saves time.

Q: How has using this tool impacted your shop's profitability?

A: Saving time while keeping my sockets organized makes us more profitable.

Q: What features did you like?

A: The magnetic base keeps the holder in place. I also loved that the sockets just need

to be simply placed in the holder. My other socket organizers require placing the socket on the square drive and then turning the socket. Being able to simply place the socket in the appropriate holder saves time.

Q: What kind of setup was involved before using the product?

A: There's no setup required. You just open the box and start organizing your sockets.

Q: How was its packaging? Did it come with any accessories?

A: Each organizer comes individually wrapped in plastic inside a box. There was also a 'thank you' note for the purchase and a sticker.

Q: Was there a manual included? If so, did you use the manual, and was the manual easy to understand?

A: There was no manual included, and there's no manual needed.

Q: How easy was it to use?

A: It is very easy to use.


Q: Is there any way you could think to improve or add to this tool?

A: The socket holders are marked for

socket placement. For example, the holder designed for 1/2" drive sockets have holders for 10mm to 27mm sockets and each one is marked. This is nice but many times, socket sets don't come in certain sizes. For example, it's not uncommon for 1/2" drive socket sets to not include a 20mm or 23mm socket. In those cases, the 20mm and the 23mm socket cavity is empty and it looks like the set is missing sockets.

I'd suggest either leaving it blank or including a way for the user to mark the cavities as desired.

Q: On a scale of 1 to 10, how would you rate this tool overall? Why?

A: 10. I do recommend these holders. They are well-made and really offer a well-organized look. They are very easy and quick to use. 



BRIN KLINE is the owner of Assured Auto Works in Melbourne, Florida, an automotive general repair business with a mobile diagnostic and module programming division. He has been in the automotive industry for 27 years. Kline also teaches for Carquest Technical Institute and Trained by Techs, is a member of the Automotive Service Association's Mechanical Operations Committee, and president of the Automotive Service Association (ASA) of Florida.

PRODUCT DESCRIPTION

The **Olsa Tools 3-Row Magnetic Socket Holder** can hold both deep and shallow sockets. This holder is compatible with 1/4", 3/8", and 1/2" drive Metric and SAE sockets, fitting impact and chrome sockets from any brand. It also features clearly labeled size markings for easy identification. Each magnetic socket organizer can hold three complete sets of its respective drive size. The magnetic socket holder can be stored in a drawer or mounted to the side of a toolbox.

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This product was given to the reviewer free of charge from the manufacturer.



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Ledlenser HF8R Work Headlamp

Reviewed by John Baumgardt, owner and operator of Baumgardt's Auto Repair in Fillmore, Indiana.



Q: How did the tool function as far as saving you time?

A: The headlamp has very good battery life and didn't need charging as often as my other headlamps, so that saved a little time.

Q: What kind of setup was involved before using the product?

A: The headlamp came fully charged with the strap already installed.

Q: How easy was it to use?

A: The HF8R beam can be focused manually, and it also has functions that will allow it to switch between flood and spot lighting or dim and focus automatically

PRODUCT DESCRIPTION

The **HF8R Work Headlamp** from **Ledlenser** is designed with the brand's patent-pending adaptive light beam technology, allowing the light to dim and focus automatically. The headlamp is waterproof, has a high color rendering index for close-range work, and an additional red front light. It has four modes: boost (1,600 lm up to 690'), high power (900 lm up to 650', 3.5-hour run-time), mid power (300 lm up to 325', 10-hour run-time), and low power (20 lm up to 80', 90-hour run-time). Additional features include a memory function, a front switch, a rotary switch that allows the user to change between colors while using the light, a comfort pad, and a connecting adapter.

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making the HF8R truly handsfree as the manufacturer says. The HF8R can also be controlled with Bluetooth by downloading an app. The app enables more functions that are not able to be utilized without it. The light is quality built.

Q: What features did you like?

A: One feature that I've never seen before is the transportation lock that prevents it from being turned on while in a tool bag. Also, being able to focus the beam is extremely useful while trying to see deep into an engine bay. I really like that it's waterproof and dustproof too. The headlamp has a charge indicator that lights up when first turning on the lamp, so you don't get surprised by a dead battery.

Q: How was its packaging? Did it come with any accessories?

A: Everything was neatly packaged in the box with illustrations on what's inside and what features the model has. The HF8R came with a charging cable, wall mount, overhead band, connecting system adapter, and helmet mount.

Q: Is there any way you could think to improve or add to this tool?

A: The magnet connection breaks free pretty easily unless you're using the wall mount. Also, I think I would make it so they could be laid on a charge pad. Having

to keep a dedicated cable for the lights could prove to become a problem.

Q: Was there a manual included? If so, did you use the manual, and was the manual easy to understand?

A: There was a paper that illustrated how to control the light. I read it so that I could figure out all the functions.

Q: What types of jobs/repairs did you use this tool for?

A: The HF8R was a bit too bulky to use under the hood but could be used under the car when pulling a couple of driveshafts for U-joints and carrier-bearing replacements.

Q: On a scale of 1 to 10, how would you rate this tool overall? Why?

A: 8.5 — It's a great headlamp, but from an auto technician standpoint, having all its weight at the front is a bit too big and bulky unless using the overhead strap. ✖



JOHN BAUMGARDT III is the owner/operator of Baumgardt's Auto Repair in Fillmore, Indiana. He has been a professional auto tech for about 20 years. He attended the two-year Auto Mechanics program at Lancaster Vocational High School. Previously, Baumgardt worked at AAMCO Transmissions and earned about a dozen AAMCO certificates. He believes it's important to provide an honest, quality service that people can depend on.

This product was given to the reviewer free of charge from the manufacturer.

KNIPEX Tools 4" Pliers Wrench

Q & A with Peter Grable, product manager at KNIPEX Tools.



Q: What makes this product innovative?

A: One of the key things about this tool is the size. It's only 4" in length...[and] has a 3-1/4" jaw capacity. The jaws are smooth, so it won't mar any surfaces [and] it has a one-hand adjustment. What I mean by that is there's no push button like our other tools. All you have to do is lower the tool one way and push it together, it'll close onto the fastener. It also has a box joint design, 10 adjustment positions, and a textured handle at the back for better grip. One of the key things that people come up and tell us is that they'll pull the tool out of their pocket and say, "I carry this tool all the time every day." That's one of the coolest compliments we get about this tool.

Q: What was the inspiration behind creating this product?

A: We got a lot of feedback from customers saying, "I really need to get into some tight areas. I like the design of the pliers wrench that you have, can you make something smaller?" So, lo and behold, we came up with the 4". That's kind of the basic premise behind the inspiration for the tool.

Q: How will this product improve the lives of technicians and shop owners?

A: Like I mentioned before, a lot of our customers put this in their pocket for everyday carrying [and] the amount of projects they work on is unbelievable. They'll say, "I got in a really tight area [and] this was the only tool that I could use to get into that tight spot and finish the job." That's the real reason for it.

Q: What has the feedback been like from technicians who have purchased this tool?

A: It's been outstanding, I mean, every show that we go to [people] come up and tell us that [it's] the coolest tool they've seen. If they

haven't seen it, we show it to them. They [say], "Wow, that is really cool. I want that tool; I have to have it." So, that's really cool for us.

Q: Is there anything else you think our readers should know about the tool?

A: We've covered all the major highlights on it, [but] one of the key things is that if you're used to using [KNIPEX's] other push-button tools, this one doesn't have the push button. All you have to do is just lower the handle all the way down and then push it back up. Another key feature is the chrome finish. The nice thing about the chrome finish is, if you're working in an environment that has some chemicals [present], it is a little more chemically resistant than other finishes. ✕

 To view the full interview, visit: VehicleServicePros.com/53078050

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The Innovation Awards honor companies that take their products to another level and offer unique features that make a technician's job easier. If you would like to submit a product to be considered for the 2024 Innovation Awards, entries will be accepted starting in February.

CATEGORY SPOTLIGHT

TIRE & WHEEL SERVICE

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The **Platinum Tech 1/2" Drive Split Beam Torque Wrench**, No. PLT-12250, offers a range from 40 to 250 ft-lbs, with 5 ft-lbs increments. It measures 24.2" in overall length and its head flexes up to 15 degrees for improved access. The PLT-12250 is certified DIN ISO accurate to ± 4 percent CW (specific calibration results at the time of manufacture will be shown on the included certificate) and each wrench is calibrated according to ASME B107.300-2010 standard.

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FEATURES REVERSE TAPERED THREADS

The **17mm Emergency Lug Nut Remover**, No. 5905, from **CTA Tools** is designed to take on stripped, swollen, and missing key lug nuts with ease. The reverse tapered threads bite down, restoring grip to remove lug nuts.

Redesigned with durable steel, the remover socket is reusable to tackle future lug nut mishaps. The tool is meant to be used with a 1/2" drive impact wrench.

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CAN WIRELESSLY PROGRAM UP TO EIGHT SENSORS

The **TP150 TPMS Diagnostic Tool** from **Xtooltech USA** integrates tire pressure programming, tire pressure diagnosis, and tire pressure matching. It supports activation of 315MHz to 433MHz tire pressure sensors and can wirelessly program up to eight Xtooltech TS100 universal tire pressure sensors.

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CATEGORY SPOTLIGHT

Tire & Wheel Service



CONCAVE CENTER PREVENTS WHEEL SLIP OFF

The **Tool Aid 10-pc Wheel Stud Pin Hanger Set**, No. 65180, is designed to thread into the wheel hub of many European vehicles, assisting in safe removal and installation. The set helps align and stabilize brake discs to the hub during service. The pins are color coded, have laser etched sizes for easy identification, and are packaged in an EVA foam tray with their sizes etched into the tray as well. Their concave center also helps prevent wheel slip off. The set includes two of each size: M12 by 1.25, M12 by 1.5, M14 by 1.25, M14 by 1.5, and M16 by 1.5. All sizes are also available individually.

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The **Ascot Supply Wheel Stud Service Kit** is designed to provide fast and effective removal and installation of wheel studs. It's recommended to use with an air-powered impact wrench. This kit allows users to remove or install wheel studs without removing the hub. It includes interchangeable adapters for maximum access and ensures accurate installation.

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The **OEMTOOLS 8-pc Torque Limiting Extension and Thin Wall Socket Set**, No. 24228, can help prevent over-tightening of wheel lug nuts and prevent breakage or damage on studs and wheels. By limiting the torque to the required rating, this set can help extend the life of thin wall sockets and allow easier access to tighter spaces. This set comes with four limiting extension bars (65 ft-lb, 90 ft-lb, 100 ft-lb, and 110 ft-lb) and four deep sockets (17mm, 19mm, 21mm, and 22mm).

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The **HawkEye XL Alignment System** from **Hunter Engineering** is designed for speed, durability, and ease of use for a wide range of commercial vehicles, including trucks, trailers, buses, and more. The aligner features Hunter's patented 3-D targets that are low maintenance and non-electronic as well as high-definition cameras to monitor each wheel in a 3-D space to provide accurate measurements. Users can also see live alignment readings from three axles at a time and are able to perform alignments on either the floor or a lift thanks to its moveable camera beam and portable cabinet. Additionally, HawkEye XL connects to the HunterNet 2 customer portal, allowing shop owners to monitor alignment performance remotely and in real time.

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The **Ranger TruSensor TS58R Universal TPMS Kit** is designed to diagnose and program import and domestic tire pressure monitoring systems. Offering 98 percent global vehicle coverage, the kit includes a portable TS58R tool with a color touch-screen, four metal stem sensors, four snap-in rubber sensors, a USB interface cable, an OBD-II cable, and a power cord, all packaged in a durable, padded carrying case. TruSensor TS58R can test tire pressure, temperature, and battery life; read and clear TPMS diagnostic trouble codes; reset warning lights; and accurately diagnose car key remotes and fobs. It supports all 315 and 433 MHz aftermarket and OEM sensors.

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The **ATEQ TPMS Tools VT67 TPMS and Tire Management Diagnostic Tablet** is Android-based and has a large screen, expansive memory, and a built-in camera, making it easy for users to store and manage essential customer data. The VT67 is equipped to handle features such as compatibility with the company's upcoming TPMS Cloud platform, BLE sensor scanning, and secure gateway. Similar to all ATEQ tools, the VT67 offers 100 percent OE sensor coverage as well as coverage for 20+ aftermarket sensor brands. It also includes ID match functionality, built-in email, Wi-Fi/real-time updating, and more.

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Photo courtesy of Robby Layton

The wall of storage

By utilizing Milwaukee Tool's PACKOUT storage system, this shop owner was able to organize an entire wall of tools.

By Kayla Nadler, Associate Editor

When Robby Layton, technician and owner of Layton Autobody and Paint in Ephraim, Utah, found out about Milwaukee Tool's PACKOUT wall storage system he knew it was an obvious solution for him.

Although he already has four Snap-on toolboxes — two 72", one 54", and a side locker — he still found most of his tools lying around the shop, whether sitting on top of a toolbox or on the ground under cars.

"I'm organized but not very good at figuring out organization," he says. "Milwaukee makes it super simple with their PACKOUT cabinets and drawers. I mean basically, they give you the solution for putting stuff away and keeping it organized."

CUSTOM-FIT

Spanning 7' high and 7' across, Layton was able to create his own "toolbox" by utilizing a modular system to fit his needs.

OWNER

Robby Layton
 Shop: Layton Autobody and Paint
 Location: Ephraim, Utah

"It's like a toolbox but it's connected to the wall," he notes. "It's pretty sleek and it actually takes up less space than a [typical] toolbox. It goes higher on the wall but it's not as deep as a toolbox."

Everything from his cordless tools and batteries to bits, sockets, and tap and die sets has a dedicated spot on the wall, keeping both him and his team ready for anything.

"Everything has a place; everything has a holder," he says. "Everything is just so efficient. [Milwaukee] really thought it through and made it very user-friendly to organize."

Aside from functionality, Layton's favorite part is how it looks.

"It looks pretty cool," he states. "Having an entire wall that is nothing but tools is very aesthetically pleasing," he adds.

TOOL OBSESSION

There's just one rule when it comes to Layton's wall of modular storage solution: It's only to house Milwaukee tools. All other tools go in his Snap-on boxes — which are 90 percent Snap-on tools anyway, he claims.

He not only admits that the PACKOUT wall is "a little bit obsessive" but he also confesses that he's fixated on having good tools. "I go a little overboard when it comes to tools because you have to have the correct tool for the job."

He started his Milwaukee collection in 2012 and since 2013 he completely switched to using Milwaukee cordless tools.

The main reason is due to compatibility.

"The cool thing about Milwaukee is they don't break compatibility," he says. "I can clip on their new M18 Redlithium Forge XC6.0 battery into a tool that I have from 2012 and it will run just like a brand-new tool from 2023."

JUST THE BEGINNING

In addition to owning a collision repair shop as well as a tow company, Layton is also a full-time YouTube content creator (@RobbyLayton). Having the right tools is essential and staying organized is just as important.

When asked if he'll be adding to his 'wall of storage', he responded, "Definitely."

"This is my start," he says. "I'll probably end up getting the entire PACKOUT wall system." ❌

Want to see more photos of Layton's box? Visit: [VehicleServicePros.com/53078776](https://www.vehicleServicePros.com/53078776)



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DIAGNOSTIC PROCESS

DECEMBER 2023

GUIDE TO DIAGNOSTIC PROCESS AND TOOLS

ESSENTIAL TOOLS, ADAS,
AI TECHNOLOGY, AND PRODUCTS

Scan tools

Finding the right tool for your shop

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ADAS Recalibration

a step-by-step guide with expert insights

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Follow the process

A set diagnostic process keeps the shop running smoothly.

By Emily Markham, Editor
Emily@VehicleServicePros.com

Vehicles are only getting more complex. Between ADAS, electric vehicles, and all the creature comforts being added and/or updated on today's vehicles, it's easy to get overwhelmed. When a customer brings in their vehicle with an issue that isn't easily resolved, what do you do? Answer: Follow your diagnostic process. Or create one using the steps below and then follow it.

STEP 1 – RECREATE THE CUSTOMER'S CONCERN

Though your first instinct may be to plug in your scan tool and see which DTCs pop up, resist this urge. The first step in your process should always be to recreate the issue your customer is having with their vehicle. This may mean doing a ride-along with them to ensure all the circumstances are the same and you don't get a different result than your customer when doing that final test drive.

STEP 2 – BACK TO BASICS

One of the dangers of not having a set diagnostic process in your shop is that all your technicians may be going about diagnosing a vehicle in different ways. This means they could be glossing over some of the more basic tests and making assumptions about the vehicle, which could lead to a misdiagnosis.

By having all your technicians follow the same steps on every vehicle and perform the same tests checking the basic mechanical and electrical standards, you ensure that nothing is overlooked. This also helps when training a new technician because the steps are the same for everyone.

STEP 3 – UPPING THE ANTE

With the basics out of the way, it's time to do some more intrusive tests if necessary. Something along the lines of compression testing or time belt alignment. After completing steps 1 to 3, if you still don't have a diagnosis, it's time to perform some pinpoint tests from the computer to individual components.

Implementing a standard diagnostic process in your shop not only keeps everyone on the same page but also makes it easier to explain to customers what's being done to their vehicle and provide them with any diagnostic test results.

In the following pages, we'll take a closer look at some essential tools every shop should have to aid in their diagnostic processes, how to pick these, and tips, tricks, and new techniques on how to use them. We'll also delve into ADAS and why your shop should consider tapping into this additional revenue stream if you're not already. Lastly, we'll look at some additional diagnostic products to keep in your toolbox. 🔧



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A systematic approach to finding the right scan tool

If you are in the market for a scan tool, there is more to consider than cost.

By Brandon Steckler



Brastock Images | AdobeStock

As a technician in the industry for about 25 years, I have had my hands on many different scan tools. Many of them were factory tools and many more were after-market tools. With the ever-changing advancements in technology, I have seen so many new convenient features implemented that make the scan tool even more powerful today.

However, one thing is certain. The scan tool will always serve as a liaison between the technician and the vehicle. Regardless of how much or how little capability the tool features, if it doesn't do what you need it to do, it is not a wise investment.

COST

Obviously, one of the first items to factor in is how much the scan tool is going to cost. There are functional scan tools that can be purchased for under \$200. Probably unsurprisingly, the functionality of

that tool is likely limited to simple and basic functions, like requests for OBD-II stored DTCs (Mode \$03) and perhaps the ability to request a list of completed monitors (Mode \$06). Although this data is useful, it certainly won't suffice as the tool to always get the job done, especially for a professional automotive technician. However, a technician needing a simple device to verify that OBD monitors have run to completion would need little more than the capability of a device like this one from Innova (Figure 1). The key is to realize the limitation of the device before making the investment.

VEHICLE COVERAGE

Vehicle coverage should be an important factor to consider when choosing a scan tool for obvious reasons. It's true that scan tools have come a very long way and the coverage they now provide is very extensive compared to how they used to. But be aware that certain scan tools shine brightly

within certain car lines, and very dimly (or sometimes not at all) with other car lines. It's important to have a scan tool that is going to serve you and your shop well in as many conditions as possible. In other words, choose a tool that is going to give you the most "bang for your buck," and be prepared to add other scan tools that are better suited to specific car lines when called upon.

SCANNING FUNCTIONS

I see the scan tool as a device that should offer us the ability to view data in a fashion that tells a story. With the data arranged properly, we should be able to easily



Figure 1— This scan tool from Innova is very functional for the cost of approximately \$200. However, the trade-off for such an inexpensive device is that it serves to provide only basic functions and will not support what is required for professional technicians in most situations.

Photo from Advance Auto Parts

perform a comparison of:

- Inputs
- ECU processing (response/reaction)
- Outputs
- Default/adaptive strategies

Having this ability will allow us to make diagnostic decisions from the driver's seat. What is the takeaway? This technique not only guides you to the next logical test but prevents you from performing a multitude of unnecessary tests, such as this Snap-on MODIS capture (Figure 2). In this instance, a slippage is occurring internally to a transaxle at the main shaft. Did I mention all of this is carried out from the driver's seat and without disassembling a thing?

ADDED FEATURES

Described above are necessities every professional technician needs to consider when purchasing a scan tool. The good news is that almost every scan tool a professional technician will encounter possesses those features. However, those need-to-have features can be complemented by nice-to-have features.

Many scan tools, such as this one from TOPDON, now offer a topological view of the ECUs sharing information on the data bus. This feature is incredibly efficient, as it allows for several time-saving techniques to be carried out. For instance, the tech can see which ECUs are communicating. This is tremendously handy to know when dealing with communication issues. This helps the tech triangulate where a fault is located.

Since the proper data arranged in an adequate format yields diagnostic decisions, better-arranged data may bring a diagnostician to those same conclusions easier and/or more efficiently. By taking the same collected data and arranging it in a different format, a certain pattern may stand out more easily. It's for those same reasons that pie charts, line graphs, and bar graphs exist in many industries. All are a

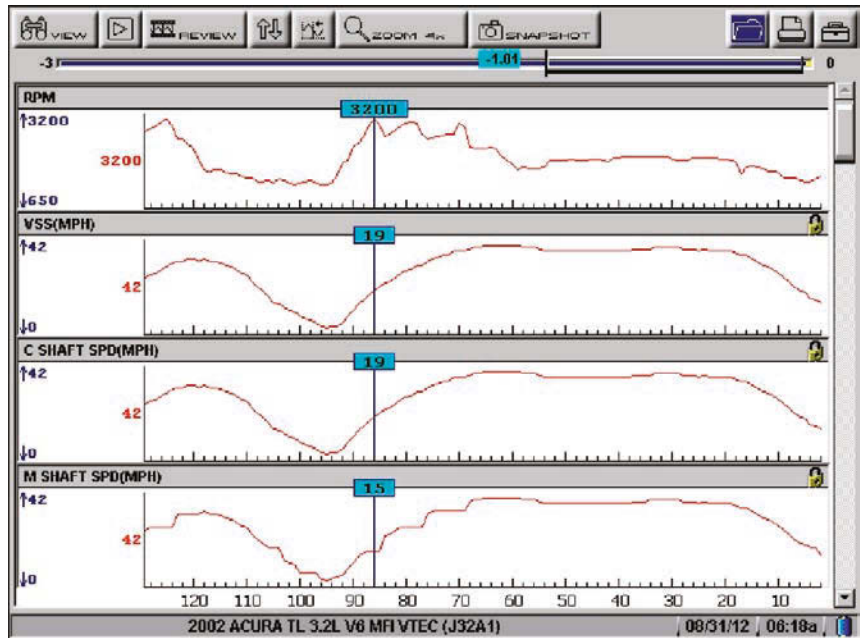


Figure 2— This graphed scan tool data provides insight to an internal transmission slippage occurring within a clutch assembly at the main shaft. This was deduced in only minutes, from the driver's seat and without any disassembly.

Photo courtesy of Brandon Steckler

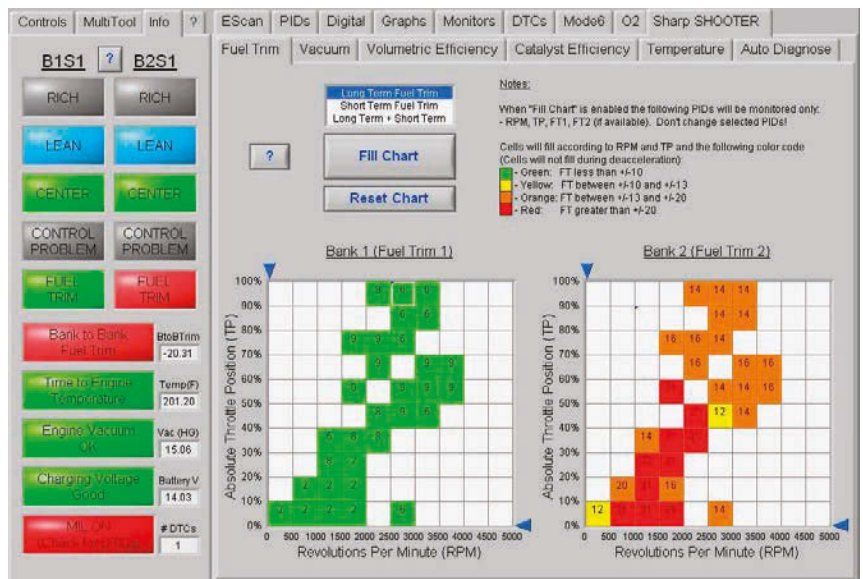


Figure 3— Graphing fuel trim data in color-coded load/rpm cells allows the analyst to see fuel trim trends under all operating conditions simultaneously. This helps identify a surplus or deficiency in fuel supply and under which operating conditions.

Photo courtesy of Brandon Steckler

form of comparative measure but each of the charts expresses different characteristics more easily.

Some scan tools will feature cellular charts data displaying a value at a

cross-reference point of two different criteria. Having the ability to sell all the possible cross-reference points at the same time (along with correlating data) is not just displaying a story...but all the chapters

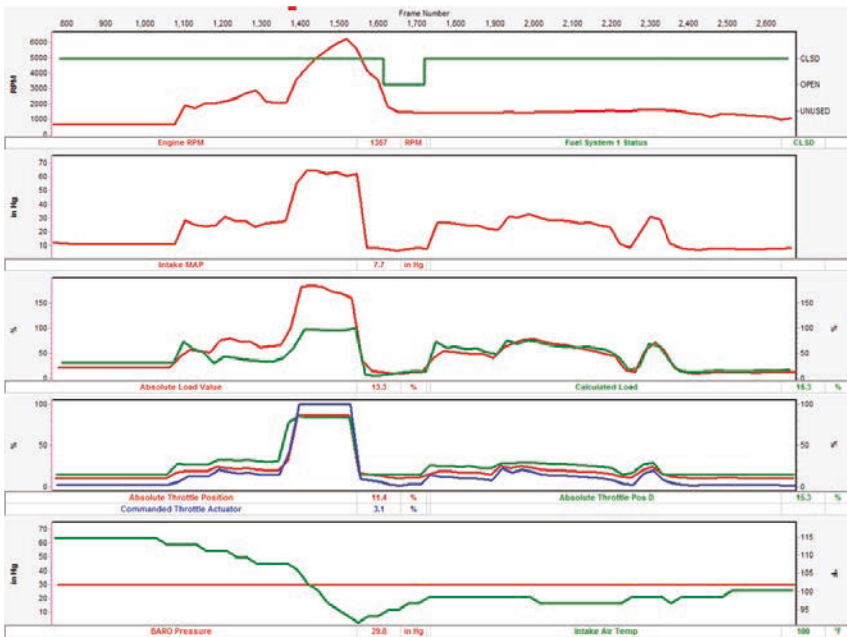


Figure 4— Superimposing line graphs allow an easy-to-compare view of data (like throttle position PIDs) that represents desired and actual positions. If the lines deviate from one another, an underlying fault exists.
 Photo courtesy of Brandon Steckler

of the book simultaneously. This is a great chart to discover trends. An example of this would be one from Automotive Test Solutions and their eSCAN ELITE Fuel Trim Chart (Figure 3).

Another example of a unique data arrangement would be merging graphed data to allow a superimposed view of two or more PIDs. A direct and easy-to-view comparison results and offers a quick view of like PIDs that differ from one another. For instance, this one from an old E.A.S.E. scan tool (Figure 4).

For instance, viewing actual and desired camshaft position PIDs is a quick “go/no-go” test of the VVT system’s functionality. No need to chase anything else if the two pieces of graphed data remain superimposed throughout the entire operating range of the engine.

BIDIRECTIONAL CONTROLS

The ability to take control of a system’s components allows the technician to virtually split a troublesome system in half, offering a “divide and conquer” strategy.

Assume for a moment you are faced with a power window concern with the passenger-front window being nonfunctional in the downward position of the master switch.

After viewing a wiring diagram, a logical approach would be to then view data displaying the command status of the right-front power window. Assuming the command was never issued by the ECU, it’s logical to verify the input request from the master switch. Regardless if the command was received, one would still like to know if the window functions as designed.

Using the bidirectional controls of the scan tool (like this screen capture from Autel) will bypass the switch input and directly command the ECU to roll the window down (Figure 8). Assuming that window then functioned, the integrity of the entire output side of the power window system has been verified. Again, no need for wasted time disassembling components. The answer was yielded from the driver’s seat.

J2534 FUNCTIONALITY

This feature is one that should be particularly considered nowadays; more so if no other such capabilities exist in-house. Locating the source of a fault and properly diagnosing the root cause is important. But if the job can’t be completed due to the inability to place software in barren ECU, you are forced to hire expensive outside assistance or pass the job along to a capable shop.

Keep in mind that in several scenarios, even having the ability to upload the appropriate software may not be enough. Some procedures known as post-programming routines may have to be performed (routines like a throttle angle relearn, steering angle sensor relearn, or some security system functions). Some scan tools will allow the software to upload but have no ability to perform certain post-programming routines. This could render a vehicle inoperable until the routine is complete.

A few scan tool providers even offer remote access ability to aid in these programming and post-flash routines. These paid-for sessions can also be used as a teaching guide to help a programming novice progress.

EXPORT FILES

Today, many scan tools offer the ability to save data in a format like a PDF or one that is interactive. This allows for the ability to export. Transferring these stand-alone files will allow the data to be analyzed remotely and offer the same abilities (to a PC) as the actual scan tool offers.

How can this come in handy? Many shops are structured with a shop foreman overseeing productivity, dispatching jobs, and providing technical assistance to other technicians requiring it. With the ability to export files, the diagnostician/shop foreman can remain in an office or at a desk. Any technician can be easily trained to capture data and send files to the shop foreman.

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With a structure like the above implemented, the technicians addressing the vehicles become the shop's eyes and ears. The experienced shop foreman/diagnostician becomes the brain not for one tech, but for any of the technicians in the shop. This can be a temporary or even a permanent solution to preventing inaccurate diagnoses. Reducing the need to have several A-techs on board can also be cost-effective.

These same files can be screen-captured and uploaded to free apps like Microsoft Paint, giving the ability to highlight, annotate, or otherwise call attention to certain characteristics of a particular capture. This same capture now becomes priceless training material to add to your archives or to reference for a new tech trying to enhance their depth of knowledge.

ADAS FUNCTIONALITY

Advanced driver assistance systems (ADAS) are prevalent in virtually all vehicles nowadays. After the repair or replacement of certain components, calibration of

certain ADAS subsystems must be carried out. Some of these calibrations are carried out dynamically, requiring them to be driven under certain specific operating conditions. Others are carried out statically, requiring objects and specific targets to be appropriately placed, and then registered by the vehicle's ECU.

In either scenario, the routines or calibrations must be initiated by the scan tool. Displayed here is an example from TOPDON's Phoenix Smart (Figure 5). These are certain factors to consider, especially given the current and growing prevalence of ADAS and the subsystems and components they encompass.

SCAN TOOL SOFTWARE UPDATES

One thing that many shops and individual technicians fail to consider when purchasing a scan tool is the cost to maintain that tool. Without mentioning names, some scan tool software annual upgrades can reach prices nearing \$1,000.

It's important to note or inquire about the consequences of not upgrading a tool

when new software is available. In other words, will a lacking software upgrade simply omit new features, or will the scan tool performance degrade or cease to function at all?

Many scan tool companies will offer special deals which may include free software upgrades for a year (or maybe several years). Also, keep in mind that scan tools can be found online anywhere you look. It's true that many times a lower cost scan tool found online may appear to be authentic but is not manufactured to function properly in the U.S. You may find yourself dead in the water when it comes time to upgrade the software and have nowhere to turn for technical assistance. Be sure to purchase your scan tool from a reputable source, regardless of the potential savings of purchasing online from an unknown source.

SCAN TOOL SPECIFICATION GUIDE

Of the scan tool features mentioned, they are just a few of many. Don't get yourself overwhelmed; these were merely suggested features to keep in mind to help guide you and your shop to a tool that will be less likely to disappoint.

Understand not one scan tool can do it all. If it could, everyone would own it and it would cost a lot of money. But being sure the tool you choose to go with is based on a decision that considers some of the factors mentioned above is always a wise one.

There has been research done across the industry to help narrow down the decision-making process for you. Information pertaining to many different scan tools can be found in the annual *Professional Tool and Equipment News (PTEN)* Scan Tool Spec Guide supplement. This comparative chart allows one to easily compare one scan tool to the rest with all the factors mentioned above (and many more). Keeping this information in mind when shopping for a scan tool will likely put one in your hand that will serve you and your shop well. 🛠️



Figure 5— Advance driver assistance systems (ADAS) prevalent in today's vehicles will be further implemented with time. Calibration of these systems will be required with even some of the most basic repairs we see in the shop on a daily basis. Scan tool functionality must support these required calibrations.
Photo courtesy of Brandon Steckler

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Old tools, new tricks

With the increase of electric vehicles pending, the need for a milliohmmeter may be in your shop's future.

By Jack Rosebro

It's been more than 20 years since some of us first started using milliohmmeters in hybrid and EV repair, generally to measure phase-to-phase resistances of motor-generators on first-generation Prius hybrids and the vehicles that came after it. Briefly, a milliohmmeter is a precision ohmmeter that can measure very small resistances in the thousandths of ohms (milliohms), and in some cases, millionths of ohms (microohms), as we will see. It does this, in part, by (1) employing four-wire Kelvin leads, which use two wires per lead to separate test voltage and test current, and by (2) generating a higher current than the average DVOM. It's a tool that might not be used regularly, but when you need to measure resistances of less than an ohm, and measure them precisely, nothing else will do.

USEFUL FEATURES IN A MILLIOHMMETER

These days, there are many milliohmmeters to choose from. In this article, I'll discuss functions to look for when choosing one, using the Hioki 3548 milliohmmeter as well as the relatively new laptop-based Pico MT03 milliohmmeter as examples.

Note: Milliohmmeters are often used to measure resistances of high-voltage components after the components have been de-energized. Care must be taken to follow all safety protocols as directed by the OEM before measuring.

Three features come to mind when I think of what I need in a milliohmmeter:

1. ACCURACY

The Hioki is accurate to ± 0.08 milliohms; the Pico is accurate to $\pm 0.5\% \pm 100\mu\Omega$. Both



Hioki 3548 showing 152.99 milliohms of U-to-V phase resistances on a 2013 Toyota Prius C. Photo courtesy of Jack Rosebro

of these meters are accurate enough for our automotive needs.

2. BATTERY-OPERATED

Some milliohmmeters are designed to be used for bench-testing components, rather than on-the-car testing. They run on 120V and usually require an extension cord to reach the vehicle. Battery-operated milliohmmeters, on the other hand, are portable as well as generally built to be more sturdy and resistant to damage than bench units.

3. AMBIENT TEMPERATURE SENSOR

Component resistance specifications in the milliohm range typically refer to resistance at a given reference temperature, usually 68 degrees F. If the component being tested is not at the reference temperature – and it probably isn't – the measurement reading must be adjusted for ambient temperature, using a rather

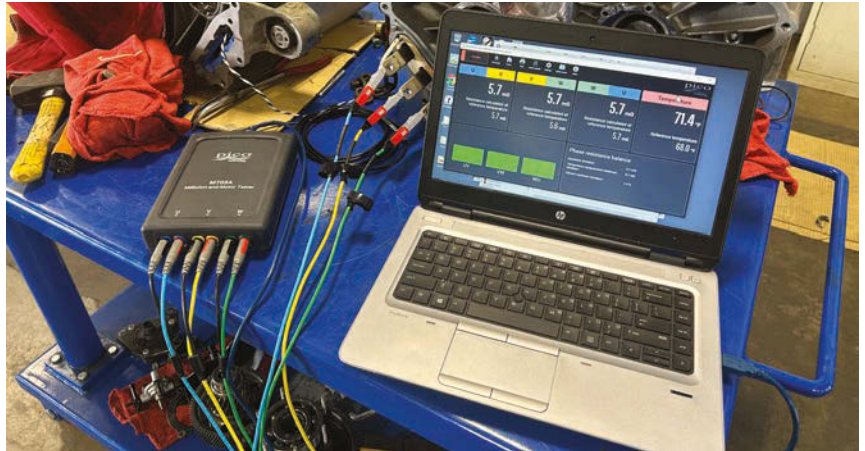
cumbersome equation that can sometimes be found in service information, if it is used. This creates a potential for error if the calculation is made incorrectly. Both the Hioki milliohmmeter and the Pico milliohmmeter come with ambient temperature sensors. These sensors, along with some circuitry, enable the meters to compensate for temperature during testing and to calculate the resistance that would be present if the resistance had been measured with the component at the reference temperature. Let the machine do the math.

Tip: Keep in mind that a milliohmmeter's ambient temperature sensor (if equipped) measures ambient temperature, not component temperature. If the component being measured has not cooled sufficiently, your readings will be high, as heat increases electrical resistance. Toyota specifies, for example, that low-ohms measurements be made only after the vehicle has been turned off for at least eight hours.

TAKING READINGS WITH A MILLIOHMETER

In the automotive service world, milliohmmeters are most commonly used to measure and compare phase-to-phase resistances of three-phase stator windings, as used in hybrid, plug-in hybrid, and electric vehicles. Such measurements can range from a few milliohms to several hundred milliohms.

Milliohmmeter leads are typically equipped with alligator-type leads, with a twist: rather than gaining a good connection by biting into the test point, the quality of the electrical connection to the test point is often more dependent on the amount of contact area between the leads' jaws and the test point. Quality milliohmmeter leads are typically gold-plated to inhibit corrosion and reduce the

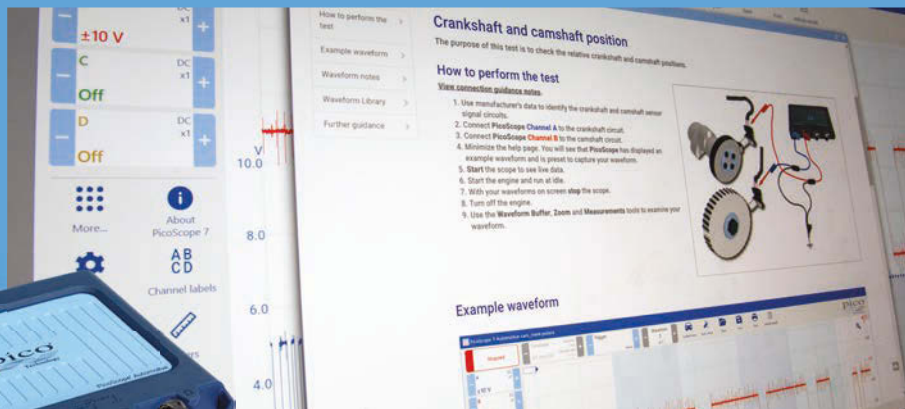


Pico MT03 is being used to measure phase-to-phase drive motor resistances on a 2013 Toyota RAV4EV.
Photo courtesy of Jack Rosebro

likelihood of unwanted resistance in the leads themselves. Sometimes it takes a bit of fiddling to get a stable reading; cleaning

the stator winding terminal ends with isopropyl alcohol may help. It may also help to twist the leads as with communication

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lines, to reduce line capacitance.

Note, however, that unstable readings can also be caused by loose motor-generator cables, which can set performance DTCs, and/or prevent a motor-generator from operating. Check fastener torque at both ends of the cable (inverter side and transaxle side), and don't trust resistance readings until they become stable.

HIOKI RM 3548 MILLIOHMMETER

The Hioki 3548 milliohmmeter is a popular resistance meter designed for automotive use. It's the tool that both Toyota and Tesla specify for their service centers. Hioki also offers a range of leads for specialized resistance measurements, in addition to the standard L2107 alligator-clip leads which come with the RM 3548.

PICO MT03 MILLIOHMMETER

The Pico MT03 is a relatively new product that uses a laptop to display test results. Test results are easy to print or send as a digital file. The MT03 is also unique in that all three phase-to-phase resistances of a stator winding can be tested at the same time, instead of individually. Results

are easy to see, with resistance readings for each phase pair displayed on the laptop along with green or red indicators that act as "go-no go" or "pass-fail" gauges.

Which meter is best? It's close enough to be a matter of personal preference. The MT03 leads have less contact area than the Hioki's, and may take a little more care to stabilize the reading, but it's not a dealbreaker. On the plus side, many technicians prefer the MT03, citing its ability to measure all three phases of a motor-generator at once, as well as the graphically displayed results which can be easily saved to share with the customer. The Hioki 3548 can also save measurements; however, readings must be saved to the meter and then uploaded to a PC.

USING A MILLIOHMMETER TO ESTIMATE APPLIED FASTENER TORQUE


In the shop, we apply torque to bolts and measure that torque to create the clamping loads required by the OEM. While a torque reading is not a direct measurement of the strength of the clamping load, the torque applied correlates with the required clamping load.

Another way to "measure" bolt torque, if the vehicle manufacturer provides a specification, is to measure the electrical resistance of the bolted connection, for example between the bolt head and HV busbar. Such measurements test the limits of milliohmmeters, as the resistance specification is often much less than one milliohm, and may be stated in micro-ohms ($\mu\Omega$), or millionths of ohms.

Why would this kind of measurement be useful? Well, most hybrid and electric vehicles have multiple high-voltage bolted connections. Correct torque of these connections is essential to maintaining the integrity of the connection as high-voltage current flows through it. Incorrect torque can produce heat that is easily enough to melt copper or aluminum and lead to component failure or worse.

A common diagnostic step when tracking down high-voltage circuit issues is confirming proper torque so as to rule out an issue caused by an incorrectly torqued high-voltage connection. If the vehicle manufacturer provides resistance specifications, such connections can be tested using a milliohmmeter with pin-type probes, such as the Hioki rather than alligator clips.

This kind of measurement is especially useful when bolted HV connections use single-use bolts that must be replaced if they are loosened, such as high-voltage connections in many Tesla vehicles. Keep in mind that getting an accurate measurement can be a challenge, and may only be possible if (1) the connection surfaces are first cleaned with isopropyl alcohol, and/or (2) the user presses down on the pin probes to ensure that they are getting a sufficient bite into the area under test. If the meter's readings are unstable, the measurement is invalid.

Most OEMs do not yet require measurements in the micro-ohm range, but with the increased uptake of electric vehicles, they may become more common in the future. We shall see. 



Alligator clip leads are used when measuring phase-to-phase motor-generator resistances. Pin probes are used to measure the resistance of bolted connections, including ground points.

Photo courtesy of Jack Rosebro

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Are you calibrating ADAS-equipped vehicles?

Add a new revenue stream for this essential service.

By Ross Colket



Photo courtesy of Snap-on

When it comes to today's vehicles, why wouldn't you plan on investing in your future? I recently attended a TechNet meeting representing approximately 60 to 80 shops. I sat on a panel with three other shop owners who are currently performing advanced driver assistance systems (ADAS) calibrations. To my surprise, of all those shops represented, not one of them performs ADAS calibrations.

We have a unique business model in that we service a larger-sized glass shop in the area and eight body shops. The glass company is very progressive in that it does a lot of insurance work. As a result of this, the insurance companies will not compensate the shop without proof of calibration and proof that no trouble codes in any of the ADAS systems remain. I also find the chain body shops to be more progressive

and understanding of ADAS because of their relationship with the training and education organization Inter-Industry Conference on Auto Collision Repair (I-CAR). Keep in mind, I deal directly with the body shops and not through the insurance company (much less stress and no runaround). As a result, this now accounts for one-third of my business.

I encourage you to investigate becoming an ADAS-equipped shop. Early ADAS systems are now 23 years old. It is strange to think, but in another two years, ADAS vehicles will literally be classics. If you are equipped to service and repair/calibrate ADAS, you won't have to send your customers down the road. I have several shops in the area that send their customers to me for programming, R-1234yf, and/or ADAS. More than once I have had those customers continue to come back to me because they know our capabilities.

INFORMATION RESOURCES

In terms of training, more and more sources are coming online to provide hands-on training. Autel just built a training center in New York where they offer a two-day course. Once you get the basic concept of performing the calibrations, it really does become quite easy. Understand that you are either working with a distance sensor or a camera. Yes, there are different styles of distance sensors, but the reality is, any one is just a distance sensor.

Diagnosing a system is just like diagnosing an engine issue. The best part of working with ADAS is that most of the sensors are usually either four- or six-wire sensors – a voltage and ground supply, and two or four network wires. As long as you have an oscilloscope to check for communication, and a scan tool to see if the sensor is reporting on the network and to check for any trouble codes, you're all set.

The information sources of ALLDATA, Mitchell 1, I-CAR, and Direct-Hit have come a long way in making OEM information much more accessible. Mitchell 1 and ALLDATA have a special section devoted to ADAS. Yes, on the newer cars, you are sometimes going to have to log onto the OEM's website, but those instances are few and far between.

One of the things I have found interesting is that Audi will often list in the labor guide that calibration is required. Several of their models not only will require an alignment after replacing a clutch or transmission, but they will also need a forward-looking camera calibration. Autel has a great website for ➔



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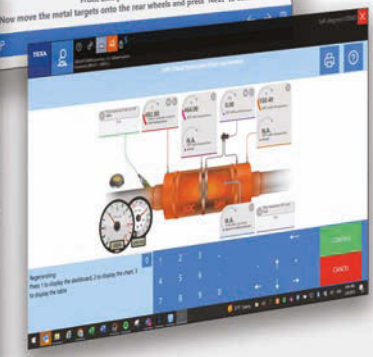
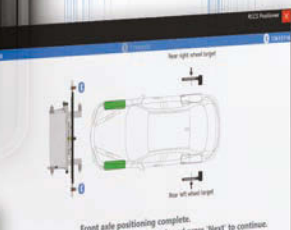
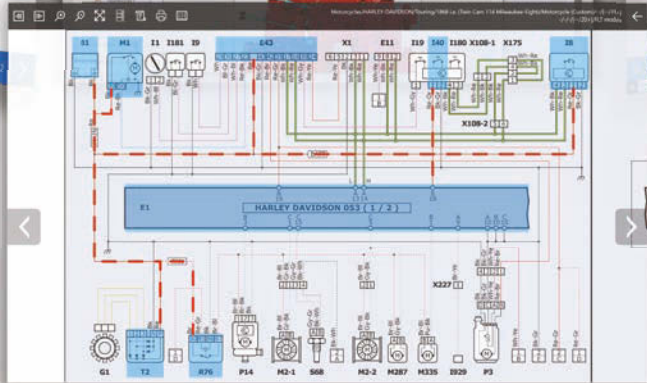
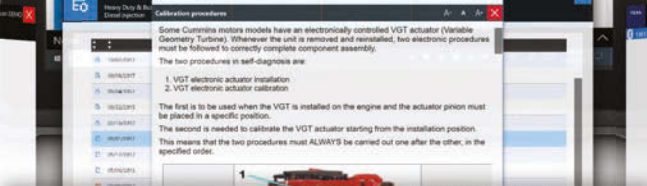
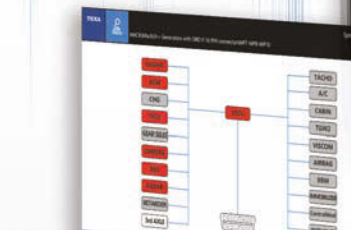
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looking up targets and placement of the targets at autel.com/us/adas-setup-reverse-lookup-guide/. That site has a ton of good information on ADAS tooling as well as a return-on-investment calculator. Another good place to get information has been Facebook groups on ADAS. Most of the time, I sit back and watch the conversations and can distinguish which users are helpful and have good quality information to add.

THE BEST TOOLS ARE THE ONES THAT WORK FOR YOUR SHOP

When it does come time for you to purchase the equipment, I strongly encourage you to do your homework on who you purchase from. I am sure from the article that you can tell I am an Autel guy. They were one of the first to market with a complete



Toyota blind spot sensor.

Photo courtesy of Ross Colket

solution and have been doing it the longest. Also, keep in mind they are the factory tool for all the Stellantis divisions. I have found their technical support team for ADAS to be very helpful at times.

Another item you will want to take into consideration is you can buy the mobile equipment or equipment that uses cameras to get the correct frame placement. I am a strong believer in the camera equipment. When you get a vehicle that won't calibrate after a repair, the first thing you are going to question is your measurements of where the target is placed. When I first started doing the calibrations, I had such a car that I kept rechecking and rechecking. As it turned out, it was a distorted windshield.

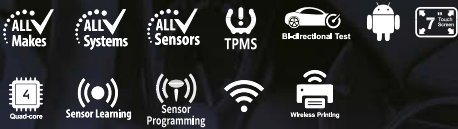
CAUSES OF SOME COMMON FAULTS

If you are unable to calibrate a vehicle, there are many things that can cause that. With blind spot monitors, the body can be damaged under the radar sensor, the bracket can be bent, or the sensor can be

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installed backwards. The sensor itself can be damaged from the impact, but typically, you will have no communication with the module. If the wiring is damaged, that is simple enough to repair. When you have a blind spot sensor that does not calibrate, the first thing you want to do is get the bumper off. I have had many guys tell me there was no damage around the blind spot sensor. Sure enough, as soon as the bumper comes off, I see it right away.

For a front radar sensor problem, make sure the correct emblem is installed. The emblems used with radar sensors are made of a different material and are very expensive as a result. Other typical radar sensor faults are similar to those of blind spot sensors. One difference that you will see with the radar sensor is that some are mechanically adjustable, and

some are adjusted electronically during the calibration.

Forward-facing cameras can have a mount positioned incorrectly during manufacturing, or the glass can be distorted from when it was manufactured. We have seen the glass dusty in front of the camera, and the glass guys did not catch it. We did have one customer come in from the glass shop who wanted his windshield replaced, but the camera would not communicate. We offered to diagnose it for him, but he refused. I was impressed by the glass shop; they turned him away.

If you are concerned about replacing the sensors and needing to perform programming, don't be. We do all our GM and Ford programming in-house. For other vehicles, we utilize Autel's Remote Expert Service, which is remote programming

through the internet. We have had great results with it, so I feel completely comfortable that we have a total solution. Also, some of the sensors are just plug-and-play.

By not moving forward with ADAS, you are setting a bad standard for the industry and opening yourself up to potential litigation. Really, if you think about it, you are doing a disservice to your customer. Even seemingly simple repairs can require calibration. For example, if you install a new radiator or condenser on a car equipped with a front radar sensor, and you touch that sensor, that vehicle needs to be calibrated.

Equipping the shop to handle ADAS repair and calibration solutions may seem like a big expensive undertaking, but the return on investment is huge. To gear up for ADAS doesn't cost...it pays! 🚗

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A step-by-step guide with expert insights on mastering ADAS tech recalibration

As vehicles become more complex and interconnected, the ability to perform accurate and thorough diagnostic scans will remain a cornerstone of effective maintenance and repair practices.

By Duane “Doc” Watson, Scott McKinney

As new vehicle innovations, including ADAS technology, become more prevalent, so too will the need for diagnostic scan tools with advanced capabilities. The importance of performing a diagnostic scan cannot be understated and is excellent for establishing a baseline of the vehicle’s condition and identifying the problem areas that need to be diagnosed and repaired.

In this article, we’ll walk through the step-by-step process of performing a diagnostic scan and leading into a dynamic recalibration of an ADAS system.

STEP 1: CONNECTING TO THE VEHICLE

Let’s set the stage and say that a customer comes into the shop saying the lane-keeping assist on their 2019 Chevrolet Equinox isn’t working properly and would like your shop to take a look at fixing the issue.

At first glance, this may seem like a standard job since this Equinox will most likely need a dynamic recalibration to repair the issue. However, it’s important to perform a pre-scan to be thorough and check for any other issues that may be hiding in the vehicle.

To start, the technician will need to connect to the wireless vehicle communication interface (VCI) into the vehicle’s OBD-II connection port. The VCI will show the technician that the power is on, the quality of the connection to the vehicle, and the wireless connection to the scan tool. A wireless VCI is important to allow

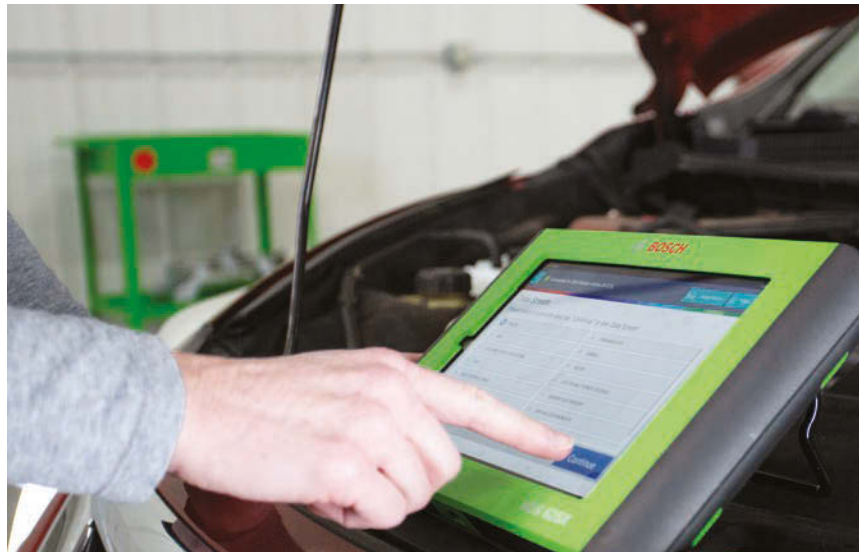


Photo courtesy of Bosch Diagnostics

the technician to have mobility throughout the shop and work comfortably.

At this point, you will only need to turn on the vehicle electronics and leave the engine off until a later point in the scanning process.

STEP 2: IDENTIFYING THE VEHICLE

Once the VCI is plugged into the vehicle and wirelessly connected to the scan tool, you’ll want to identify the make and model of the vehicle on your tool. Vehicles newer than 2005–2006 model years have mode 9 pre-installed on the vehicle’s onboard computer system.

Simply put, mode 9 identifies the vehicle by VIN number and sends that information to the scan tool. If a technician is working on a vehicle older

than 2005, or a specially built vehicle (police cars, cabs, etc.), they can identify the vehicle by manually entering the vehicle’s information.

STEP 3: PRE-SCAN AND IDENTIFYING CODES

A pre-scan is the first step in actually diagnosing the vehicle’s issues, and it should be run on all modules to ensure all issues in the vehicle can be properly identified.

This process, while seeming unnecessary on the surface given we’re only fixing the lane-keeping assist, is important to make sure all the modules exist on the vehicle and are communicating. Too often, technicians will run into a problem while diagnosing an issue with ADAS ➔

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SCAN TOOL TECHNIQUES

technology simply because that technology does not exist on the car.

You'll want to become familiar with how your tool indicates communication with a module and whether or not there are remaining codes. By simplifying this process, the scan tool allows the technician to focus on their expertise without needing to worry about analyzing data and making high-level calculations. Fast and efficient diagnostic scans lead to efficient repairs.

In the case of the 2019 Chevrolet Equinox, the only module that's coming back with DTC codes is related to the lane-keeping assist, informing the technician that a recalibration will need to be done.

STEP 4 – DYNAMIC RECALIBRATION

A dynamic recalibration, or moving recalibration, is performed on most domestic

vehicles and will require the technician to follow manufacturer-specific directions which can be found on their scan tool.


The first step in dynamic recalibration is to put the vehicle into a learn mode and take it for a test drive. Depending on the manufacturer, the scan tool will instruct the technician to seek out specific road characteristics including lane markings, guard rails, and more. From there, the AI system in the scan tool will take all of those inputs into account and calibrate the lane-keeping assist.

STEP 5 – THE POST-SCAN

Once the recalibration is complete and all systems are working correctly, the technician should run a post-scan of all systems to ensure any issues with the

vehicle have been addressed. Not only does this help the technician further show their work, but it also gives them and their customers peace of mind in knowing the vehicle is back to 100 percent of the OE specifications.

IN CONCLUSION

As the automotive industry continues to evolve, the need for advanced diagnostic scan tools becomes increasingly evident. These tools can empower technicians to confidently identify a vehicle's status and resolve issues efficiently. The ability to perform accurate and thorough diagnostic scans will remain a cornerstone of effective maintenance and repair practices, ensuring both vehicle safety and customer satisfaction in an ever-changing automotive landscape. 

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FEATURES A 12" TOUCHSCREEN

The **Thinkcar Platinum S12** includes features such as dynamic ADAS calibration, multimeter, oscilloscope, TPMS communication, 12" touchscreen, and guided diagnostic processes for select vehicles at no extra charge. The Android-based scan tool is also compatible with Thinkcar static calibration systems and includes step-by-step instructions with illustrations. It supports CAN FD and offers 34 maintenance functions, auto VIN scan, topology mapping, and bidirectional communication. Includes THINKDIAG 3 VCI and two years of software updates.

For more information visit
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MORE THAN 40 SERVICE/ MAINTENANCE TASKS

The **Autel MaxiCheck MX900** is an 8" touchscreen all-systems scan tool and service tablet, compatible with U.S., Asian, and European vehicles, 1996 and newer. The corded tablet can read and erase codes, view freeze frame and, view and graph live data, and perform bidirectional active tests and special functions. The MX900 is also a full-featured service tablet with more than 40 service and maintenance tasks, including brake bleed, oil and service light resets, battery registration, DPF regen, and electronic parking brake and steering angle resets. The MX900 runs on Android 11 and is powered by 1.8 GHZ processor and comes with one year of free software updates.

For more information visit
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PERFORMS BIDIRECTIONAL ACTIVE TESTS

The **Innova Electronics SDS Tech**, No. SDS50, is designed to be an all-in-one OBD-II diagnostics plus OEM diagnostics tool for professional technicians seeking advanced powertrain diagnostics. Its drop-tested 5" touchscreen is ideal for shop environments and its technician-designed interface focuses on speed and navigation. In addition, the tablet is equipped with bidirectional active tests and special functions to access the engine, transmission, anti-lock brakes, and TPMS control modules for Ford, GM, Toyota, Fiat/Chrysler, Honda, Nissan, and Hyundai/Kia. Also included are workshop tools with access to 16 of the most popular resets, relearns, routines, calibrations, and vehicle inspections, such as oil maintenance reset, battery reset, EPB reset, TPMS relearn, ABS bleeding, transmission reset, and more.

For more information visit
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PROVIDES COVERAGE FOR OVER 85 BRANDS

The **Xtooltech USA XT70W Smart Diagnostic System** is based on an Android 10 operating system and features a 7" LCD display. It supports automotive diagnostics for a full module system, including ECU version information, fault codes, live data, and freeze frames. The XT70W has 30+ common special functions such as throttle matching, ABS bleed, maintenance light reset, EPB test, SAS, BMS, injector coding, DPF regeneration, and TPMS reset. It offers 98 percent vehicle coverage on more than 85 brands and 10,000 cars.

For more information visit
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ACCESS TO LIVE DIAGNOSTICS ASSISTANCE

The **Opus IVS CarDAQ-Pro** is an all-in-one Pass-Thru device for multiple vehicle brands. Users can either use their own OEM subscriptions to employ CarDAQ-Pro as a J2534 Pass-Thru device or they can use it like a RAP Kit and have Opus do the programming for them. The device offers access to live diagnostics assistance, including non-programming requirements through IVS 360 Support. Additional features include Dolp, Can FD, and Toolbox3 for OEM application descriptions, video tutorials, and the latest J2534 news, as well as, access to OEM key codes, PIN numbers, and immobilizer reset information to enable locksmith and vehicle security for multiple brands in-house.

For more information visit
VehicleServicePros.com/53063596



DIAGNOSES INCONSISTENT CELL VOLTAGE

The **Launch Tech USA ELB300 EV Battery Pack Cell Equalizer** is a battery maintenance diagnostic tool for EV batteries and technology. The ELB300 diagnoses numerous issues including inconsistent cell voltage, and individual battery cell capacity variances. It is designed for new energy batteries such as lithium iron phosphate, ternary lithium, and lithium manganate, and can quickly solve the cruising range degradation caused by the difference in cell capacity due to inconsistent cell voltages. It features a 7" LCD touchscreen, has Bluetooth and Wi-Fi capabilities, and is easy to carry and transport.

For more information visit
VehicleServicePros.com/53070329

PRODUCTS



USES ANY SMARTPHONE

The **TOPDON TopScan** is a pocket-sized tool designed to turn any smartphone into a professional-grade scanner. TopScan is capable of reading and clearing fault codes for over 60 different vehicle makes across American, Asian, and European vehicles as well as offers advanced diagnostics and bidirectional control through the user's phone. With TopScan, users can access eight maintenance services, AutoVIN technology, vehicle performance testing, and a repair data library. Additionally, it offers Bluetooth connectivity and multilingual support, includes feedback functions, and can test emissions easily with a one-click I/M ready button that generates a testing report.

For more information visit
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PERFORMS DPF RESETS AND REGENS

The **CanDo HD Mobile II** transforms a smartphone, iOS or Android, into a Class 4-8 code scanner that can read and clear trouble codes, log live data, and perform DPF resets and regens for Detroit, Cummins, Paccar, Mack/Volvo, International, Isuzu, and Hino. It also has Caterpillar on- and off-highway coverage, as well as can work on OBD-II engine diagnostics for passenger cars and light trucks. The VCI comes with six, nine, 16-pin, and CAT connectors and has free updates.

For more information visit
VehicleServicePros.com/53056941



HAS ONBOARD MICRO AIR COMPRESSOR

The **Smoke Pro Air** from **Redline Detection** comes with its own onboard micro air compressor, eliminating the need to connect to air lines or inert gas. By eliminating the need for shop air or inert gas tanks, technicians can quickly diagnose, locate, and repair leaks anywhere, anytime. Smoke Pro Air improves the accuracy of repairs and eliminates comebacks by verifying that difficult-to-find component leaks are repaired accurately the first time, the company says.

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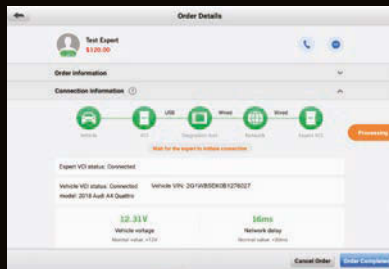
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