EVfriendly

Guide to Performing Electric Vehicle Inspections

for Auto Dealers & Consumers

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Electric Vehicle Inspections

A pre-purchase inspection of any vehicle is critical for determining the quality of the vehicle and whether any major or minor repairs will be necessary in order for the vehicle to remain in good service. Performing an inspection on an electric vehicle is very similar to inspecting an internal combustion engine vehicle, with a few additional steps.

Research has shown that consumers have many of the same concerns when buying an EV as they do when buying an ICE vehicle. This is particularly true for first-time EV buyers. EVs are equipped with some components, such as the high voltage batteries and charging units, which require specialized equipment and expertise to properly diagnose and repair. Only a qualified technician should perform repairs or maintenance on these components.

However, EVs do also have many of the standard components found on ICE vehicles, such as the suspension and lighting systems. While the technician performing the inspection is not required to be a specialized EV repair technician, they should have a basic understanding through EV training. Training and/or certification like EVfriendly is ideal.

The EVfriendly technician must understand and apply critical importance to the high voltage systems. Other items, like HVAC for example, will be very similar to their ICE counterparts, but in an EV there are unique differences that set it apart and will require the technician to be well-versed with this technology to identify potential problems during the vehicle inspection.

About the inspection guidebook

The inspection guidebook was designed for dealers looking to conduct pre-sale inspections for their inventory or for consumers who are looking to purchase a used EV and are looking for some assurances that the vehicle they are considering is a good investment. While a pre-purchase inspection cannot tell you everything about a vehicle, it can—if performed by a qualified technician—give some indication of the vehicle's overall condition and what, if any, repairs will be required. It is an important tool in helping you determine whether the EV you are considering is right for you. This guidebook contains the following tools and resources:

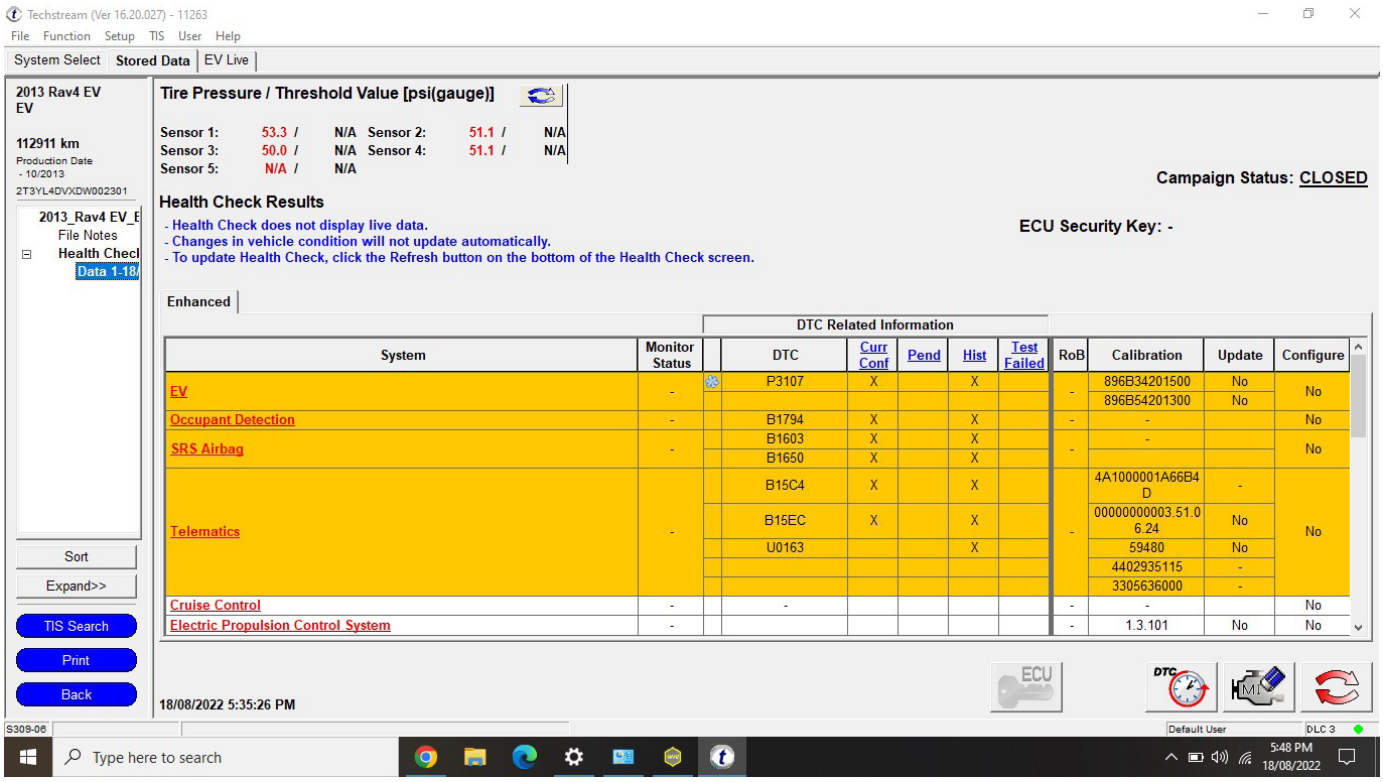
- A dealer and repair technician inspection checklist and dashboard report template
- An explanation of some of the key EV inspection areas and critical things to look for
- A link to an education video showing a typical EV inspection and other resources
- A quick reference EV state of health (SOH) diagnostics

There are multiple reasons why a technician may be asked to complete an inspection of an EV. Pre-purchase is generally the most common, but they are also common for pre-road trip, or for licensing an out of province vehicle.

The following are specific areas a technician needs to scrutinize when performing an EV inspection:

Vehicle Systems Scan Report

Performing a system scan of the entire vehicle is always a good idea regardless of whether it is an EV or and ICE vehicle, but on an EV the codes may reveal an issue with the charger or HV battery. It is not uncommon to find erroneous codes stored in EVs that have no related problems to be concerned about. This is where experience in code diagnostics is an asset, but recording and providing codes with the inspection report is also a good practice. Most aftermarket scan tools will allow the technician to attach a digital copy of the system scan to the report.

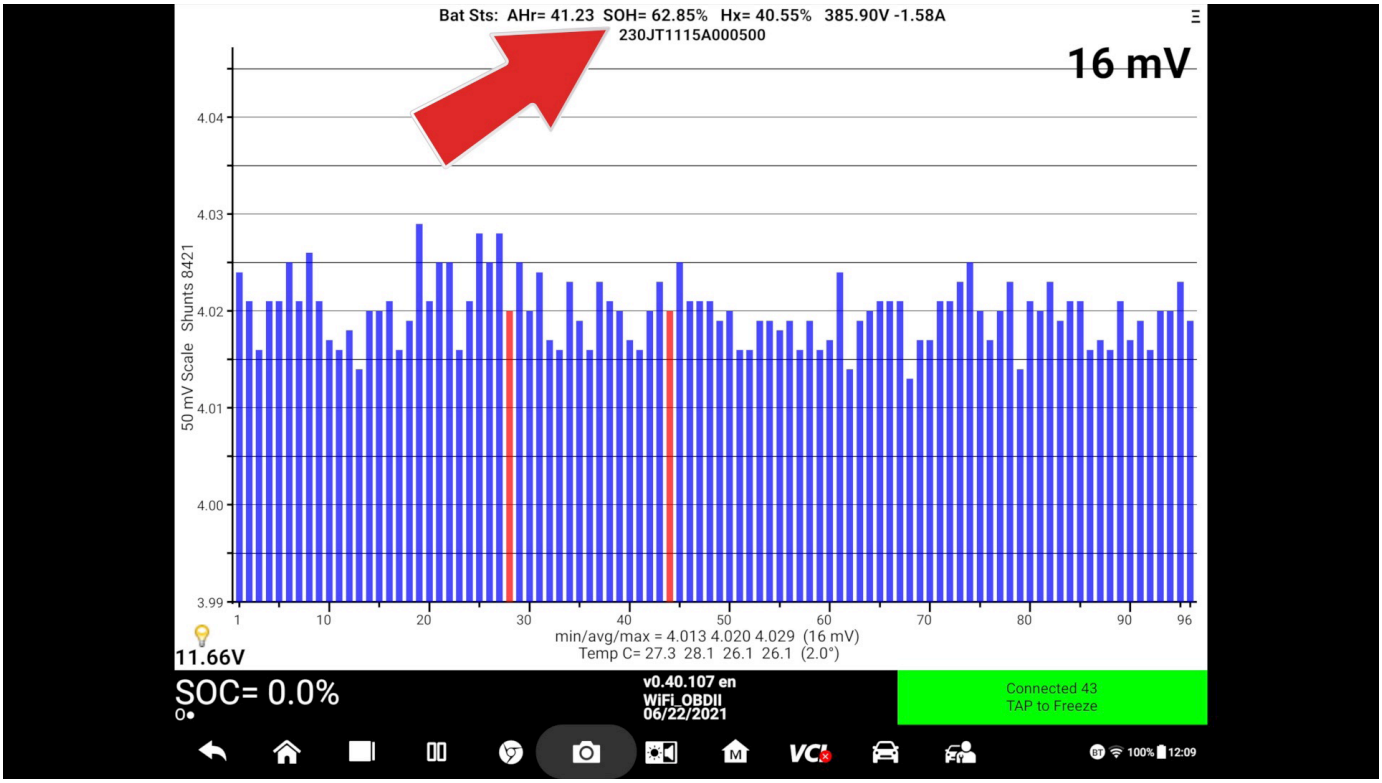


Importance of Quality Checks of HV Batteries

Research has shown that for new or potential new owners of EVs the biggest concern is the quality and/or degradation of the vehicle's HV battery. There are a few items the technician needs to record before they can make a true evaluation of the HV battery. It requires specialized scan tools and training to be able to determine the health of the HV battery. In some cases the information can be hard to find and may require vehicle specific scan tools. However, some information is easily available, often on the driver's vehicle information display.

State of Health (SOH)

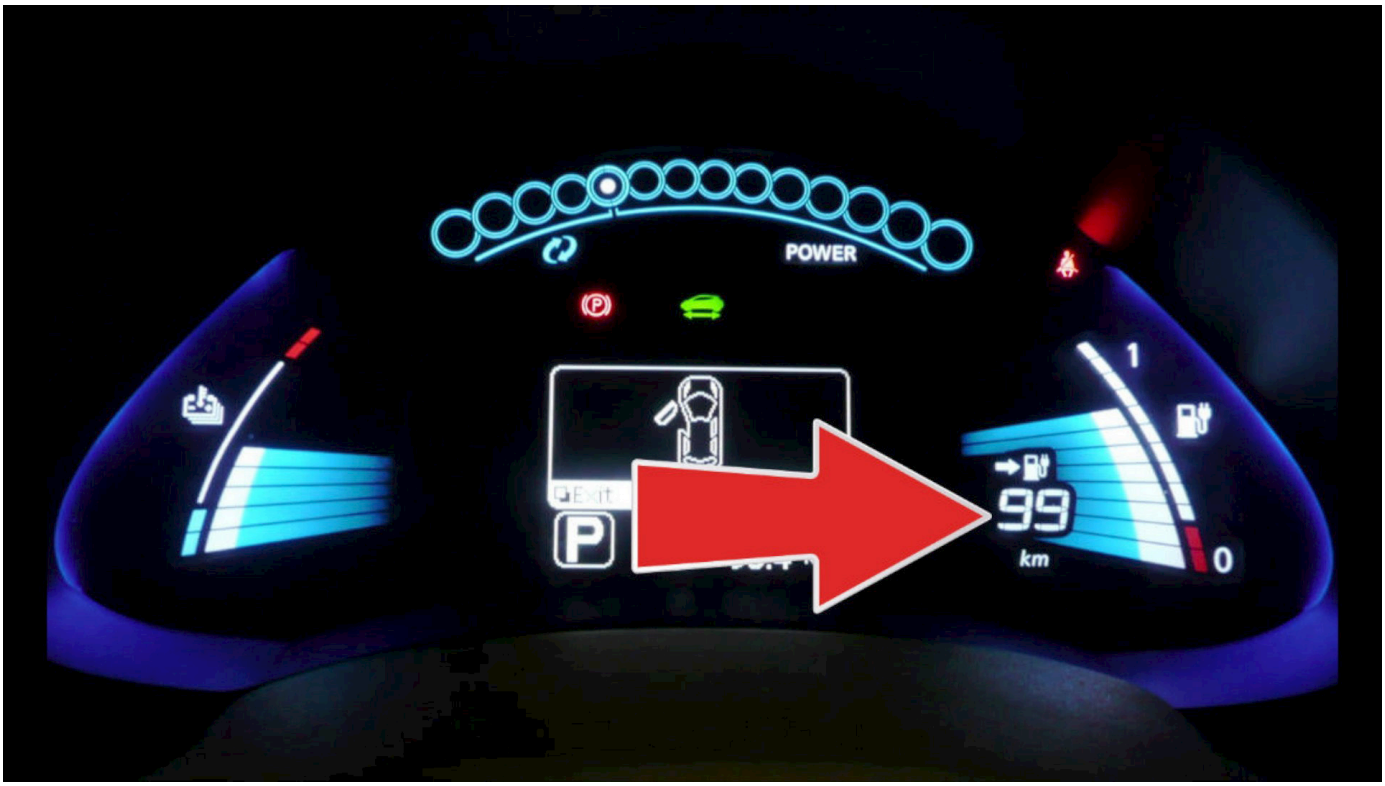
State of health (SOH) is the ultimate indicator of a battery's degradation from the factory output. Some manufacturers' batteries are known to degrade faster than what is considered to be normal, which makes it even more critical to determine the quality of the used battery. SOH can sometimes be displayed on the driver's information display – (e.g. the driver screen on a Nissan Leaf displays a 12-bar gauge indicating SOH, a simple and easy way to identify the battery's health).



SOH can often be displayed in the Battery Energy Control Module (BECM) using a scan tool. A vehicle specific scan tool is often required to retrieve the SOH information, but it can also be found using a generic scan tool that utilizes OEM functionality. The information will not be found using an OBD2 code reader. SOH is displayed as a percentage and does not exactly correspond with the information center's bar graph gauge, or the predicted vehicle range.

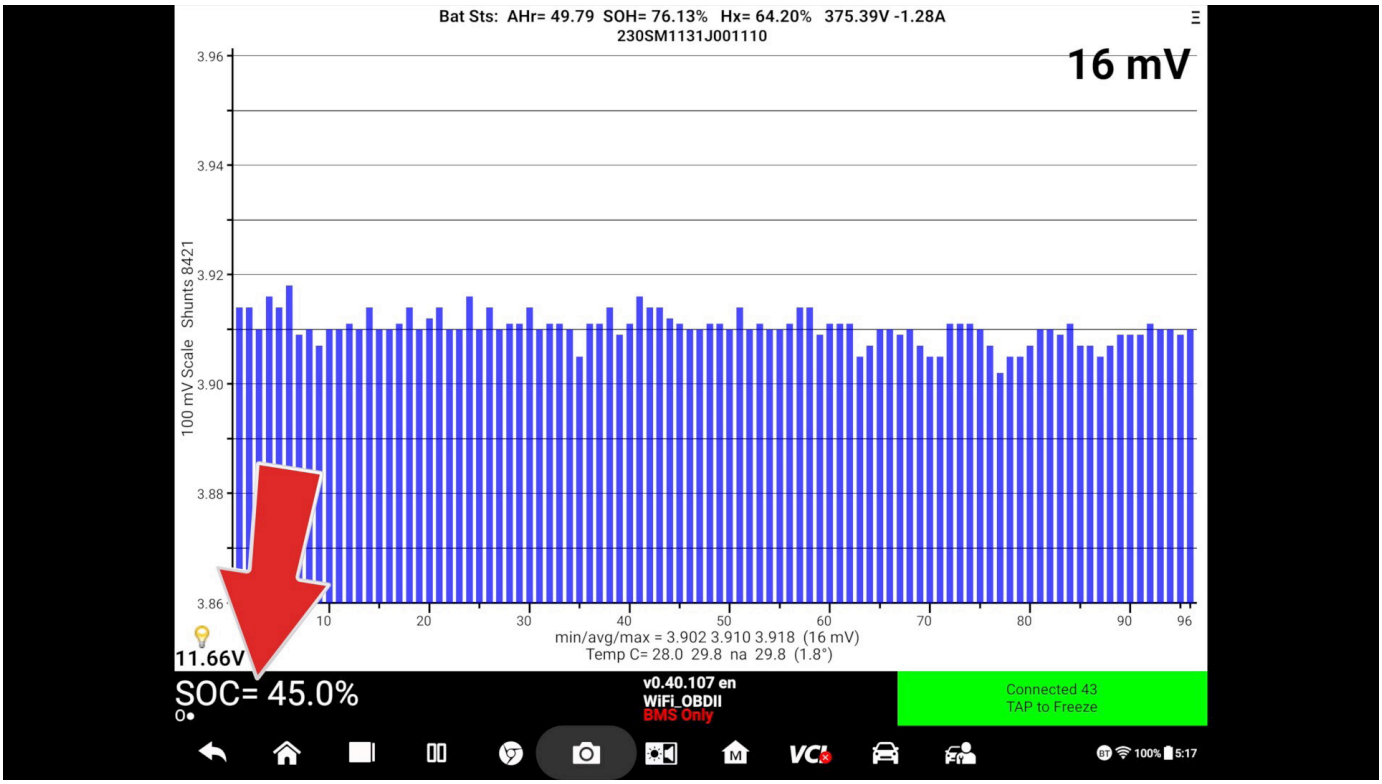
Obviously, if the reading is closer to 100% it means the quality of the battery is excellent, but batteries at 80% or possibly even lower may still be usable for users who do not require the full range of the new battery. Some BECMs may display the current KW rating of the HV battery. Comparing it to the factory KW rating is another way to determine the degradation of the battery. These calculations are best made with a fully charged battery.

Predicted Vehicle Range (PVR)



PVR is a way to determine the SOH when the technician has no access to the required scan tool. The PVR is displayed on the driver's information center in kilometres or miles. The PVR is an estimated vehicle driving distance based on the previous driving habits of the last drive cycle. A fully charged battery's PVR can be compared to the factory's recorded expected range, and from that, a theoretical SOH of the battery can be determined. SOH is not a linear representation of the PVR, and PVR will not behave the same from vehicle to vehicle. If the manufacturer's rating is 130KM and the PVR displays 100KM after a charge, the technician would know that a significant amount of degradation has occurred. PVR is most useful for a fully charged battery, so inspecting the vehicle fully charged is ideal. Recording the PVR on the inspection is advisable.

State of Charge (SOC)



The SOC is the indicator of the level of energy an HV battery has stored compared to its capacity. The state of charge can be displayed on the driver's information display as a percentage or a level gauge. A SOC can also be recorded via a scan tool through the BECM data list near where you would find the SOH. Recording this on the inspection is recommended.

Vehicle Charging Systems

One of the most common failure points on an EV is its ability to charge the HV battery. It can often be the case that the fast charging ability operates normally but the vehicle fails to charge with the EVSE at home. During the inspection it is the technician's responsibility to test these systems to the best of their ability. The technician should start the charging system inspection by first locating the vehicle's EVSE and performing a visual inspection of the plug. Often, the 110V connection is partially melted and may require repair.

The charger port should also be visually inspected for debris, bent pins or a missing charge port cover. Plug the customer's EVSE into the wall outlet and the vehicle. Most EVs have a LED indicator to display to the user that the vehicle is being charged. LED's typically flash slowly and can indicate the current state of charge with a simple LED bar graph. Vehicles that exhibit charging issues often will have the LED flash in a way to indicate an error, or the LED's will simply not illuminate, indicating there is no charge occurring. Shops that regularly service EVs should have Level 2 (220V) charging capability and it is recommended that Level 2 charging be performed as well as Level 1 (110V). Some vehicles will be equipped with DC Fast Charging. However, it may not be possible for a technician to perform testing of this feature due to the location of the nearest charging station, but the technician can advise on the inspection that this feature has not been tested. It is recommended that the technician use all three versions of charging when preforming an inspection on an EV.

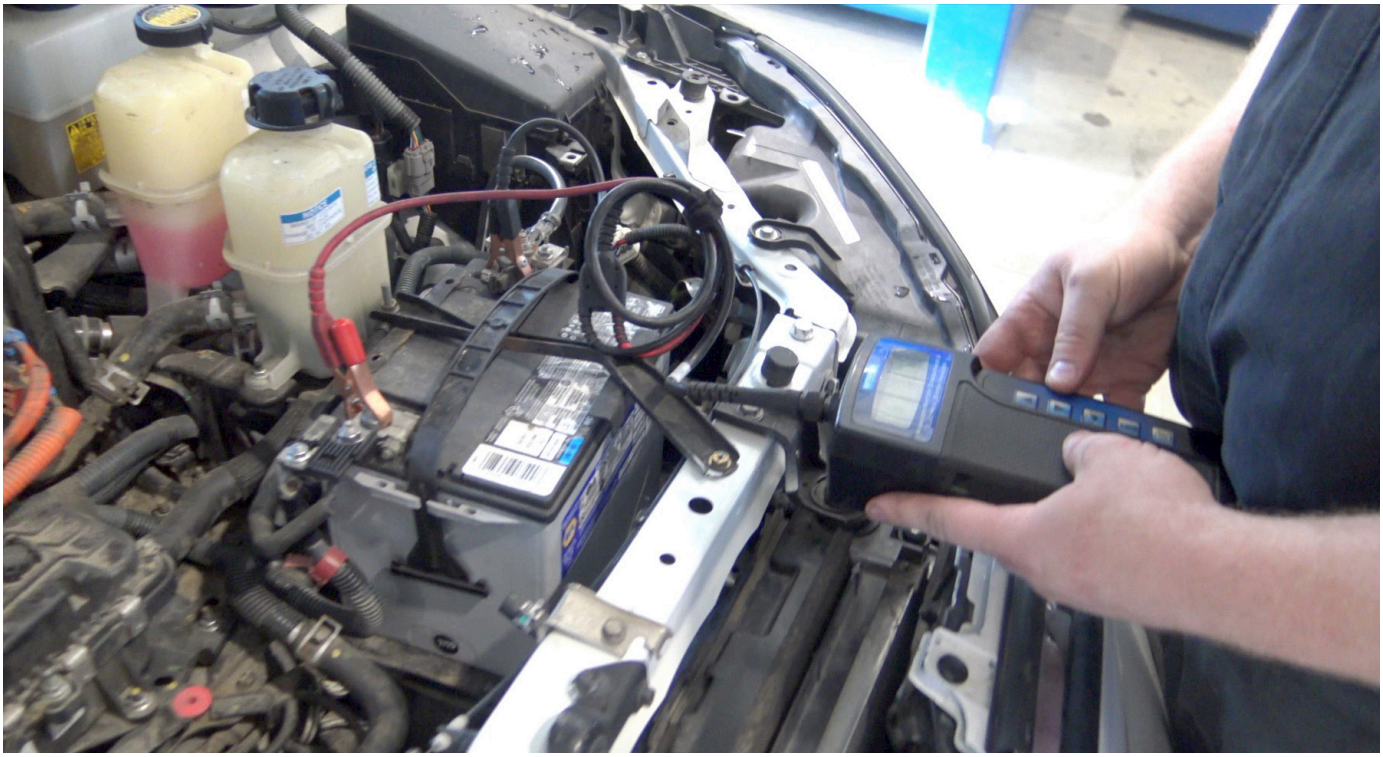
A vehicle may show no indication of issues until the function is attempted. Codes may only set when cleared before the inspection and these functions are then initiated.

Heating and Air Conditioning

EVs have very similar HVAC components to ICE vehicles but typically are more complicated because of the use of High Voltage and other unique components. Repairs to these systems can be very costly, so simple checks can go a long way toward prevention. Checking these systems is also important because they are responsible for cooling the High Voltage systems on the vehicle as well as the cabin temperature. During an inspection the technician needs to simply identify whether a problem exists, not necessarily what the root cause of the issue is. Performing a simple HVAC performance check while road testing can point out areas that require further diagnosis. Simple visual checks of coolant levels, hoses, and signs of leaks can reveal potential costly repairs and/or items that may require further inspection.

Low Voltage Systems

EV low voltage systems are often overlooked but can cause major issues when it comes to getting a vehicle into ready mode. Technicians should make every effort to perform a low voltage battery performance test with the appropriate tool as well as estimate the battery's age. Checking the low voltage battery can also reveal issues with the DC to DC charging system.



EV Component Inspections

EV system failures typically identify themselves to the technician through warning lights and messages, but visual inspections of the components may indicate future problems that are unknown to the vehicle owner. It is recommended that technicians inspect HV cables for signs of physical damage such as rubbing through or rodent damage. Visually inspecting for coolant leaks from the drive motor, inverter or HV battery is also recommended. The oil level and condition of the drive motor's final drive unit can also reveal potential issues, like bearing wear. Physical damage to the undercarriage shields and HV battery case should also be recorded.

Tires, Brakes, and Suspension

EV tires are often overlooked by the consumer. Proper rating, tire pressure and tread wear must be recorded. EV regenerative braking systems are utilized less often, but because of this they may require servicing before the pads are worn out to ensure they are working properly. When inspecting EV brakes refer to the vehicle's maintenance schedule for brake servicing.

EV suspensions will be identical to ICE vehicles, but noises may become prevalent upon further inspection. It is recommended that technicians record any suspension noises during the inspection.

Advanced Driver Assistance System (ADAS)

In the future it will become standard for every vehicle to be fully electric. Vehicles will also become increasingly automated. Technicians should check the function of each system on the vehicle to make sure it functions normally. During a road test the technician should test the Lane Keep Assist / Departure Warning, Adaptive Cruise, Parking Aids, Blindspot/Crosstraffic Alert, Back-up Camera, and Surroundview Camera.

Guide to Finding EV Battery State of Health

Research has shown that for new or potential new owners of EVs the biggest concern is with the quality and/or degradation of the vehicle's HV battery. As a result, technicians are often asked to report the State of Health (SOH) on electric vehicles. Unfortunately not all manufacturers make this information available, and even with a fully-functioning factory scan tool, some manufacturers do not display that data as a percentage or kilowatt rating. With more electric vehicles on the road this may change, but for now, determine SOH will vary depending upon the vehicle. Sometimes the vehicle owner is better off to simply log energy usage through a third party app rather than have the technician scan the vehicle to look for SOH information. It is recommended that customers with vehicles that only have predicted vehicle range use a tool to determine SOH such as an OBD2 dongle with a third-party app to better calculate state of health through drive cycles.

Here is a list of common EVs on the road today and which method is best used for a technician to report a state of health on the high voltage battery:

Make and Model	How to Determine SOH
Ford Mach E	Factory function scan tool displays SOH in %
Ford Focus EV	Factory function scan tool compare kWh to empty PID to original specification
All Hyundai EVs	Factory function scan tool displays SOH in %
All Kia EVs	Factory function scan tool displays SOH in %
Mercedes Smart EV	Factory function scan tool compare AmpHr rating to the original battery
Nissan Leaf	Use the instrument cluster or Leafspy Scan tool
BMW I3	Access kWh rating though the instrument cluster and compare to the factory specification
Chevy Bolt	Use the predicted vehicle range and compare to factory specification
All Teslas	Use the predicted vehicle range and compare to factory specification
Fiat 500e	Use the predicted vehicle range and compare to factory specification
Toyota Rav4 EV	Use the predicted vehicle range and compare to factory specification