

Automotive Recyclers Association's High Voltage Vehicle Dismantling Protocol (HVVDP) for a Certified Auto Recycler (CAR)

High Voltage awareness and protocols for safe and environmentally conscious Electric and Hybrid Vehicle processing and dismantling.

With the guidance of this protocol and utilizing team members that have completed the ARA University Electric and High Voltage Technology training modules. High Voltage vehicles can be successfully and safely recycled. The result of these qualified efforts will result in a clean environment, worker safety, and the harvesting of high quality Recycled Original Equipment parts (ROE) and recyclable materials.

It is important to recognize that Hybrid Electric and Electric Vehicles have unique high voltage systems that are very dangerous if not handled properly. This danger can be higher yet if the vehicles high voltage systems have been compromised from an accident or flooding. Improper handling of these vehicles can easily lead to serious injury or death from electric shock. There is also a high risk of fire and potential health risk from leakage of electrolytes if the batteries are damaged. It is imperative that these vehicles are only dismantled and processed to the end of life by a facility that is a Certified Auto Recycler (CAR) with the HVVDP in place.

The necessary procedures have been separated into sections. We do understand that not every facility has the same workflow, but these are the areas that must be addressed to qualify for this protocol.

Before vehicle collection:

As soon as a recycler is aware they are acquiring a Hybrid electric or Electric vehicle (HEV/EV), the vehicle record should be noted as a "HIGH VOLTAGE" if possible. The goal of this step is to alert the transportation drivers and the initial vehicle intake and inventory team of the potential danger the HEV/EV may have. Transportation drivers and loader operators should be trained of the potential dangers and exercise HEV/EV safety steps while transporting these types of vehicles. HEV/EV specific Personal Protective Equipment (PPE) and neutralizing kits should be available to all involved in the collection and intake of the vehicle. These staff members should also be trained in how to use the PPE and which hazards to watch for. The personnel involved in acquiring the vehicles should assess the type of damage the vehicle has and identify any vehicle at high risk of having a compromised battery compartment. If there are concerns, they should alert the transportation staff and the initial staff involved in unloading the vehicle at the dismantling facility.

During vehicle collection

During the vehicle retrieval process, when an HEV/EV is identified, the vehicle must be clearly marked, so the vehicle is easily identifiable as “High Voltage” ARA High Voltage Warning signage must be applied to multiple sides of the vehicle. Whenever possible, and depending on the transportation arrangements, Proper PPE, neutralizing kits, and personnel trained to use them, must be present. The staff involved must be trained whenever possible to assess possible damage to the high voltage batteries prior to loading the vehicle. The transportation team should be looking for physical damage to the high voltage battery and symptoms such as leakage or a thermal incident which could be indicated by fire or discoloration of the high voltage cables. If leakage is identified, the transportation team should work with the pickup location to neutralize the battery spill, and if problems are identified work to follow the manufactures processes to de-energize the vehicle. If the transportation folks are unsure, they should call and consult with other experts for advice and if unsure, leave the vehicle until a specialist can be consulted. Flooded vehicles should also have special attention paid to them.

Vehicle on site and initial check in

Once the HEV/EV arrives at the recycler’s location, if it has not been done already, the ARA high voltage signage must be added to multiple sides of the vehicle. Workflow decisions must be made and consider what systems will need the factory power, for proper inventory and removal of certain parts. Once those decisions have been made, you will then determine your order of events. Once the proper information has been recovered from the vehicle and inventory and workflow decisions have been made, it is time to take the next step. A team member who has been trained using the ARA University and utilizing the proper PPE, can now remove the High Voltage Battery master disconnect service plug and zip tie it to the steering wheel. PPE necessary for High Voltage safety must be readily available, and properly maintained at the facility. This PPE includes insulated High Voltage lineman’s gloves, approved face shield, insulated tools and a safety pull away hook. A high voltage meter should be available for checking circuits also. It is also important to recognize that each vehicle can be different, and you must also follow the manufactures processes to make the vehicle safe. Some manufactures have different processes and research of each new make and model will be required along with the normal safety awareness.

Important: If the workflow of the facility does not bring this HEV/EV directly to dismantling for high voltage battery removal, proper safeguards are a must. With the vehicle properly

safeguarded and displaying ARA High Voltage Warning the HEV/EV should be placed in a segregated area if possible, awaiting final dismantling.

Inventory and Dismantling and High Voltage Battery Storage

If it had not already been done during the initial vehicle check in and inventory, and after the dismantler has recovered the data they need from the vehicle, a properly trained dismantler utilizing the proper PPE will 1st remove the High Voltage Battery master disconnect. The dismantler should place the master disconnect on their tool cart away from the vehicle and let the vehicle discharge for a minimum of 15 mins before working on the vehicle. While this will be the process for most of the HEV/EV, always research with the manufacture of that vehicle, to find the exact process to make the vehicle safe for high voltage battery removal. It is also important to consider if the vehicle systems may be needed for any of the dismantling and part removal process.

After the proper time has passed for the high voltage system to discharge, a properly trained dismantler utilizing the proper PPE and tools will remove the High Voltage Battery assembly. These batteries can be very heavy. It is important to confirm you have the proper lifting device or cooperation of a protected teammate, to be able to remove the battery following the manufactures recommended processes. Once the battery is safely removed and secured to a nonconductive pallet, it is recommended to zip tie the master disconnect plug to the opposite side of the plug in on the battery case. (Hybrid batteries should never have their cases opened by anyone other than a trained professional in High Voltage Batteries.) The properly trained dismantler will wrap any exposed/disconnected individual High Voltage wire ends in electrical tape to insulate them properly for safety.

All ARA High Voltage Warning signage, should now be replaced with ARA High Voltage Battery Removed signage, marking the vehicle safe for further dismantling and processing.

The High Voltage Battery assembly will then be properly stored for future sale as a ROE component or for proper recycling. Trained team members must follow the storage procedures in the ARA University. The storage must also be correct for local fire code. It is recommended that quantities of batteries be stored in a separate area, if possible segregated in a separate building or protected outdoor structure, that is easily identifiable and accessible in the event of an emergency. Store away from other combustible materials whenever possible.

Batteries must be properly stored, away from moisture, away from direct sunlight and in a clearly marked and controlled area. Nickel-metal hydride (NiMH) and Lithium-ion (Li-ion) batteries must be separated in the storage area. Batteries can be stacked no more than two high and must be separated by a non-conductive layer such as wood or rubber sheeting. Follow the specific storage instructions for each type of battery (see ARA University and reference the Electric and Hybrid Vehicle Technology Guide)

The vehicle is now ready for dismantling, storage, and end of life processing once the other normal depollution of the vehicle has taken place. Following the HVVDP and the normal processes that are inherent to a Certified Auto Recycler will lead to a safe process that is good for the environment, and the cyclical economy of the vehicle and its components. Every vehicle is an opportunity to find great parts for reuse and if not sold for reuse, recycling.

Please be aware of all specially colored High Voltage wiring (usually orange) and components that are unique when transporting with forklifts or dismantling the vehicle. As an additional reminder, Inverters and other high voltage components that have been damaged in an accident or flood should be treated with caution, pending inspection by a trained specialist. The electric motor can produce energy if the drive wheels are rotated, so be mindful if moving vehicles in a manner that could result in wheel turn. Once the battery has been removed, the High Voltage energy is in the battery, and not with the vehicle but caution must always be observed.

Transportation

HEV/EV High Voltage batteries must be transported as “dangerous goods” when shipped on ground transportation or shipping carriers. If the proper procedures have been followed, the complete high voltage battery assembly, sealed in its factory housing, with the safety interlock plug removed, can be transported safely. Safe Transportation of High Voltage batteries or cells include being packed in such a manner as to prevent short circuits, including movement which could lead to short circuits. Once the connectors or leads are protected to prevent short circuit, the battery or cell should be wrapped with adequate dunnage to prevent movement or damage and secured or strapped to a non-conductive shipping container such as a wooden pallet or crate or other strong outer packaging conforming to general packaging requirements. Batteries must be secured to prevent inadvertent movement, and the terminals may not support the weight of other superimposed elements. Batteries that are damaged in an accident, causing the leaking of fluids or exposure of the conductors, must be handled in a very specific manner and will require special best management practices and requirements.

Selling and Disposal

Every vehicle is full of opportunities to harvest good parts for reuse, saving consumers budgets and contributing to the sustainability goals for our planet. Along with reuse, recycling of the non useable parts is paramount, with so many precious commodities used in the manufacturing

of these vehicles. The high voltage battery and the special high voltage components are of particular focus. The most effective use of HV/EV high voltage batteries is reuse. Reuse is the purest form of recycling saving money and precious resources. High voltage batteries and other high voltage components can be safely reused if the HVVDP protocols are followed. Another use for these components will be repurposing for other solutions. There are developing markets for people to use the high voltage components in other environmentally sustainable solutions, outside of the automotive use. There are also developing markets for remanufactures that need the high voltage batteries as components, or the reusable resources found within them. The markets to properly dispose of the unneeded and damaged batteries are rapidly developing and a certified HVV dismantler must assure that all batteries sold or processed for recycling are delivered through proper shipping channels to be processed by an EPA R2 certified facility that will provide a traceable end of life use of the battery and or its components in a documented environmentally correct method.

I acknowledge that I have read and understand the contents of this HVVDP and Have been properly trained with the ARA University, completing the 8 modules of the Electric & Hybrid Vehicle Technology Training. This process must be completed every 3 years to remain in compliance with the ARA HVVDP Protocol.

Employee Name Printed _____

Employee Name Signature _____

Supervisor Name Printed _____

Supervisor Name Signed _____

Date _____ **Month** _____ **Day** _____ **Year** _____