



## **New High Voltage / Electric Vehicle / Hybrid Tasks, Tools, and Equipment in ASE Truck, Collision, and Auto Accreditation Standards & Training Resource List**

The ASE Accreditation Standards are updated approximately every three years to account for changes in technology, tools, and service practices. In 2022, 2023, and 2024, technical revision committees from industry and education, recognizing the growing number of high voltage systems and electric vehicles, began to add related tasks, tools, and equipment to the standards. The initial focus of these changes is to ensure that entry-level students are able to learn and work around these systems in a safe manner.

This document lists those updates, and also provides a list of industry-provided training resources. That resource list is not exhaustive, and inclusion in this list does not constitute an endorsement by ASE or the ASE Education Foundation.

### **M/H Truck – Tasks, Tools, and Equipment added to 2022 Medium/Heavy Truck Standards in the Electrical/Electronic Systems section**

A new warning has been added to the header of the task list: **Comply with manufacturers' current safety practices, documentation, and training associated with high voltage/electric vehicle lock-out/tag-out and service procedures.**

**Tasks 1-5 have a P-1 priority at all levels: IMMR, TST and MTST.**

1. Demonstrate knowledge of hazards related to high voltage systems/electric vehicles, including electrocution, fire, explosion, arc flash, gases and fumes, hazardous chemicals, and EMF, and how to properly respond to emergency situations.
2. Demonstrate knowledge of high voltage system and component coloring, warning labels, lights, signage, and lock-out/tag-out procedures.
3. Demonstrate ability to identify which components and circuits contain high voltage.
4. Demonstrate knowledge of steps needed to assess possible hazards prior to servicing a high voltage/electric vehicle, including awareness of automatic systems that may operate while the key switch/ignition is off.
5. Understand limitations on which systems, components, and circuits of a high voltage/electric vehicle a technician is capable of safely servicing based on their level of training and qualification.

**Tasks 6-10 – IMMR: not included, TST: P-3, MTST: P-2.**

6. Demonstrate knowledge of special multimeters, insulated tools, and other test equipment required for use in high voltage/electric vehicle circuits.
7. Demonstrate knowledge of personal protective equipment (PPE) required for use in high voltage/electric vehicle circuits.
8. Demonstrate knowledge of proper procedures used to disconnect/isolate the high voltage traction battery.
9. Demonstrate knowledge of the use of a live-dead-live test to verify isolation of the high voltage traction battery.
10. Demonstrate knowledge of the testing and verification of ground circuit isolation between vehicle chassis ground and the high voltage circuits and components.

The following specialty tools were added for TST and MTST programs:

- Insulation Tester/Multimeter and leads (recommended) – must meet CAT III 600 volt, CAT III 1000 volt, or CAT IV 600 volt rating
- Electrical Insulating Gloves (recommended) – must meet CAT 0 1000 VAC and 1500 VDC electrical safety glove rating – may have expired certification if used for demonstration only
- Insulated Retrieval Hook (optional)

**Collision Repair – Tasks, Tools and Equipment added to the 2023 Collision Repair and Refinish Standards**

Foundational Skills now include Personal Standards, Work Habits/Ethics, Workplace and Personal Safety, and the following Hybrid/Electric Vehicle Safety tasks, and are 100% required for all students in all Collision Repair and Refinish programs under the updated standards.

1. Demonstrate knowledge of hazards related to high voltage systems/electric vehicles, including electrocution, fire, explosion, arc flash, gases and fumes, hazardous chemicals, and EMF, and how to properly respond to emergency situations.
2. Demonstrate knowledge of high voltage system and component coloring, warning labels, lights, signage, and lock-out/tag-out procedures.
3. Demonstrate ability to identify which components and circuits contain high voltage.
4. Demonstrate knowledge of steps needed to assess possible hazards prior to servicing a high voltage/electric vehicle, including awareness of automatic systems that may operate while the key switch/ignition is off.

5. Understand limitations on which systems, components, and circuits of a high voltage/electric vehicle a technician is capable of safely servicing based on their level of training and qualification.
6. Demonstrate knowledge of high voltage/electric vehicle intake process, inspection, handling, and in-process monitoring for collision-damaged vehicles.

In addition, the following tasks have been added to a new Hybrid/Electric Vehicle Service section of the Mechanical and Electrical Components accreditation area.

1. Locate procedures for safe disabling and re-enabling of high voltage systems on hybrid/electric vehicles. HP-I
2. Identify potential safety and materials handling concerns associated with high voltage hybrid/electric vehicle battery systems. HP-G
3. Demonstrate knowledge of special multimeters, insulated tools, and other test equipment required for use in high voltage/electric vehicle circuits. HP-G
4. Demonstrate knowledge of personal protective equipment (PPE) required for use in high voltage/electric vehicle circuits. HP-I
5. Demonstrate knowledge of the use of a live-dead-live/zero potential test to verify isolation of the high voltage traction battery. HP-G
6. Demonstrate knowledge of the testing and verification of ground circuit isolation between vehicle chassis ground and the high voltage circuits and components. HP-G
7. Demonstrate an understanding of safe handling procedures associated with high voltage A/C compressors and wiring. HP-G
8. Demonstrate an understanding of hybrid/electric cooling systems. HP-G
9. Demonstrate an understanding of safe handling procedures associated with high voltage powertrain components. HP-G
10. Demonstrate knowledge of recommendations/requirements for the storage of high voltage batteries removed from vehicles and replacement high voltage batteries. HP-G

The following *recommended* Hybrid/Electric Vehicle Tools & Equipment have been added to the General Shop/Lab Equipment list.

- Hybrid/Electric Vehicle Safety Kit
- Electrical Insulating Gloves – must meet CAT 0 1000 VAC and 1500 VDC electrical safety glove rating – may have expired certification if used for demonstration only
- EV charging equipment
- Vehicle lift with weight and physical configuration appropriate for hybrid/electric vehicles
- Insulated Retrieval Hook

- Insulation Tester/Multimeter and leads – must meet CAT III 600 volt, CAT III 1000 volt, or CAT IV 600 volt rating
- Battery Lift Table
- Leather Gloves to go over Electrical Insulating Gloves

### **Automobile – Tasks, Tools and Equipment added to the 2024 Automobile Program Standards**

The following definition was added to the Technical Terms:

xEV – Any electrified propulsion vehicle with a high-voltage system, including, but not limited to, HEV, PHEV, PEV, BEV, FCEV, and EV (SAE J1715-1 SEP 2022).

Foundational Skills include Personal Standards, Work Habits/Ethics, Workplace and Personal Safety, and the following xEV Safety tasks, and are 100% required for all students in all Automobile programs under the updated standards.

1. Demonstrate knowledge of personal protective equipment (PPE) required for use in high voltage/electric vehicle circuits.
2. Demonstrate knowledge of hazards related to high voltage systems/electric vehicles, including electrocution, fire, explosion, arc flash, gases and fumes, hazardous chemicals, and EMF, and how to properly respond to emergency situations.
3. Demonstrate knowledge of high voltage system and component coloring, warning labels, lights, signage, and lock-out/tag-out procedures.
4. Demonstrate ability to identify which components and circuits contain high voltage.
5. Demonstrate knowledge of steps needed to assess possible hazards prior to servicing a high voltage/electric vehicle, including awareness of automatic systems that may operate while the key switch/ignition is off.
6. Understand limitations on which systems, components, and circuits of a high voltage/electric vehicle a technician is capable of safely servicing based on their level of training and qualification.
7. Demonstrate knowledge of high voltage/electric vehicle intake process, inspection, handling, and in-process monitoring for all vehicles, including damaged/compromised vehicles.

In addition, the following tasks have been added to a new xEV Systems section of the Electrical/Electronic Systems task list for Master Automobile Service Technology (MAST) accredited programs.

1. Locate procedures to safely de-energize/disable and energize/enable high-voltage systems. P-3
2. Identify potential safety and materials handling concerns associated with high-voltage battery/energy storage systems. P-3
3. Demonstrate knowledge of special multimeters, insulated tools, and other test equipment

required for use in high-voltage circuits. P-3

4. Demonstrate knowledge of personal protective equipment (PPE) required for use while servicing high-voltage circuits. P-3
5. Demonstrate knowledge of the use of a live-dead-live/zero potential test to verify isolation of the high-voltage battery/energy storage system. P-3
6. Demonstrate knowledge of the testing and verification of ground circuit isolation between vehicle chassis ground and the high-voltage circuits and components. P-3
7. Demonstrate knowledge of safe handling procedures associated with high-voltage A/C compressors and wiring. P-3
8. Demonstrate knowledge of high-voltage thermal management systems. P-3
9. Demonstrate knowledge of safe handling procedures associated with high-voltage powertrain components, such as electric motors. P-3

The following *recommended* xEV Shop/Lab Equipment have been added to the Specialty Tools and Equipment list for MAST accredited programs.

- xEV Vehicle Safety Kit
- Electrical Insulating Gloves – must meet CAT 0 1000 VAC and 1500 VDC electrical safety glove rating – may have expired certification if used for demonstration only
- Leather Gloves to go over Electrical Insulating Gloves
- xEV charging equipment (level 1 or higher)
- Insulated Retrieval Hook
- Insulation Tester/Multimeter and leads – must meet CAT III 600-volt, CAT III 1000-volt, or CAT IV 600-volt rating

### **Training Resources**

**NOTE:** All instruction and training, including high voltage/electric vehicle/ hybrid system training, must always follow the vehicle manufacturer’s current recommendations and guidelines. Instructors are encouraged to participate in OEM training whenever possible and obtain access to manufacturer service information as needed.

**ATech Training** – Provides a Structured Skill Development approach towards electrical vehicle technology. Foundational skills in electrical are followed by the EV architecture, and then applying that knowledge on a vehicle, such as fully functional Nissan Leaf with fault insertion capability. We invite you to check out the links below or contact us at 1-888-738-9924.

<https://www.atechtraining.com/products/electrical>

<https://www.atechtraining.com/vehicle-technology-trainer>

**Automotive Career Development Center (ACDC)** – ACDC creates unique classes that are delivered in person worldwide. ACDC also uses the latest technologies to deliver training and education over the world wide web. They webinars as well as instructor-led and online training, including a High Voltage Safety program, and a **High School & College EMV (Electrified Motor Vehicle) Technology** training course. To learn more, visit <https://www.fixhybrid.com/>.

**AVI OnDemand** – AVI offers training course materials on Hybrid Vehicles and Electric Vehicles, the Electric Vehicle Training Aid (EVA) system simulator, and a full Hybrid Electric Cutaway vehicle trainer. Download the Educator Catalog at [https://aviondemand.com/wp-content/uploads/2022/09/EDUCATOR\\_CATALOG\\_V2-8.31.22\\_FINAL.pdf](https://aviondemand.com/wp-content/uploads/2022/09/EDUCATOR_CATALOG_V2-8.31.22_FINAL.pdf).

**Cengage Learning - Hybrid, Electric, and Fuel-Cell Vehicles** covers the cutting-edge technology and technology that are revolutionizing today's automotive industry. Author Jack Erjavec combines in-depth industry expertise with an engaging, reader-friendly style, providing extensive detail on new and upcoming electric vehicles. View the details at <https://www.cengage.com/c/hybrid-electric-and-fuel-cell-vehicles-2e-erjavec/9780840023957PF/>.

**CCAR & Electude** - CCAR and Electude provide several online learning modules to prepare instructors and students for the ASE EV Certification test(s). One resource is a special product for automotive teachers, **Electric Drive for Instructors**. Only available to instructors teaching automotive technology courses, the program components include Electude's Electric Drive Course, CCAR's Battery and Safety Module, an Assessment, and a Certificate of Completion. For more information, call (847) 749-4375 or email [info@ccar-greenlink.org](mailto:info@ccar-greenlink.org).

**CDX** - Starting with the basics, **MAST: Light Duty Hybrid and Electric Vehicles** provides students with the building blocks necessary to become highly competent entry-level technicians. This title breaks down the different types of vehicle systems to their most fundamental components and then builds on that knowledge to bring the learner up to speed on cutting-edge topics and systems. Visit <https://www.cdxlearning.com/automotive/shop-auto/productdetails/9781284198010>.

**Consulab** – Have you ever wondered how to give your students hands-on exploration of a complete electrical vehicle in a safe environment? Consulab's ALL EV iDEV training car is not just a training aid, it's an actual Tesla Model 3 training car with cutaway displays for maximum learning! To learn more, visit <https://www.consulab.com/products/all-products/ev-601-ts-053322-all-ev-idev-training-car-by-consulab>.

**Electude** – Electude has a comprehensive online course for students concerning electric and hybrid vehicles. Using Electude's unique discovery-based learning method, this course may be used as a stand-alone or as a part of their popular Light Vehicle Essentials + product as well as their Light Vehicle Classroom - with versions designed for MLR and AST/MAST. For more information, call (781) 577-6757 or [sales@electude.com](mailto:sales@electude.com).

**Goodheart-Willcox Publishers – Electric Vehicles: A Systems Approach** provides the foundational knowledge technicians need to safely service all types of electric vehicles (EVs). With a strong emphasis on high-voltage safety, this textbook navigates the complexities of high-voltage drive trains using an easy-to-understand, approachable writing style and engaging visuals. Visit <https://www.g-w.com/electric-vehicles-2024> for more information.

**I-CAR** – Discover vehicle and technician safety considerations, comprehensive resources, and a full EV training portfolio – including online and hands-on courses. Get access to OEM-specific repair and safety information, best practices for safe high-voltage battery disconnection, technical articles, videos, and guides. To view I-CAR courses and resources for EVs, visit <http://I-CAR.com/EV>.

**Lucas-Nuelle** – The company offers a variety of training aids and multi-media curriculum to provide a one-stop solution for HEV/EV training. This starts with how electric drive systems work and how they are controlled in motor vehicles, but then goes deeper into various drive configurations used in hybrids and EVs. Lucas-Nuelle offers an ASE L3 Training System which is also used at SkillsUSA. Aside from technical content, there is a major focus on safety at work and how to deal safely with high-voltage systems. View the catalog at <https://print.lucas-nuelle.de/In/view/5710>.

**MotoLogic** – Advance Auto Parts has partnered with Electude to provide their vehicle-specific online diagnostic and service software to educators. This may be purchased as a stand-alone or made available via Electude as an integrated product. MotoLogic includes an excellent selection of hybrid and electric vehicles, including service information for several models of EVs. For more information, call (781) 577-6757 or [sales@electude.com](mailto:sales@electude.com).

**Pearson** – Jim Halderman and Curt Ward’s *Electric and Hybrid Electric Vehicles* meets the needs of a 3rd- or 4th-semester course in electrical systems. It’s also designed as a standalone text for a special topic or certificate course in electric and hybrid electric vehicles or for an intro course in connected and autonomous vehicles. To learn more, visit <https://www.pearson.com/en-us/subject-catalog/p/electric-and-hybrid-electric-vehicles/P200000001163?view=educator>.

**Sinclair Community College** - Sinclair offers a week-long Battery Electric Vehicle Summer Institute that gives instructors from ASE accredited post-secondary programs the opportunity to learn about battery electric vehicles and labs that can be integrated into your courses. Visit <https://www.selfdrivesinclair.org/event/> for details.

**SP/2** - The S/P2 Electric Vehicle Safety course is now available and has been added to the Automotive Service, Collision Repair and Refinish, and Heavy-Duty/Diesel bundles. This 40-minute course contains the basics about electric vehicle safety and how you can stay safe in the shop when working around these vehicles. To learn more, visit <https://sp2.org/2022/02/28/s-p2-electric-vehicle-safety-now-available/>

**Switch** – The Switch Lab is a high-impact, project-based learning system for STEM and CTE education at the college, high school and junior high levels, using a complete road-ready EV kit that is designed to be built, tested and driven, and then disassembled for the next class to use – every semester, and year after year. Get more details at <https://theswitchlab.com/>.

**Weber State University** – Weber State provides advanced EV training through a three-phase program that combines online and in-person training: Phase I – High-Voltage Safety Training, Phase II – Hybrid and Electric Vehicle Systems, and Phase III – Hybrid and Electric Vehicle Boot Camp. Visit <https://continue.weber.edu/professional/programs/evtraining/> to learn more.

## **ASE xEV Safety Standards and Certifications**

The ASE Electrified Propulsion Vehicles (xEV) High Voltage Electrical Safety Standards were developed by a panel of industry experts through a consensus standards development process to provide guidance and establish electrical safety requirements, standards, procedures, and safe work practices for automotive service professionals working on or around xEVs.

The standards define three levels for working individuals. Level One is an Electrically Aware Person. This is anyone who may encounter an EV in school or the workplace and requires high-voltage electrical safety awareness to identify the hazards and reduce the associated risks when working on or near xEVs.

Level Two is a High-Voltage Vehicle Technician. This is a service professional or specialist who has received high-voltage electrical training, has demonstrated skills and knowledge related to the construction, operation, and repair of electrically powered high-voltage vehicles, maintains an electrically safe working area, and uses required personal protective equipment (PPE). They have also received safety training to identify the hazards and reduce the associated risk.

Level Three is a High-Voltage Vehicle and Battery Technician. This is a service professional who has attained Level Two and has received specific high-voltage battery pack training, can perform "live work," and has demonstrated such skills and knowledge.

These safety standards define the knowledge and skills needed by individuals at each level. They do not provide training but do provide guidance for companies that develop and deliver training for xEV safety. The current standards document can be downloaded from <https://www.ase.com/dist/docs/ASExEVElectricalSafetyStandardsVersion1Industry.pdf>.

In addition, ASE offers online assessments and certification for individuals that have obtained the needed xEV training and possess the knowledge necessary to function at Level One or Level Two. An assessment for Level Three is still under development. Visit [www.ase.com/ev](http://www.ase.com/ev) to get more details and purchase the Level One and Level Two assessments. **Students should receive safety training prior to attempting the xEV certification tests.**

ASE also offers the Light Duty Hybrid/Electric Vehicle Specialist (L3) Test as part of the traditional ASE professional certifications. It is designed to measure a technician's knowledge of the skills needed to diagnose both high- and low-voltage electrical/electronic problems, as well as other supporting system problems, on hybrid/electric vehicles. It is an extension of the repair and diagnostic skills tested by the Automobile Electrical/Electronic Systems (A6) and Engine Performance (A8) tests, both of which are prerequisites for the L3 test. For more information on the L3 certification, visit [https://www.ase.com/uploads/ASE\\_L3\\_Study\\_Guide\\_2023.pdf](https://www.ase.com/uploads/ASE_L3_Study_Guide_2023.pdf).

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