

**Transportation, Distribution and Logistics Career Cluster
General Automotive Technology Pathway
Light Duty Hybrid/Electric Vehicle Technology
Course Number (Given by GaDOE-CTAE)**

Course Description:

This course is designed as the fourth course for the General Automotive Technology Pathway. Students in this course will learn the basic skills and knowledge needed to gain employment as an entry level automotive technician. Students will be exposed to evolving technologies related to light duty hybrid/electric vehicles. Emphasis on overall shop safety with high voltage systems will be addressed.

Instructor/Program Qualifications:

Due to the extreme nature associated with hybrid/electric vehicles. All current safety equipment and procedures must be followed to prevent injury or death!

Programs are required to be Accredited by the National Institute of Automotive Service Excellence (ASE) at the AST Level or Higher. Instructors teaching Light Duty Hybrid/Electric Vehicle Technology are required to be certified by ASE in L3: Light Duty Hybrid/Electric Vehicle Technology. Instructors must have completed a manufacturer Hybrid/EV Training Program.

Course Standard 1

TDL-AT3-EV1

The following standard is included in all CTAE courses adopted for the Career Cluster/Pathways. Teachers should incorporate the elements of this standard into lesson plans during the course. The topics listed for each element of the standard may be addressed in differentiated instruction matching the content of each course. These elements may also be addressed with specific lessons from a variety of resources. This content is not to be treated as a unit or separate body of knowledge but rather integrated into class activities as applications of the concept.

Standard: Demonstrate employability skills required by business and industry.

The following elements should be integrated throughout the content of this course.

1.1 Communicate effectively through writing, speaking, listening, reading, and interpersonal abilities.

Person-to-Person Etiquette	Telephone and Email Etiquette	Cell Phone and Internet Etiquette	Communicating At Work	Listening
Interacting with Your Boss	Telephone Conversations	Using Blogs	Improving Communication Skills	Reasons, Benefits, and Barriers
Interacting with Subordinates	Barriers to Phone conversations	Using Social Media	Effective Oral Communication	Listening Strategies
Interacting with Co-workers	Making and Returning Calls		Effective Written Communication	Ways We Filter What We Hear
Interacting with Suppliers	Making Cold Calls		Effective Nonverbal Skills	Developing a Listening Attitude
	Handling Conference Calls		Effective Word Use	Show You Are Listening
	Handling Unsolicited Calls		Giving and Receiving Feedback	Asking Questions
				Obtaining Feedback
				Getting Others to Listen

Nonverbal Communication	Written Communication	Speaking	Applications and Effective Résumés
Communicating Nonverbally	Writing Documents	Using Language Carefully	Completing a Job Application

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Reading Body Language and mixed Messages	Constructive Criticism in Writing	One-on-One Conversations	Writing a Cover Letter
Matching Verbal and Nonverbal communication		Small Group Communication	Things to Include in a Résumé
Improving Nonverbal Indicators		Large Group Communication	Selling Yourself in a Résumé
Nonverbal Feedback		Making Speeches	Terms to Use in a Résumé
Showing Confidence Nonverbally		Involving the Audience	Describing Your Job Strengths
Showing Assertiveness		Answering Questions	Organizing Your Résumé
		Visual and Media Aids	Writing an Electronic Résumé
		Errors in Presentation	Dressing Up Your Résumé

1.2 Demonstrate creativity by asking challenging questions and applying innovative procedures and methods.

Teamwork and Problem Solving	Meeting Etiquette
Thinking Creatively	Preparation and Participation in Meetings
Taking Risks	Conducting Two-Person or Large Group Meetings
Building Team Communication	Inviting and Introducing Speakers
	Facilitating Discussions and Closing
	Preparing Visual Aids
	Virtual Meetings

1.3 Exhibit critical thinking and problem-solving skills to locate, analyze and apply information in career planning and employment situations.

Problem Solving	Customer Service	The Application Process	Interviewing Skills	Finding the Right Job
Transferable Job Skills	Gaining Trust and Interacting with Customers	Providing Information, Accuracy and Double Checking	Preparing for an Interview	Locating Jobs and Networking
Becoming a Problem Solver	Learning and Giving Customers What They Want	Online Application Process	Questions to Ask in an Interview	Job Shopping Online
Identifying a Problem	Keeping Customers Coming Back	Following Up After Submitting an Application	Things to Include in a Career Portfolio	Job Search Websites
Becoming a Critical Thinker	Seeing the Customer's Point	Effective Résumés	Traits Employers are Seeking	Participation in Job Fairs
Managing	Selling Yourself and the Company	Matching Your Talents to a Job	Considerations Before Taking a Job	Searching the Classified Ads
	Handling Customer Complaints	When a Résumé Should be Used		Using Employment Agencies
	Strategies for Customer Service			Landing an Internship
				Staying Motivated to Search

1.4 Model work readiness traits required for success in the workplace including integrity, honesty, accountability, punctuality, time management, and respect for diversity.

Workplace Ethics	Personal Characteristics	Employer Expectations	Business Etiquette	Communicating at Work
Demonstrating Good Work Ethic	Demonstrating a Good Attitude	Behaviors Employers Expect	Language and Behavior	Handling Anger
Behaving Appropriately	Gaining and Showing Respect	Objectionable Behaviors	Keeping Information Confidential	Dealing with Difficult Coworkers

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Maintaining Honesty	Demonstrating Responsibility	Establishing Credibility	Avoiding Gossip	Dealing with a Difficult Boss
Playing Fair	Showing Dependability	Demonstrating Your Skills	Appropriate Work Email	Dealing with Difficult Customers
Using Ethical Language	Being Courteous	Building Work Relationships	Cell Phone Etiquette	Dealing with Conflict
Showing Responsibility	Gaining Coworkers' Trust		Appropriate Work Texting	
Reducing Harassment	Persevering		Understanding Copyright	
Respecting Diversity	Handling Criticism		Social Networking	
Making Truthfulness a Habit	Showing Professionalism			
Leaving a Job Ethically				

1.5 Apply the appropriate skill sets to be productive in a changing, technological, diverse workplace to be able to work independently and apply teamwork skills.

Expected Work Traits	Teamwork	Time Management
Demonstrating Responsibility	Teamwork Skills	Managing Time
Dealing with Information Overload	Reasons Companies Use Teams	Putting First Things First
Transferable Job Skills	Decisions Teams Make	Juggling Many Priorities
Managing Change	Team Responsibilities	Overcoming Procrastination
Adopting a New Technology	Problems That Affect Teams	Organizing Workspace and Tasks
	Expressing Yourself on a Team	Staying Organized
	Giving and Receiving Constructive Criticism	Finding More Time
		Managing Projects
		Prioritizing Personal and Work Life

1.6 Present a professional image through appearance, behavior, and language.

On-the-Job Etiquette	Person-to-Person Etiquette	Communication Etiquette	Presenting Yourself
Using Professional Manners	Meeting Business Acquaintances	Creating a Good Impression	Looking Professional
Introducing People	Meeting People for the First Time	Keeping Phone Calls Professional	Dressing for Success
Appropriate Dress	Showing Politeness	Proper Use of Work Email	Showing a Professional Attitude
Business Meal Functions		Proper Use of Cell Phone	Using Good Posture
Behavior at Work Parties		Proper Use in Texting	Presenting Yourself to Associates
Behavior at Conventions			Accepting Criticism
International Etiquette			Demonstrating Leadership
Cross-Cultural Etiquette			
Working in a Cubicle			

Support of CTAE Foundation Course Standards and Georgia Standards of Excellence L9-10RST 1-10 and L9-10WHST 1-10:

Georgia Standards of Excellence ELA/Literacy standards have been written specifically for technical subjects and have been adopted as part of the official standards for all CTAE courses.

Course Standard 2

TDL-AT3-EV-2

Identify and utilize general safety procedures and proper tools.

- 2.1 Identify general shop safety rules and procedures.
- 2.2 Utilize safe procedures for handling of tools and equipment.
- 2.3 Identify and use proper placement of floor jacks and jack stands.
- 2.4 Identify and use proper procedures for safe lift operation.
- 2.5 Utilize proper ventilation procedures for working within the lab/shop area.
- 2.6 Identify marked safety areas.
- 2.7 Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment.
- 2.8 Identify the location and use of eye wash stations.
- 2.9 Identify the location of the posted evacuation routes.
- 2.10 Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities.
- 2.11 Identify and wear appropriate clothing for lab/shop activities.
- 2.12 Secure hair and jewelry for lab/shop activities.
- 2.13 Demonstrate awareness of the safety aspects of supplemental restraint systems (SRS), electronic brake control systems, and hybrid vehicle high voltage circuits.
- 2.14 Demonstrate awareness of the safety aspects of high voltage circuits (such as high intensity discharge (HID) lamps, ignition systems, injection systems, etc.)
- 2.15 Locate and demonstrate knowledge of material safety data sheets (MSDS).

Course Standard 3

TDL-AT3-EV-3

Research and utilize proper handling procedures for general high voltage systems.

- 3.1 Identify tools and their usage in high voltage automotive applications.
- 3.2 Demonstrate safe handling and use of appropriate high voltage tools and equipment.
- 3.3 Demonstrate proper cleaning, storage, and maintenance of high voltage tools and equipment.
- 3.4 Describe the difference between high voltage glove ratings.
- 3.5 Identify and demonstrate high voltage glove testing procedure.
- 3.6 Identify and demonstrate proper key fob isolation procedures.
- 3.7 Identify and apply high voltage work area preparation.
- 3.8 Identify and perform manufacturer's safety protocols.
- 3.9 Identify high voltage components and wiring/color designations.

Course Standard 4

TDL-AT3-EV-4

Research and utilize vehicle service information.

- 4.1 Identify information needed and the service requested on a repair order.
- 4.2 Identify purpose and demonstrate proper use of fender covers and mats.
- 4.3 Demonstrate use of the three C's (concern, cause, and correction).
- 4.4 Review vehicle service history.
- 4.5 Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.
- 4.6 Ensure vehicle is prepared to return to customer per school/company policy (floor mats, steering wheel cover, etc.).
- 4.7 Identify and use applicable service information materials to include service manuals, manufacturer service information, and bulletins to develop a process/procedure for diagnostics.

Course Standard 5

TDL-AT3-EV-5

Develop an understanding of automotive careers, describing the principal fields of specializations and identifying associated career opportunities.

- 5.1 Identify education requirements for automotive occupations and locations where programs of study are available.
- 5.2 Match automotive job titles with qualifications and responsibilities.
- 5.3 Participate in activities related to career interests.

Course Standard 6

TDL-AT3-EV-6

Identify and utilize general hybrid/electric vehicle service.

- 6.1 Identify different types of hybrid and electric vehicles.
- 6.2 Explain the difference in hybrid vehicle levels and electric vehicle types.
- 6.3 Identify the differences and uses of vehicle propulsion alternatives.
- 6.4 Describe vehicle lifting procedures on a hybrid and electric vehicle.
- 6.5 Explain preventative maintenance on hybrid and electric vehicles.
- 6.6 Perform oil and filter change on a hybrid vehicle and describe the service caution needed.
- 6.7 Identify procedures necessary to establish the proper vehicle operational power mode during service (OFF, ACCESSORY, POWER ON, READY TO DRIVE).
- 6.8 Identify hybrid and electric vehicle high voltage components including inverter, converter, high voltage cables, traction battery, traction motor, etc.
- 6.9 Describe DC and AC current.
- 6.10 Describe electric shock potential of high voltage systems.
- 6.11 Identify health and environmental concerns of carbon-based fuels and their alternatives.
- 6.12 Identify transmission fluid and coolant fluid requirements and verify fluid levels.

Course Standard 7

TDL-AT3-EV-7

Identify and apply hybrid/electric battery systems safety and diagnostic procedures.

- 7.1. Apply high voltage safety practices.
- 7.2. Analyze or perform high voltage disconnect procedure and reconnect/enable high voltage system.
- 7.3. Select, test, and use proper high voltage safety gloves.
- 7.4. Select, qualify, and use proper electrical testing equipment and leads.
- 7.5. Retrieve and diagnose Diagnostic Trouble Codes (DTCs) and determine needed repairs.
- 7.6. Diagnose problems caused by damaged or failed harnesses, connectors, terminals, and fuses.
- 7.7. Identify and describe high voltage (HV) battery pack malfunctions.
- 7.8. Identify and describe removal and installation of high voltage battery pack according to manufacturer's service procedures.
- 7.9. Identify and describe high voltage leaks/loss of isolation testing.
- 7.10. Identify and describe high voltage battery pack heating and cooling systems.
- 7.11. Identify and describe charging problems when using electric vehicle supply equipment (EVSE).
- 7.12. Describe the difference between Level 1 AC, Level 2 AC and DC Fast Charge according to SAE Standard J1772.
- 7.13. Describe the different types of high voltage batteries.

Course Standard 8

TDL-AT3-EV-8

Identify and explain Internal combustion engine operations related to hybrid systems.

- 8.1. Apply high voltage safety practices.

- 8.2. Retrieve and diagnose Diagnostic Trouble Codes (DTCs) and determine needed repairs.
- 8.3. Determine if the internal combustion engine (ICE) is in CRANK mode or RUN mode.
- 8.4. Differentiate between drivability problems caused by the internal combustion engine and/or hybrid drive system.
- 8.5. Perform internal combustion engine cranking compression test.
- 8.6. Perform a procedure to put the vehicle into inspection mode that keeps the ICE actively running.
- 8.7. Describe the process of diagnosing internal combustion engine no-crank condition.
- 8.8. Describe the process of diagnosing internal combustion engine cranks/no-start condition.
- 8.9. Interpret vacuum and compression readings on Atkinson cycle engines.
- 8.10. Explain the Atkinson cycle and how it affects engine efficiency compared to the Otto cycle.
- 8.11. Identify engine start/stop strategy and diagnose malfunctions.
- 8.12. Describe engine cooling system service.

Course Standard 9

TDL-AT3-EV-9

Identify and explain hybrid/electric vehicle drive systems.

- 9.1. Apply high voltage safety practices.
- 9.2. Describe and explain high voltage disconnect procedure; reconnect/enable high voltage system.
- 9.3. Select, test, and use proper high voltage safety gloves.
- 9.4. Select, qualify, and use proper electrical testing equipment and leads.
- 9.5. Retrieve and diagnose driveline Diagnostic Trouble Codes (DTCs) and determine needed repairs.
- 9.6. Diagnose problems caused by damaged or failed harnesses, connectors, and terminals.
- 9.7. Describe the procedure test and diagnose and repair high voltage leaks/loss of isolation.
- 9.8. Describe the process to remove and install rotor from stator.
- 9.9. Explain the difference between resolver and encoder type motor-rotor position sensor.
- 9.10. Research electrically actuated parking pawl operations.
- 9.11. Identify transmission fluid and coolant fluid requirements and verify fluid levels.

Course Standard 10

TDL-AT3-EV-10

Identify and explain hybrid/electric vehicle power electronics systems.

- 10.1. Apply high voltage safety practices.
- 10.2. Describe and explain high voltage disconnect procedure and reconnect/enable high voltage system.
- 10.3. Select, test, and use proper high voltage safety gloves.
- 10.4. Select, qualify, and use proper electrical testing equipment and leads.
- 10.5. Retrieve and diagnose Diagnostic Trouble Codes (DTCs) and determine needed repairs.
- 10.6. Diagnose problems caused by damaged or failed harnesses, connectors, and terminals.
- 10.7. Identify procedures necessary to establish the proper vehicle operational power mode during service (OFF, ACCESSORY, POWER ON, READY TO DRIVE).
- 10.8. Describe hybrid system warnings displayed on the instrument panel and/or a drivability complaint.
- 10.9. Describe impact sensor functions.
- 10.10. Explain the operation of the AC/DC inverter.
- 10.11. Analyze the functions and failures in the data communications bus network.
- 10.12. Describe the purpose of high voltage capacitors.
- 10.13. Describe or locate safety interlocks.
- 10.14. Explain the operations of the DC/DC converter.
- 10.15. Describe how to test high voltage cable integrity and loss of isolation.

- 10.16 Describe the function of a low voltage battery.
- 10.17 Identify types of low voltage batteries.
- 10.18 Perform low voltage battery testing.
- 10.19 Explain the function of the HV system main relay (SMR)/contactor malfunctions.

Course Standard 11

TDL-AT3-EV-11

Identify and explain hybrid supporting systems.

- 11.1 Apply high voltage safety practices.
- 11.2 Describe and explain high voltage disconnect procedure and reconnect/enable high voltage system.
- 11.3 Select, test, and use proper high voltage safety gloves.
- 11.4 Select, qualify, and use proper electrical testing equipment and leads.
- 11.5 Diagnose problems caused by damaged or failed harnesses, connectors, and terminals.
- 11.6 Observe and interpret driver indicators, power flow display and energy monitor and determine necessary action.
- 11.7 Analyze high voltage air conditioning compressor systems.
- 11.8 Determine the proper AC system oil.
- 11.9 Identify and describe cabin heating system performance problems.
- 11.10 Identify and describe electric/electronic steering systems.
- 11.11 Analyze brake system performance problems; differentiate between braking problems caused by hydraulic system and regenerative system malfunctions.
- 11.12 Explain the procedure to deactivate brake system self-test prior to service.
- 11.13 Describe power electronics and battery coolant systems.

Course Standard 12

TDL-AT3-EV-12

Examine how related student organizations are integral parts of career and technology education courses through leadership development, school and community service projects and competitive events.

- 12.1 Explain the purpose, mission, objectives, motto, colors, official dress, and other distinguishing characteristics of SkillsUSA.
- 12.2 Explain how participation in SkillsUSA can promote lifelong responsibility for community service, professional growth, and development.
- 12.3 Explore the impact and opportunities SkillsUSA can develop to bring business and industry together with education in a positive working relationship through innovative leadership and career development programs.
- 12.4 Explore the local, state, and national opportunities available to students through participation in SkillsUSA including but not limited to conferences, competitions, community service, philanthropy, and other SkillsUSA activities.