

Automotive Technology 5th Edition

Chapter 89 INTRODUCTION TO HYBRID VEHICLES

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class provides complete coverage of the components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and NATEF and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Real World Fixes, Videos, Animations, and NATEF Task Sheet references.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.	<p>Explain learning objectives to students as listed below:</p> <ol style="list-style-type: none"> 1. Discuss the evolution of electric vehicles and how driving and owning a hybrid electric vehicle is different from a conventional vehicle. 2. Explain the classifications of hybrid electric vehicles. 3. Explain the operation of belt-alternator-starter (BAS) systems. 4. Discuss the common features of most hybrids and the levels of hybrid vehicle.
Establish the Mood or Climate	Provide a <i>WELCOME</i> , Avoid put downs and bad jokes.
Complete Essentials	Restrooms, breaks, registration, tests, etc.
Clarify and Establish Knowledge Base	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

NOTE: This lesson plan is based on the 5th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 89: [ATE5 Chapter Images](#)

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1. SLIDE 1 CH89 INTRODUCTION TO HYBRID ELECTRIC VEHICLES

Check for ADDITIONAL VIDEOS & ANIMATIONS @
<http://www.jameshalderman.com/>
WEB SITE IS CONSTANTLY UPDATED

Videos

2. SLIDE 2 EXPLAIN Figure 89-1 components of GM electric vehicle (EV1). Many of features of this vehicle, such as regenerative braking, currently used on hybrid vehicles were first put into production on this vehicle

DISCUSSION: Ask the students to discuss **Evolution of Automobiles.** Have them share how automobiles have changed over time. What advances will future vehicles have? **FIGURE 89-1**

DISCUSSION: Review with students different methods of propulsion. What **two common combinations** are being used to classify vehicles as hybrids?

DISCUSSION: Review **Ohm's law:** 1 volt is required to push 1 ampere through 1 ohm of resistance; therefore, if voltage is doubled, then number of amperes of current flowing through circuit will also double if the resistance of circuit remains the same. How does Ohm's law apply to electric vehicles?

SAFETY Remind students to use **INSULATED TOOLS** when working on vehicles that use **HIGH VOLTAGE.**

DISCUSSION: Gather information about newest **ZEV Vehicles** available. Ask students to identify current benefits, problems, and future of these vehicles.

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DISCUSSION: Have the students consider the benefits or drawbacks concerning cost of a vehicle vs. fuel savings. How long will you need to drive a vehicle with fuel savings in order to offset its extra cost as compared to driving an internal combustion engine vehicle?

DEMONSTRATION: Measure amperage & voltage in series and parallel circuits on vehicle. Call attention to the change in amperes and volts between series and parallel circuits.

3. **SLIDE 3 EXPLAIN Figure 89-2** Using a standardized plug to recharge an electric vehicle or a plug-in hybrid electric vehicle such as this Toyota Prius takes many hours depending on voltage of charger.

DEMONSTRATION: Start hybrid vehicle with students. Have them compare & contrast this start with a combustion engine vehicle start. Ask students to discuss differences between 2 starts.

DISCUSSION: Show the students charge port for a hybrid electric vehicle. Discuss the procedures involved with recharging along with electrical requirements of a charging facility. **FIGURE 89-2**

4. **SLIDE 4 EXPLAIN Figure 89-3** A drawing of the power flow in a typical series-hybrid vehicle.
5. **SLIDE 5 EXPLAIN Figure 89-4** This diagram shows the components included in a typical series-hybrid design. The solid-line arrow indicates the transmission of torque to the drive wheels. The dotted-line arrows indicate the flow of electrical current
6. **SLIDE 6 EXPLAIN Figure 89-5** The power flow in a typical parallel-hybrid vehicle.
7. **SLIDE 7 EXPLAIN Figure 89-6** Diagram showing the components involved in a typical parallel-hybrid vehicle. The solid-line arrows indicate the transmission of torque to the drive wheels, and the dotted-line arrows indicate the flow of electrical current

[Parallel Hybrid \(View\) \(Download\)](#)

[Regenerative Braking 2 \(View\) \(Download\)](#)

[Series Hybrid \(View\) \(Download\)](#)

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8. **SLIDE 8 EXPLAIN** Figure 89-7 series-parallel hybrid design allows vehicle to operate in electric motor mode only or in combination with internal combustion engine.

DISCUSSION: Have students compare & contrast components of series and parallel hybrid vehicles, referring to **FIGURES 89-3 to 89-7**. Ask students to identify the pros and cons of components.

DISCUSSION: Have students identify other **fuels** that can replace diesel fuel. How will these alternate fuels help reduce fuel costs?

DISCUSSION: Review idle stop mode with the students and highlight the difference between a **conventional starter & voltage motor generator**.

9. **SLIDE 9 EXPLAIN** Figure 89-8 This chart shows what is occurring during various driving conditions in a BAS-type hybrid.

DISCUSSION: Have students talk about belt alternator starter systems. What are the advantages of **BAS systems**?

FIGURE 89-8

10. **SLIDE 10 EXPLAIN** Figure 89-9 The components of a typical belt alternator-starter (BAS) system.

11. **SLIDE 11 EXPLAIN** Figure 89-10 This sticker on a hybrid vehicle allows the driver to use the high-occupancy vehicle (HOV) lanes even if there is only one person in the vehicle as a way to increase demand for hybrid vehicles in California.

HANDS-ON TASK: If you have access to a vehicle with a BAS system, have students identify the components of system, referring to **FIGURE 89-9** as needed.

DISCUSSION: Discuss benefits & drawbacks of **BAS system**. Should vehicle with a BAS system be considered hybrid vehicle? Can BAS system be added to a converted diesel vehicle to help it be considered a full hybrid vehicle? **FIGURE 89-9**

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12. **SLIDE 12 EXPLAIN** Figure 89-11 A combination starter/alternator is used to provide idle stop function to conventional vehicles. This very limited and low cost system is called a micro-hybrid drive.

DISCUSSION: Hold a discussion on the **MICRO-HYBRID DRIVE SYSTEM:** What is a bidirectional tensioner and what role does it play in a micro hybrid-drive system? Why does this belt tensioner need to provide tension in both directions?

FIGURE 89-11

HANDS-ON TASK: : If you can obtain either a **BAS or MICRO-HYBRID conversion kit,** have your class convert a common ICE vehicle into a mild hybrid by adding a BAS or MICRO-HYBRID system. This is also an opportunity for students to review safety procedures & electrical principles to develop a better understanding of hybrid vehicles.

DEMONSTRATION: While a hybrid engine is in idle stop mode, **connect a five-gas analyzer.** Have students take note of the CO₂ reading to confirm zero or low CO₂ levels in idle stop mode. Next, connect a five-gas analyzer to an ICE and compare CO₂ readings at idle. Discuss results.

DISCUSSION: What are common voltage ratings for mild, medium, and full hybrid vehicles?

Remind students of safety precautions required for working on hybrid electric vehicles

DISCUSSION: Have students discuss **efficiencies of electric motors and internal combustion engines.** Which is more efficient overall—electric motor or ICE?

HANDS-ON TASK: Have the students **RESEARCH independent repair shops that work on hybrid electric vehicles.** What types of repairs are they doing, and what safety precautions are being observed? Have students share their findings with class.

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ON-VEHICLE NATEF TASK: Locate and interpret **HEV** vehicle labels and calibration decals. **P277**

[Automatic Temperature Control, ATC Sun Load \(View\) \(Download\)](#)

[Automatic Temperature Control, ATC Temperature, Heat \(View\) \(Download\)](#)

[Automatic Temperature Control, ATC Air Quality \(View\) \(Download\)](#)

[Automatic Temperature Control, ATC Temperature, Cool, Adjust \(View\) \(Download\)](#)

[Automatic Temperature Control, ATC Temperature, Cool \(View\) \(Download\)](#)

[Automatic Temperature Control, ATC Temperature, Humidity \(View\) \(Download\)](#)

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