

# Advanced Automotive Electricity & Electronics

## Chapter 26 Introduction to Hybrid Vehicles

### Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of <b>Advanced Automotive Electricity &amp; Electronics</b> . It correlates material to task lists specified by ASE and NATEF.
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.	Explain learning objectives to students as listed on SLIDE. <ol style="list-style-type: none"><li>1. Describe the different types of hybrid electric vehicles.</li><li>2. Explain how a hybrid vehicle is able to achieve an improvement in fuel economy compared to a conventional vehicle design.</li><li>3. Discuss the advantages and disadvantages of the various hybrid designs.</li><li>4. Describe HEV components, including motors, energy sources, and motor controllers.</li><li>5. Discuss the operation of a typical hybrid electric vehicle.</li></ol>
Establish the Mood or Climate	Provide a <b>WELCOME</b> , 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.

## ICONS



## Chapter 26 Introduction To Hybrid Vehicles

### 1. SLIDE 1 CH26 INTRODUCTION TO HYBRID ELECTRIC VEHICLES

#### **VIDEO:HEVS** [www.myautomotivelab.com](http://www.myautomotivelab.com)

[http://media.pearsoncmg.com/ph/chet/chet\\_mylibs/akamai/template/video640x480.php?title=Hybrid%20Vehicle&clip=pandc/chet/2012/automotive/Auto\\_Shop\\_Safety/Clip39HybridVehic.mov&caption=chet/chet\\_mylibs/akamai/2012/automotive/Auto\\_Shop\\_Safety/xml/Clip39HybridVehic.xml](http://media.pearsoncmg.com/ph/chet/chet_mylibs/akamai/template/video640x480.php?title=Hybrid%20Vehicle&clip=pandc/chet/2012/automotive/Auto_Shop_Safety/Clip39HybridVehic.mov&caption=chet/chet_mylibs/akamai/2012/automotive/Auto_Shop_Safety/xml/Clip39HybridVehic.xml)

### 2. SLIDE 2 **EXPLAIN** Hybrid Vehicle

### 3. SLIDE 3 **EXPLAIN** Electric Vehicles

### 4. SLIDE 4 **EXPLAIN** Figure 26-1 View of 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 26-1**

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

**DISCUSSION: 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.**

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

**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.

5. SLIDE 5 **EXPLAIN** Figure 26-2 General Motors EV1 without a body.
6. SLIDE 6 **EXPLAIN** Electric Vehicles
7. SLIDE 7 **EXPLAIN NOTE**

**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.

8. SLIDE 8 **EXPLAIN** Driving and Owning Hybrid Electric Vehicle
9. SLIDE 9 **EXPLAIN** Classifications of Hybrid Electric Vehicles
10. SLIDE 10 **EXPLAIN** Figure 26-3 A drawing of the power flow in a typical series-hybrid vehicle.
11. SLIDE 11 **EXPLAIN** Figure 26-4 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
12. SLIDES 12-13 **EXPLAIN FREQUENTLY ASKED QUESTIONS**

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14. SLIDE 14 **EXPLAIN** Figure 26-5 The power flow in a typical parallel-hybrid vehicle.

15. SLIDE 15 **EXPLAIN** Figure 26-6 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

### Show ANIMATION: SERIES HEV OPERATION

[www.myautomotivelab.com](http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab.com)

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template/video640x480.php?title=Comprehensive%20Components&clip=pandc/chet/2012/automotive/OBD2\_Getting\_On\_Board/clip1.mov&caption=c  
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### Show ANIMATION: PARALLEL HEV

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[http://media.pearsoncmg.com/ph/chet/chet\\_myautomotivelab.com](http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab.com)  
2/animations/AX\_Animations/Chapter64\_Fig\_64\_5/index.htm

### Show ANIMATION: SERIES-PARALLEL HEV

[www.myautomotivelab.com](http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab.com)

[http://media.pearsoncmg.com/ph/chet/chet\\_myautomotivelab.com](http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab.com)  
2/animations/AX\_Animations/Chapter64\_Fig\_64\_7/index.htm

16. SLIDES 16-17 **EXPLAIN** Classifications of Hybrid Electric Vehicles

18. SLIDES 18-19 **EXPLAIN NOTES**

20. SLIDE 20 **EXPLAIN** Figure 26-7 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 26-3 to 26-7**. 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**.

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21. SLIDE 21 **EXPLAIN** Belt Alternator Starter Systems

22. SLIDE 22 **EXPLAIN** Figure 26-8 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**

23. SLIDE 23 **EXPLAIN** Figure 26-9 The components of a typical belt alternator-starter (BAS) system.

24. SLIDE 24 **EXPLAIN** FREQUENTLY ASKED QUESTION

**HANDS-ON TASK:** If you have access to a vehicle with a BAS system, have students identify the components of system, referring to **FIGURE 26-9** 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 26-9**

25. SLIDE 25 **EXPLAIN** **FIGURE 26-10** 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.

26. SLIDE 26 **EXPLAIN** Figure 26-11 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.

27. SLIDES 27 **EXPLAIN** Belt Alternator Starter Systems

28. SLIDE 28 **EXPLAIN** NOTE

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**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 26-11

29. SLIDE 29 **EXPLAIN** Common Features of Most Hybrids

**DEMONSTRATION:** While a hybrid engine is in idle stop mode, connect a 5-gas analyzer. Have students take note of the CO<sub>2</sub> reading to confirm zero or low CO<sub>2</sub> levels in idle stop mode. Next, connect a five-gas analyzer to an ICE and compare CO<sub>2</sub> 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.

30. SLIDE 30 **EXPLAIN** Levels of Hybrid Vehicles

31. SLIDE 31 **EXPLAIN** TECH TIP

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

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## Chapter 26 Introduction To Hybrid Vehicles

32. SLIDE 32 **EXPLAIN** Levels of Hybrid Vehicles

33. SLIDE 33 **EXPLAIN** FREQUENTLY ASKED QUESTION