Automotive Technology 6th Edition
Chapter 82 Electronic Throttle Control System
Opening Your Class

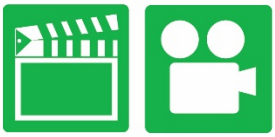
KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, Animations, and ASEEducation (NATEF) Task Sheets.
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 below: 1. Explain how an electronic throttle-control system works. 2. Explain how the position of the accelerator pedal is detected in an electronic throttle-control system. 3. List the parts of a typical electronic throttle control system. 4. Describe how to diagnose faults in an electronic throttle control system. 5. Explain how to service an electronic throttle system. 6. This chapter will help prepare for ASE content area "E" (Computerized Engine Controls Diagnosis and Repair).
Establish the Mood or Climate	Provide a ***WELCOME,*** 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: Lesson plan is based on 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 82 Chapter Images: From

http://www.jameshalderman.com/automotive_principles.html

NOTE: You can use Chapter Images or possibly Power Point files:

ICONS	CH82 ELECTRONIC THROTTLE CONTROL SYSTEM
          	**1. SLIDE 1 CH82 ELECTRONIC THROTTLE CONTROL SYSTEM** **Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **http://www.jameshalderman.com/automotive_principles.html** **DOWNLOAD** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF** **Videos** **Electronic Throttle Control (View) (Download)** **ON-VEHICLE ASEEDUCATION TASK: ELECTRONIC THROTTLE CONTROL** **Identification: Research service information, such as engine management system operation, vehicle service history, and TSBs** **2. SLIDE 2 EXPLAIN Figure 82-1** throttle pedal is connected to the accelerator pedal position (APP) sensor. The electronic throttle body includes a throttle position sensor to provide throttle angle feedback to the vehicle computer. Some systems use a Throttle Actuator Control (TAC) module to operate the throttle blade (plate) **DEMONSTRATION: Show the students vehicle with an electronic throttle control system FIGURE 82-1. Point out its components and the lack of a throttle cable or linkage.** **3. SLIDE 3 EXPLAIN Figure 82-2** opening of throttle plate can be delayed as long as 30 milliseconds (0.030 sec.) to allow time for amount of fuel needed to catch up to opening of throttle plate **DISCUSSION: Have students discuss electronic throttle control systems. What are components of an electronic throttle control system? How is**

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	**accelerator pedal position sensor similar to throttle position sensor? FIGURE 82-2** 4. **SLIDE 4 EXPLAIN Figure 82-3** A typical accelerator pedal position (APP) sensor, showing two different output voltage signals that are used by the PCM to determine accelerator pedal position. Two (or three in some applications) are used as a double check because this is a safety-related sensor
	**DISCUSSION: Ask the students to discuss the normal operation of electronic throttle control system. How could the lack of rapid response give some drivers a negative opinion of ETC system?**
	**DISCUSSION: Have the students discuss the practice of using 2 or 3 accelerator position sensors. What might happen if one sensor fails?**
	5. **SLIDE 5 EXPLAIN Figure 80-4** default position for the throttle plate is in slightly open position. The servomotor then is used to close it for idle and open it during acceleration
	**DISCUSSION: Ask the students to discuss the throttle body assembly FIGURE 82-4 for an electronic throttle control system. How is it same as & how does it differ from conventional system?**
	**HANDS-ON TASK: Show the students a throttle body from an ETC system, if available. Let them inspect throttle body, feel spring tension, and see size of DC actuator motor.**
	6. **SLIDE 6 EXPLAIN Figure 82-5 (a)** An H-bridge circuit is used to control the direction of the DC electric motor of the electronic throttle control unit 7. **SLIDE 7 EXPLAIN Figure 82-5 (b)** To reverse the direction of operation, the polarity of the current through the motor is reversed. 8. **SLIDE 8 EXPLAIN Figure 82-6** Schematic of a typical electronic throttle control (ETC) system. Note that terminal #5 is always pulse-width modulated and that terminal #3 is always constant, but both power and ground are switched to change the direction of the motor

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	**DISCUSS FREQUENTLY ASKED QUESTION:** ***What Is the "Spring Test"?*** **spring test is a self-test performed by PCM whenever engine is started. PCM operates throttle to check if it can react to command and return to default (home) position. This self-test is used by PCM to determine that spring and motor are working correctly and may be noticed by some Vehicle owners by following factors:** • **A slight delay in the operation of the starter motor. It is when the ignition is turned to on position that PCM performs the test. While it takes just a short time to perform test, it can be sensed by the driver that there could be a fault in the ignition switch or starter Motor circuits.** • **A slight "clicking" sound may also be heard coming from under the hood when the ignition is turned on. This is normal and is related to the self-test on throttle as it opens and closes.**
	**DISCUSS FREQUENTLY ASKED QUESTION:** ***Why Not Use a Stepper Motor for ETC?*** **A stepper motor is a type of motor that has multiple windings and is pulsed by a computer to rotate a certain number of degrees when pulsed. The disadvantage is that a stepper motor is too slow to react compared with a conventional DC electric motor and is the reason a stepper motor is not used in electronic throttle control systems.**
	**DISCUSSION: Have the students discuss how PCM drives throttle blade open or closed from default position. Why is a default position needed? Have the students talk about the use of 2 throttle position sensors in the throttle body. What happens if one fails? Ask students to discuss H-bridge circuit used to actuate throttle. Can they think of**

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	other motors (e.g., window motor, seat motor) that operate on same principle? **FIGURES 82-5 & 6** 9. **SLIDE 9 EXPLAIN Figure 82-7** The two TP sensors used on the throttle body of an electronic throttle body assembly produce opposite voltage signals as the throttle is opened. The total voltage of both combined at any throttle plate position is 5 volts
	**DISCUSSION:** Have the students discuss need to calibrate a replacement accelerator pedal position sensor. Why do they think calibration should be done? **FIGURE 82-7**
	**DISCUSS FREQUENTLY ASKED QUESTION:** ***How Do You Calibrate a New APP Sensor?*** **Whenever an accelerator pedal position (APP) sensor is replaced, it should be calibrated before it works correctly. Always check service information for the exact procedure to follow after APP sensor replacement. Here is a typical example of the procedure:** • **STEP 1 Make sure accelerator pedal is fully released.** • **STEP 2 Turn ignition switch on (engine off) and wait at least 2 seconds.** • **STEP 3 Turn the ignition switch off and wait at least 10 seconds.** • **STEP 4 Turn ignition switch on (engine on) and wait at least 2 seconds.** • **STEP 5 Turn the ignition switch off and wait at least 10 seconds.**
	10. **SLIDE 10 EXPLAIN Figure 82-8 (a)** A "reduced power" warning light indicates a fault with the electronic throttle control system on some General Motors vehicles. 11. **SLIDE 11 EXPLAIN Figure 82-8 (b)** A symbol showing an engine with an arrow pointing down is used on some General Motors vehicles to indicate a fault with the electronic throttle control system.
	**DISCUSSION:** Have the students talk about the "limp home" or limp-in mode situation. Why is limp home mode also called fail-safe system?

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	**DISCUSSION:** Have the students talk about the differences among OEMS in symbols or warning lamps they use to indicate a problem with electronic throttle control system. Do these differences cause problems? **FIGURE 82-8**
	12. **SLIDE 12 EXPLAIN Figure 82-9** wrench symbol warning lamp on Ford. Symbol can also be green. 13. **SLIDE 13 EXPLAIN Figure 82-10** symbol used on a Chrysler vehicle indicating fault with electronic throttle control.
	**DISCUSSION:** Have the students talk about the **wrench & lightning bolt symbols** used by Ford & Chrysler. Do they think these symbols get more attention from the driver than a check engine lamp does? **FIGURES 82-9 & 10**
	**DISCUSSION:** Have students discuss **vacuum leaks** and how they affect an engine. Can ETC compensate for leaks at any other engine speed besides idle?
	**DISCUSS CASE STUDY: *The High-Idle Toyota*** **The owner of a Toyota Camry complained that the engine would idle at over 1,200 RPM, compared with a normal 600 to 700 RPM. The vehicle would also not accelerate. Using a scan tool, a check for diagnostic trouble codes showed one code: P2101—"TAC motor circuit low." Checking service information led to the inspection of the electronic throttle control throttle body assembly. With ignition key out of ignition and the inlet air duct off throttle body, technician used a screwdriver to see if throttle plate worked.** **Normal operation—throttle plate should move and then spring back quickly to the default position.** **Abnormal operation—If throttle plate stays where it is moved or does not return to default**

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	position, there is a fault with the throttle body assembly.• SEE FIGURE 82–11. **The technician replaced throttle body assembly with an updated version and proper engine operation was restored. The technician disassembled old throttle body and found it was corroded inside due to moisture entering the unit through the vent hose. • SEE FIGURE 82–12.** **Summary:** • **Complaint—Customer stated that the engine would idle at over 2,000 RPM.** • **Cause—P2101 DTC was stored, indicating a fault with throttle body assembly.** • **Correction—throttle body was replaced with an improved version that placed the vent tube in a different position to help avoid water getting into assembly.**
	**14. SLIDE 14 EXPLAIN FIGURE 82-11** throttle plate stayed where it was moved, which indicates that there is a problem with electronic throttle body control assembly. **15. SLIDE 15 EXPLAIN FIGURE 82-12** A corroded electronic throttle control assembly shown with the cover removed. **16. SLIDE 16 EXPLAIN FIGURE 82-13** Notice the small motor gear on the left drives a larger plastic gear (black), which then drives the small gear in mesh with the section of a gear attached to the throttle plate.
	**DISCUSSION: Have the students discuss the procedure for cleaning an electronic throttle control system throttle body. Is this a new procedure? Then have students talk about procedure for a throttle body with a warning label that says "Do not clean." What would they do if this throttle body were dirty? FIGURE 82-11**
	**DISCUSSION: Ask the students to discuss the reason for removing the key when servicing an electronic throttle body. Why should they not spray cleaner into the throttle body assembly?**

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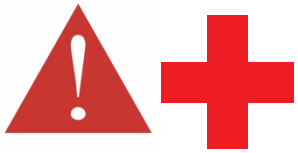	**SAFETY** Explain to the students that DC motor is strong enough to severely cut or even amputate a finger if inserted into a throttle body when actuated. Key should be removed before any service is attempted.