

Automotive Technology 6th Edition

Chapter 111 ABS DIAGNOSIS & REPAIR

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.	<p>Explain learning objectives to students as listed below:</p> <ol style="list-style-type: none"> 1. Explain the ABS diagnostic procedure and retrieval of diagnostic codes. 2. Explain how to diagnose the OBD-II ABS system. 3. Explain how to diagnose wheel speed sensors. 4. List the steps in the hydraulic ABS service procedure. 5. Discuss ABS safety precautions. 6. This chapter will help prepare for Brakes (A5) ASE certification test content area “D” (Electronic Brake Control Systems: Antilock Brake System (ABS), Traction Control System (TCS), and Electronic Stability Control System (ESC) 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

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

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1. SLIDE 1 CH111 ABS DIAGNOSIS & REPAIR

Check for **ADDITIONAL VIDEOS & ANIMATIONS**
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Crossword Puzzle (Microsoft Word) (PDF)
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Videos

2. **SLIDE 2 EXPLAIN** FIGURE 111–1 On most vehicles equipped with ABS, the ABS and the BRAKE warning lamp should come on as a bulb check when the ignition is first switched on.

3. **SLIDE 3 EXPLAIN** FIGURE 111–2 amber ABS.

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DISCUSSION: Ask students to discuss procedure for diagnosing a fault in an antilock braking system (ABS). Ask students to talk about what red brake warning lamp (RBWL) indicates when it is illuminated. What ABS problems does it signal? Ask students to discuss operation of amber ABS warning lamp.

DEMONSTRATION: Show students how ABS **DIAGNOSTICS works on the trainer**

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4. SLIDE 4 **EXPLAIN** FIGURE 111–3 visual inspection of the wheel speed sensor on this older vehicle showed metal “fuzz” had been attracted to magnetic sensor.

DISCUSS CHART 111-1 **Items that should be checked when diagnosing a concern about antilock brake system (ABS).**

EXPLAIN TECH TIP: *Sometimes It Pays to Look at Entire Vehicle.* There are often strange electrical problems that can occur including false DTCs or intermittent operation of electrical sensors, ABS, accessories, or gauges. Sometimes the root of these problems is due to rust and corrosion after a vehicle is involved in a flood. Here are some telltale signs that a vehicle may have due to flooding:

- Mud, silt, or caked dust under the dash and inside doors
- Corroded electrical connectors at the computer, fuse box, or ABS controller (computer)
- Visible waterline in the doors or behind panels
- Rust in abnormal places such as seat springs or brackets behind the dash
- Moisture in lenses
- Musty smell and/or strong air freshener smell
- Powdery corrosion on aluminum parts such as Intake manifold and inside the throttle bore
- Rust or moisture inside electrical switches or relays
- Areas that are normally dusty, such as an ashtray or glove box, are very clean

DISCUSS FREQUENTLY ASKED QUESTION: ***What’s That Noise and Vibration?*** Many vehicle owners and service technicians have been disturbed to hear and feel an occasional groaning noise. It is usually heard and felt through vehicle after first being started and

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driven. Because it occurs when first being driven in forward or reverse, many technicians have blamed transmission or related driveline components. This is commonly heard on many ABS vehicles as part of a system check. As soon as ABS controller senses speed from wheel speed sensors after an ignition cycles on, controller will run pump either every time or whenever accumulator pressure is below a certain level. This can occur while the vehicle is being backed out of a driveway or being driven forward because wheel sensors can only detect speed—not direction. Before serious and major repairs are attempted to “cure” a noise, make sure that it is not normal ABS self-test activation sequence of events.

DEMONSTRATION: Show students how to do a visual inspection looking for telltale clues of how the vehicle has been driven and maintained.

DISCUSSION: Have students talk about the importance of doing a complete visual inspection of the entire vehicle before making a diagnosis

HANDS-ON TASK: Have students perform a complete visual inspection of the antilock braking system.

DISCUSSION: Ask students to talk about the importance of a test drive in diagnosing an ABS fault. What symptoms should technicians look for in such a test?

DEMONSTRATION: SHOW HOW to retrieve ABS-related diagnostic codes by using a scan tool. Ask them to explain the results.

DISCUSSION: Ask students to discuss the procedures for clearing the diagnostic trouble codes for the vehicles on which they are working.

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5. **SLIDE 5 EXPLAIN FIGURE 111–4** GM diagnostic connector. Flash codes are available by using a jumper wire to ground (terminal A) to terminal H. This connector is located under the dash near steering column on older (pre-1996). General Motors vehicles.
5. **SLIDE 5 EXPLAIN FIGURE 111–5** breakout box is being used to diagnose an ABS problem. The controller (computer) is located in trunk of this vehicle, and a digital multimeter is being used to measure resistance and voltage at various points in system, following service manual procedure..
6. **SLIDE 6 EXPLAIN FIGURE 111–6** Tech 2 scan tool being used to diagnose an ABS problem on a General Motors' vehicle.

DISCUSS CASE STUDY: *Mystery ABS Amber Warning Light:* owner complained to a technician that ABS warning light would come on but only while driving down from a parking garage. When driver turned off ignition and restarted engine, ABS amber light was not on and did not come on again until vehicle was again driven down spiral parking garage ramp. The technician used scan tool and found that no DTCs had been stored.

NOTE: Some ABS systems will not retain a DTC unless the problem is currently present and ABS amber warning light is on.

All of brakes were in excellent condition, but brake fluid level was down a little. After topping off master cylinder with clean DOT 3 brake fluid, vehicle was returned to customer with following information:

- **ABS amber warning light may have been triggered by brake fluid level switch. While driving down the steep parking garage ramp, the brake fluid moved away from the fluid level sensor.**

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NOTE: While brake fluid level sensor normally would turn on red brake warning light, in some systems it turns on amber ABS light if brake fluid falls below a certain level in ABS reservoir.

- The difference in wheel speed between the outboard and the inboard wheels could have triggered a fault code for a wheel speed sensor during drive down the spiral parking garage ramp.

Summary

- **Complaint**—Driver stated that amber ABS warning lamp would come on but only when descending in a parking garage.
- **Cause**—Possible low brake fluid level or normal operation due to change in wheel speed while turning sharply.
- **Correction**—Added a slight amount of brake fluid to return the level to the “MAX” level and returned to owner

DISCUSSION: discuss antilock braking systems covered in this chapter. What are the advantages and disadvantages of each technology? On what types of vehicles do you typically find each system?

EXPLAIN TECH TIP: *Space Saver Spare Tire May Trigger Wheel Speed Fault Code.* If a vehicle has been using a small space saver-type spare tire, then difference in outside diameter may trigger a wheel speed sensor diagnostic trouble code (DTC) and turn on the amber ABS warning lamp. Try to find out from the customer if they had driven on a spare tire before replacing a wheel speed sensor based on a stored DTC.

EXPLAIN TECH TIP: *Check Power and Ground First* Before replacing an expensive EBCM, make sure to verify power and ground circuits at EBCM connector. Also check power and ground at the other end of the harness, such as at the fuse box



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and fuses and the bolted ground connection on the vehicle chassis. • SEE FIGURE 111-7.

7. SLIDE 7 EXPLAIN FIGURE 111-7 (a) This corroded electrical connector to the ABS hydraulic control module helped explain why there were many stored diagnostic trouble codes (DTCs). (b) The male terminals also showed signs of corrosion inside this connector.

DEMONSTRATION: DEMO wheel sensor operation

DISCUSS CASE STUDY: *Nervous Honda Civic*

A customer complained that sometimes during normal braking, ABS would be activated (brake pedal pulsated) just before coming to a stop. However, the ABS light would not come on. The technician was able to duplicate condition and there were no DTCs stored. Using a scan tool to monitor wheel speed sensors, technician discovered that left front wheel speed was slightly different than the others. A thorough visual inspection revealed that the tone wheel (reluctor ring) was cracked. This crack created a different wheel speed signal to ABS controller than other wheels and controller activated ABS as it would normally—that was why there were no DTCs. Other things that could have caused this problem, which is often called “false modulation,” include a bent wheel, mismatched tire sizes, or metal debris around the sensor.

Summary

- **Complaint—Driver complained that the ABS caused brake pedal to pulsated but only when vehicle was slowing to a stop.**
- **Cause—A cracked tone (reluctor) ring was discovered on right front.**
- **Correction—customer authorized replacement of a new wheel bearing**

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assembly which included the tone ring and the problem was corrected.

DISCUSS CHART 111-2 Selected ABS-related "C" codes.

8. **SLIDE 8 EXPLAIN FIGURE 111-8** Typical wheel speed sensor. When a tooth on sensor ring is close to sensor, strength of the magnetic field is stronger because the metal of tooth conducts magnetic lines of force better than air. When the tooth moves away, magnetic field strength is reduced. It is this changing magnetic field strength that produces changing voltage. Frequency of signal is determined by speed of rotating sensor.

DEMONSTRATION: Show students how to inspect the connections involved in the wheel speed sensor circuit for defects and corrosion.

[Wheel Speed Sensor, AC Voltage \(View\) \(Download\)](#)

[Wheel Speed Sensor, Bias Voltage \(View\) \(Download\)](#)

[Wheel Speed Sensor, Resistance \(View\) \(Download\)](#)

[Wheel Speed Sensor, Short to Ground \(View\) \(Download\)](#)

DISCUSSION: Ask students to talk about the problems caused by damaged or contaminated wheel speed sensors (WSS). What are the possible causes of low voltage readings?

HANDS-ON TASK: Have students perform steps in the Quick and Easy Wheel Speed Sensor Diagnosis to test for a fault in wheel speed sensor.

EXPLAIN TECH TIP: Perform "Wiggle Test"

Whenever testing a wheel speed sensor, it is a good idea to move or wiggle sensor wiring and connector when taking a resistance or voltage measurement in case of a broken wire or corroded connector. If reading on meter changes when wiring is being moved, then this confirms that there is a possible problem with wiring or connections so further diagnosis will be needed.

10. **SLIDE 10 EXPLAIN FIGURE 111-9** Measuring resistance of a wheel speed sensor.

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11. SLIDE 11 **EXPLAIN** FIGURE 111–10 scope can be used to check for proper operation of a wheel speed sensor.
12. SLIDE 12 **EXPLAIN** FIGURE 111–11 broken tooth on a wheel speed sensor tone ring shows on scope trace as a missing wave.

EXPLAIN TECH TIP: Quick and Easy Wheel Speed Sensor Diagnosis. A fault in a wheel speed sensor (WSS) is a common ABS problem. A quick and easy test that works on most Bosch ABS (and perhaps others) involves following steps:

STEP 1 Hoist vehicle safely.

STEP 2 Key on, engine off (KOEO).

STEP 3 Spin a tire by hand as fast as possible.

STEP 4 ABS amber warning light should come on, indicating that a speed was detected but not by all the wheel speed sensors.

STEP 5 Turn ignition off to reset ABS warning light.

STEP 6 Repeat test on each of remaining wheels.

If any wheel fails to turn on ABS light, carefully inspect wheel speed sensor for proper resistance and tone ring and wiring. If ABS light is on all time and does not reset when ignition is turned off, the problem is not caused by a wheel speed sensor.

DISCUSS FREQUENTLY ASKED QUESTION:

Why Does My Scan Tool Show Speed When Stopped? Some vehicles, especially older GM vehicles will show 2 or 3 mph on scan tool with vehicle in shop and not moving. This is perfectly normal and there is no fault so no service or repair is needed to be performed. The reading seems to be a default reading because many passive wheel speed sensors are not capable of supplying a usable wheel speed until over 3 mph..

DISCUSS FREQUENTLY ASKED QUESTION:

Is a Wheel Speed Sensor Adjustable?

Some older ABS applications use adjustable wheel speed sensors. Most sensors adjust by

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first loosening a set screw, then inserting a nonmagnetic brass or plastic feeler gauge between the tip of the sensor and a high point on the tone ring. When installing a new wheel speed sensor, look for a piece of paper or plastic on the tip. The paper or plastic is the precise thickness to guarantee a correct air gap between the tip of the sensor and tone ring. Adjust sensor so tip just touches tone ring and you can slip paper or plastic out without ripping it. Tighten the setscrew and air gap is properly set. • **SEE FIGURE 111-12**



13. **SLIDE 13 EXPLAIN FIGURE 111-12** (a) Always use nonferrous (brass or plastic) feeler (thickness) gauge when measuring gap between toothed ring and wheel speed sensor. (b) Sometimes sensor is equipped with paper spacer that is exact thickness of spacing required between toothed ring and sensor. If equipped, sensor is simply installed with paper touching toothed wheel. A typical gap ranges from 0.020 to 0.050 inch (0.5 to 1.3 mm).

DEMONSTRATION: show students how to test a WSS by using a scope.

HANDS-ON TASK: Have students test a WSS by using a scope on a lab vehicle

14. **SLIDE 14 EXPLAIN FIGURE 111-13** Special bleed valve tools are often required when bleeding some ABS units such as the Kelsey-Hayes 4WAL system.

DISCUSSION: Ask students to discuss the procedures for adjusting wheel speed sensors. What is the significance of the paper or plastic protective covering on the tip end of a WSS?

15. **SLIDE 15 EXPLAIN FIGURE 111-14** Two bleed valve tools are needed to bleed Kelsey-Hayes 4WAL system, which attaches to the bleeder valves **on the accumulator**

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DEMONSTRATION: Show students how to use a nonmagnetic feeler gauge to check the wheel speed sensor gap.

HANDS-ON TASK: Have students use a nonmagnetic feeler gauge to check the wheel speed sensor gap on a Lab Vehicle

HANDS-ON TASK: Have students use a scan tool to test a WSS and explain the results.

DEMONSTRATION: Show students how to make certain that the ABS system is not pressurized before you open a bleeder screw or loosen a hydraulic line.

ON-VEHICLE ASE EDUCATION TASK: G1. Identify and inspect electronic brake control system components (ABS, TCS, ESC); determine needed action.

ON-VEHICLE ASE EDUCATION TASK: G3. Diagnose poor stopping, wheel lock-up, abnormal pedal feel, unwanted application, and noise concerns associated with the electronic brake control system; determine needed action.

ON-VEHICLE ASE EDUCATION TASK: G4. Diagnose electronic brake control system electronic control(s) and components by retrieving diagnostic trouble codes, and/or using recommended test equipment; determine needed action.

ON-VEHICLE ASE EDUCATION TASK: G5. Depressurize high-pressure components of an electronic brake control system.

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ON-VEHICLE ASE EDUCATION TASK G6:

Bleed the electronic brake control system hydraulic circuits

ON-VEHICLE ASE EDUCATION TASK: G7.

Test, diagnose, and service electronic brake control system speed sensors (digital and analog), toothed ring (tone wheel), and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO) (includes output signal, resistance, shorts to voltage/ground, and frequency data).

ON-VEHICLE ASE EDUCATION TASK: G8.

Diagnose electronic brake control system braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).

SEARCH INTERNET: Have students use Internet to research three vehicle antilock braking systems. Ask them to write a brief description of the ABS technology used for each vehicle and the additional cost of this option.