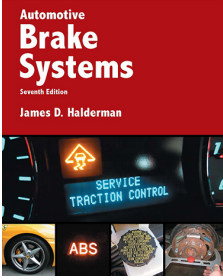


Automotive Brake Systems



CHAPTER 17

ABS Components and Operation

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OBJECTIVES

- Explain the need for Antilock brake system (ABS).
- Describe the operation and system configurations of ABS.
- Describe the purpose and function of the ABS components, such as wheel speed sensors, electronic control unit, ABS warning lamp, and hydraulic modulator assembly.

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OBJECTIVES

- Explain the operation of the brake pedal travel sensor and the tire pressure monitoring system.

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ANTILOCK BRAKING SYSTEM

- Overview
 - Antilock braking systems (ABS) help prevent the wheels from locking during sudden braking, especially on slippery surfaces
 - ABS helps to eliminate lockup and minimize the danger of skidding

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ANTILOCK BRAKING SYSTEM

- Overview
 - ABS can improve braking when road conditions are less than ideal
 - ABS monitors the relative speed of the wheels to one another to modulate brake pressure as needed to control slippage and maintain traction when the brakes are applied

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ABS OPERATION

- Wheel Speed Sensor Input
 - Wheel speed is monitored by one or more wheel speed sensors
 - If one wheel starts to slow at a faster rate than the others, or at a faster rate than that which is programmed in the antilock control module, it indicates a wheel is starting to slip and is in danger of losing traction and locking

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ABS OPERATION

- Wheel Speed Sensor Input
 - The ABS responds by momentarily reducing hydraulic pressure to the brake on the affected wheel or wheels, allowing the wheel to regain traction
 - As traction is regained, brake pressure is reapplied to slow the wheel
 - The cycle is repeated over and over until the vehicle stops or until the driver eases pressure on the brake pedal

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ABS OPERATION

- Control Valves
 - Electrically operated solenoid valves are used to hold, release, and reapply hydraulic pressure to the brakes, producing a pulsating effect, which can be felt in the brake pedal during hard braking

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ABS OPERATION

- Control Valves
 - The rapid modulation of brake pressure in a given brake circuit reduces the braking load on the affected wheel and allows it to regain traction
 - Once the rate of deceleration for the affected wheel catches up with the others, normal braking function and pressure resume, and antilock reverts to a passive mode

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SYSTEM CONFIGURATIONS

- Four-Channel ABS System
 - Each wheel speed sensor provides input for a separate hydraulic control circuit or “channel” for that wheel
- Three-Channel ABS System
 - Have a separate wheel speed sensor for each front wheel but use a common speed sensor for both rear wheels

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SYSTEM CONFIGURATIONS

- Have a separate wheel speed sensor for each front wheel but use a common speed sensor for both rear wheels
- The rear wheel speed sensor is mounted in either the differential or the transmission and reads the combined or average speed of both rear wheels
- Both rear wheels are controlled simultaneously
- This is known as the select low principle

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SYSTEM CONFIGURATIONS

- Three-channel systems are the most common type of ABS setup used on rear-wheel-drive applications
- Single-Channel ABS System
 - Used on many rear-wheel-drive pickups and vans
 - The front wheels have no speed sensors; a single speed sensor mounted in the differential or transmission is used for both rear wheels

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SYSTEM CONFIGURATIONS

- Rear-wheel antilock systems are typically used on applications where vehicle loading can affect rear wheel traction
- Integral and Nonintegral
 - Integral systems combine the brake master cylinder and ABS hydraulic modulator, electric pump, and accumulator into one assembly

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SYSTEM CONFIGURATIONS

- Integral systems do not have a vacuum booster for power assist
- Nonintegral ABS systems, “add-on” systems, have become the most common type of ABS system because of their lower cost and simplicity
- Nonintegral ABS systems have a conventional brake master cylinder and vacuum power booster with a separate hydraulic modulator unit

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ABS COMPONENTS

- Basic components that are common to all antilock brake systems include the following:
 - Wheel speed sensors
 - Electronic control unit
 - ABS warning lamp
 - Hydraulic modulator assembly with electrically operated solenoid valves

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ABS CONTROL MODULE

- Module Inputs
 - The key inputs come from the wheel speed sensors and the brake pedal switch
 - The brake pedal switch signals the control module when the brakes are being applied

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HYDRAULIC MODULATOR ASSEMBLY

- Purpose and Function
 - The modulator valve body is part of the master cylinder assembly in nonintegral antilock systems but separate in nonintegral systems
 - It contains solenoid valves for each brake unit
 - The exact number of valves per circuit depends on the ABS system and the application

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HYDRAULIC MODULATOR ASSEMBLY

- The wheel speed sensors provide information about what is happening to the wheels while the brakes are being applied

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HYDRAULIC MODULATOR ASSEMBLY

- Purpose and Function
 - Some use a pair of on-off solenoid valves for each brake circuit while others use a single valve that can operate in more than one position

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BRAKE PEDAL TRAVEL SWITCH (SENSOR)

- Purpose and Function
 - Some ABS systems use a brake pedal travel switch (sensor) to turn on the hydraulic pump when the brake pedal has been depressed to 40% of its travel
 - The pump runs and pumps brake fluid back into the master cylinder, which raises the brake pedal until the switch closes again, turning off the pump

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BRAKE PEDAL TRAVEL SWITCH (SENSOR)

- Purpose and Function
 - When the brakes are applied, the electronic controller “gets ready” to act if ABS needs to “initialize” the starting sequence of events

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TIRE PRESSURE MONITORING SYSTEM (TPMS)

- Tire pressure monitoring systems (TPMS) are required on all new vehicles
- A tire that is underinflated will have a slightly smaller rolling radius than one that is properly inflated, creating a difference in the wheel speed sensor reading if the difference in inflation pressure is 12 PSI or more

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TIRE PRESSURE MONITORING SYSTEM (TPMS)

- The ABS controller will then turn on the low tire pressure warning lamp
- To help compensate for speed variation during cornering, an indirect tire pressure monitoring system checks the rotating speeds of diagonally opposed wheels

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TIRE PRESSURE MONITORING SYSTEM (TPMS)

- The system adds the speeds of the right front and left rear and then subtracts that value from the sum of the left front and right rear tires
- If the total is less than or equal to a threshold value, no warning is given
- However, if the total is greater, the TPMS warning light is lit until air is added to the tire and the ignition is cycled off and on

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SUMMARY

- Antilock braking systems (ABS) help prevent the wheels from locking during sudden braking, especially on slippery surfaces
- Wheel speed is monitored by one or more wheel speed sensors
- The key inputs for the ABS control module come from the wheel speed sensors and the brake pedal switch

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