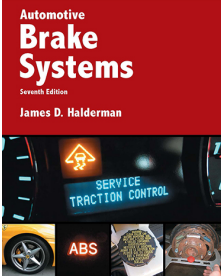


# Automotive Brake Systems



## CHAPTER 06

### Hydraulic Valves and Switches

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## OBJECTIVES

- Describe the operation of a pressure-differential switch and a brake fluid level sensor switch.
- Describe the operation of a residual check valve.
- Describe the operation of the proportioning valve.

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## OBJECTIVES

- Discuss the need and use of a metering valve.
- Describe how a brake light switch works.

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## RESIDUAL CHECK VALVE

- A residual check valve is used on some drum brake systems to keep a slight amount of pressure on the entire hydraulic system
- A check ball and spring permit all the brake fluid to return to the master cylinder until the designated pressure is reached

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## RESIDUAL CHECK VALVE

- With a low pressure kept on the hydraulic system, any small hole will cause fluid to leak out rather than permit air to enter the system
- Slight pressure also keeps the wheel cylinder sealing cups tight against the inside wall of the wheel cylinder
- Residual check valves are not used often on late-model vehicles equipped with front disc/rear drum brakes

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## PRESSURE-DIFFERENTIAL SWITCH (BRAKE WARNING SWITCH)

- A brake warning switch is used to warn the driver of a loss of pressure in one of the two separate systems by lighting the dashboard red brake warning indicator lamp
- The brake lines from both sections of the master cylinder are sent to the switch, which lights the brake warning indicator lamp

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## BRAKE FLUID LEVEL SENSOR SWITCH

- The red brake warning lamp on the dash will light if low brake fluid level is detected
- A float-type sensor or a magnetic reed switch are commonly used and provide a complete electrical circuit when the brake fluid level is low
- After refilling the master cylinder reservoir to the correct level, the red “brake” warning lamp should go out

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## PROPORTIONING VALVE

- Purpose and Function
  - A proportioning valve improves brake balance during hard stops by limiting hydraulic pressure to the rear brakes
  - Inertia creates a weight shift toward the front of the vehicle during braking
  - The weight shift unloads the rear axle, which reduces traction between the tires and the road

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## PROPORTIONING VALVE

- Unless application pressure to the rear wheels is limited, the rear brakes will lock
- Vehicles with front disc and rear drum brakes require a proportioning valve for two reasons:
  - Disc brakes require higher hydraulic pressure for a given stop than do drum brakes. In a disc/drum system, the front brakes always need more pressure than the rear brakes.

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## PROPORTIONING VALVE

- Drum brakes require less pressure to maintain a fixed level of stopping power than they did to establish that level. In a disc/drum system, the rear brakes will always need less pressure than the front brakes.
- Before proportioning action will begin, brake system hydraulic pressure must reach a minimum level called the split point. Below the split point full system pressure is supplied to the rear brakes.

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## PROPORTIONING VALVE

- Once system hydraulic pressure exceeds the split point, the rear brakes receive a fixed percentage of any further increase in pressure
- Brake engineers refer to the ratio of front to rear brake pressure proportioning as the slope
- The proportioning valves on most vehicles have a slope between 0.25 and 0.50

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## PROPORTIONING VALVE

- Proportioning Valve Operation
  - A simple proportioning valve consists of a spring-loaded piston that slides in a stepped bore and is exposed to pressure on both sides
  - The valve is located in the center of the piston and is opened or closed depending on the position of the piston in the stepped bore

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## PROPORTIONING VALVE

- When the brakes are first applied, hydraulic pressure passes through the proportioning valve to the rear brakes and the piston moves to the left against the spring tension
- As pressure to the front brakes increases, enough force is developed on the master cylinder side of the piston to overcome pressure trapped in the rear brake circuit.

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## PROPORTIONING VALVE

- Before pressure in the two circuits can equalize, the force developed on the larger piston area in the rear circuit moves the piston back to the left and closes the valve
- As long as system pressure continues to increase, the piston will repeatedly cycle back and forth, opening and closing the proportioning valve, and maintaining a fixed proportion of full system pressure to the rear brakes

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## PROPORTIONING VALVE

- When the brakes are released, the spring returns the piston all the way to the right, which opens the valve and allows fluid to pass in both directions

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## METERING VALVE (HOLD-OFF) OPERATION

- A metering valve is used on all front-disc, rear-drum-brake-equipped vehicles to prevent full operation of (holds off) the disc brakes until between 75 to 125 PSI is sent to the rear drum brakes to overcome rear-brake return spring pressure
- This allows the front and rear brakes to apply at the same time for even stopping

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## METERING VALVE (HOLD-OFF) OPERATION

- Most metering valves allow pressure to the front brakes to be blended up to the metering valve pressure to prevent front brake locking under light pedal pressures on icy surfaces
- A metering valve consists of a piston controlled by a strong spring and a valve stem controlled by a weak spring

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## METERING VALVE (HOLD-OFF) OPERATION

- When the brakes are not applied, the strong spring seats the piston and prevents fluid flow around it, while the weak spring holds the valve stem to the right and opens a passage through the center of the piston
- Brake fluid is free to flow through this passage to compensate for changes in system fluid volume

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## METERING VALVE (HOLD-OFF) OPERATION

- When the brakes are applied and pressure in the front brake line reaches 3 to 30 PSI, metering valve stem moves to the left, which closes the passage through the piston and prevents fluid flow to the front brakes

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## METERING VALVE (HOLD-OFF) OPERATION

- While the fluid flow to the front calipers is shut off, the rear brake shoes move into contact with the drums, braking begins, and hydraulic pressure throughout the brake system increases
- When the pressure at the metering valve reaches 75 to 300 PSI, the tension of the strong spring is overcome and the valve stem and piston move farther to the left

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## METERING VALVE (HOLD-OFF) OPERATION

- When the brakes are released, the strong spring seats the piston and prevents fluid flow around it, while the weak spring opens the fluid passage through the center of the piston
- Excess fluid returns to the master cylinder through this passage and the valve is ready for another brake application

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## BRAKE LIGHT SWITCH

- The brake light switch is used to turn on the brake lights at the back of the vehicle
- A properly adjusted light switch will activate the brake lights as soon as the brake pedal is applied and before braking action begins at the wheels

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## BRAKE LIGHT SWITCH

- A brake light switch can be called:
  - Stop light switch
  - Brake pedal position (BPP) switch
  - Brake on/off (BOO) switch (Fords)
- Brake light switches are normally open and close when the brakes are applied, completing the brake light circuit

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## BRAKE LIGHT SWITCH

- Most newer vehicles use the brake switch as an input to the body computer for many functions including:
  - Brake lights
  - Antilock brake system (ABS) input signal
  - Traction control is disabled when the brake pedal is depressed
  - Electronic stability control (ESC) system input signal

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## SUMMARY

- A residual check valve is used on some drum brake systems to keep a slight amount of pressure on the entire hydraulic system.
- The red brake warning lamp on the dash will light if low brake fluid level is detected.
- The brake light switch is used to turn on the brake lights at the back of the vehicle.

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