ANTI LOCK BRAKING SYSTEM

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Introduction

- Wheel lockup during braking causes skidding which in turn cause a loss of traction and vehicle control.
- This reduces the steering ability to change direction. So the car slides out of control.
- With ABS system, the driver can brake hard, take the evasive action and still be in control of the vehicle in any road condition at any speed and under any load.
Concept of ABS

• A skidding wheel (where the tire contact patch is sliding relative to the road) has less traction than a non-skidding wheel.

• By keeping the wheels from skidding while you slow down, anti-lock brakes benefit you in two ways:

• You'll stop faster, and you'll be able to steer while you stop.
comparison

WITH ABS

WITHOUT ABS

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A simple braking system consists of a master cylinder, and four wheel cylinders. When the brake pedal is pressed, the piston in the master cylinder forces the liquid out of the cylinder. This liquid presses the two pistons in the wheel cylinders outwards. These two pistons push the brake shoes out.
Master cylinder

- When the pedal is pressed, the primary piston moves to the left.
- When it crosses the bypass port, the liquid is forced along the pipe lines to the wheel cylinders.
- When the pedal is released, the primary piston is moved back wards. It is the spring, which pushes the piston back ward.
Principles of ABS

- The skidding and lack of control was caused by the locking of wheels.
- The release and reapply of the brake pedal will avoid the locking of the wheels which in turn avoid the skidding.
- This is exactly what an antilock braking system does.
Pressure modulation

- When the brake pedal is pumped or pulsed the pressure is quickly applied and released at the wheels. This is called **pressure modulation**. Pressure modulation works to prevent the wheel locking.
- ABS can modulate the pressure to the brake as often as 15 times per seconds
- ABS precisely controls the slip rate of the wheels to ensure maximum grip force from the tyre and it there by ensures maneuverability and stability of the vehicle
Slip rate

- During ABS operation, the target slip rate can be from 10 to 30%.
- 0% slip means the wheel is rolling freely, while 100% means the wheel is fully locked.
- A slip rate of 25% means the velocity of a wheel is 25% less than that of a freely rolling wheel at the same vehicle speed.
ABS components

- **Hydraulic components**

  1. **Accumulator**
     
     An accumulator is used to store hydraulic fluid to maintain high pressure in the brake system and provide the residual pressure for power assisted braking.

  2. **Antilock hydraulic control valve assembly**
     
     This assembly controls the release and application of the brake system pressure to the wheel brake assemblies.

     It may be of integral type and non-integral type.
3. **Booster pump**

The booster pump is an assembly of an electric motor and pump. The booster pump is used to provide pressurized hydraulic fluid ABS.

4. **Booster/Master cylinder assembly**

   It is referred as the hydraulic unit, contains the valves and pistons needed to modulate hydraulic pressure in the wheel circuit during the ABS operations.

5. **Fluid accumulator**

   Accumulator temporarily stored brake fluid that is removed from the wheel brake unit during ABS cycle. This fluid is then used by pump to build pressure for the brake hydraulic system.
6. **Hydraulic control unit**

This assembly contains solenoid valve, fluid accumulator, pump and electric motor. The unit may have one pump and one motor or it have one motor and two pumps.

7. **Main Valve**

This is a two position valve and is also controlled by ABS control module and is open only in the ABS mode.

8. **Modulator unit**

The modulator unit controls the flow of pressurized brake fluid to the individual wheel circuits. Normally the modulator is made up of solenoid that open and close valves.

9. **Solenoid valves**

The solenoid valves are located in the modulator unit and are electrically operated by signals from the control module.
**Electrical\ electronic components**

1. **ABS control module**  
   This small computer is normally mounted inside the trunk on the wheel housing, mounted to the master cylinder or is part of the hydraulic control unit. It monitors system operation and controls antilock function when needed.

2. **Brake pedal sensor**  
   The antilock brake pedal sensor switch is normally closed. When the brake pedal exceeds the antilock brake pedal sensor switch setting during an antilock stop, the antilock brake control module senses that the antilock brake pedal sensor switch is open.

3. **Wheel speed sensor**  
   It is mounted near the different toothed rings. As the rings teeth rotate, an ac voltage is generated.
Types of antilock brake systems

- **Four channel, four sensor ABS**
  This is the best scheme. There is speed sensor on all four wheels and a separate valve for all the four wheels.

- **Three channel, three sensor ABS**
  This scheme is commonly found on pickup trucks with four wheels ABS, has a speed sensor and a valve for each of the front wheels, with one valve and one sensor for both rear wheels.

- **One channel, one sensor ABS**
  It has one valve, which controls both rear wheels, and one speed sensor, located in the rear axle.
Four wheel system

- The hydraulic circuit for this type of system is an independent four channel type. One for each wheel. The hydraulic control unit is a separate unit.
- The system prevents wheel lock up during an emergency stop by modulating brake pressure.
Operation

1. SENSORS DETECT WHEEL ROTATION.
2. SENSORS RELAY ANALOG SIGNAL INDICATING IMPENDING LOCKING CONDITION.
3. ANALOG SIGNAL CONVERTED TO DIGITAL SIGNAL.
4. MICROPROCESSOR COMPARES INPUT WITH INFORMATION IN RAM AND DETERMINES POTENTIAL BRAKE LOCKUP.
5. OUTPUT DRIVERS CLOSE.
6. ACTUATOR GROUND CIRCUITS CLOSE.
7. CURRENT FLOWS TO SOLENOIDS
   FROM MASTER CYLINDER
   TO RESERVOIR
   FROM BOOSTER CHAMBER.
8. HYDRAULIC PRESSURE TO BRAKE IS REDUCED.
9. NORMALLY CLOSED OUTLET VALVES OPEN.
10. NORMALLY OPEN INLET VALVES CLOSED.

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Advancements

- AUTOMATIC TRACTION CONTROL (ATC)
- AUTOMATIC STABILITY CONTROL
AUTOMATIC TRACTION CONTROL (ATC)

- Automatic traction control systems apply the brakes when a drive wheel attempts to spin and lose traction.
- The system works best when one drive wheel is working on a good traction surface and the other is not.
- The system also works well when the vehicle is accelerating on slippery road surfaces, especially when climbing hills.
AUTOMATIC STABILITY CONTROL

- Stability control systems momentarily apply the brakes at any one wheel to correct over steer or under steer.
- The control unit receives signals from the typical sensors plus a yaw, lateral acceleration (G-force) and a steering angle sensor.
Advantages

- It allows the driver to maintain directional stability and control over steering during braking.
- Safe and effective.
- Automatically changes the brake fluid pressure at each wheel to maintain optimum brake performance.
- ABS absorbs the unwanted turbulence shock waves and modulates the pulses thus permitting the wheel to continue turning under maximum braking pressure.
Disadvantages

- It is very costly
- Maintenance cost of a car equipped with ABS is more.
Conclusion

- Statistics show that approximately 40% of automobile accidents are due to skidding.
- These problems commonly occur on vehicles with conventional brake systems which can be avoided by adding devices called ABS.
- If there is an ABS failure, the system will revert to normal brake operation. Normally, the ABS warning light will turn on and let the driver know there is a fault.
Thank you
Wheel speed sensor
ABS control module