# ABS SYSTEM IN AUTOMOBILES

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***Abstract*- Today the road accidents are increasing day by day. So In this paper presentation we studying about Antilock Breaking System for vehicle control and breaking purpose. About its principle of working and working o f each part . Different sensors used and how they are used. Advantages and Disadvantages of ABS System. Stating different hardware used in ABS system. We also studied about different types of brakes sensors used . Thus concluding that abs is very important in today world vehicle safety.**

**Keywords:Antilock breaking system, ABS, Vehicle Breaking, Sensors ,Safety.**

## I. INTRODUCTION

One of the most unnerving things that can happen in motoring is that you brake and one or more of the wheels locks up. This has two possible effects. It can make the car slew to one side or, if the car happens to skid in a straight line, the steering becomes useless and you lose all directional control. The best way to prevent skidding is to apply a form of braking called cadence braking. A driver who is skilled at this can usually avoid wheel lockup, but an anti-lock braking system does the job automatically and usually more efficiently. More and more cars are now being fitted with such a system.

An anti-lock system automatically applies a form of cadence braking by detecting when a wheel is about to lock, releasing the brake at that wheel and then immediately reapplying it. The system, therefore,

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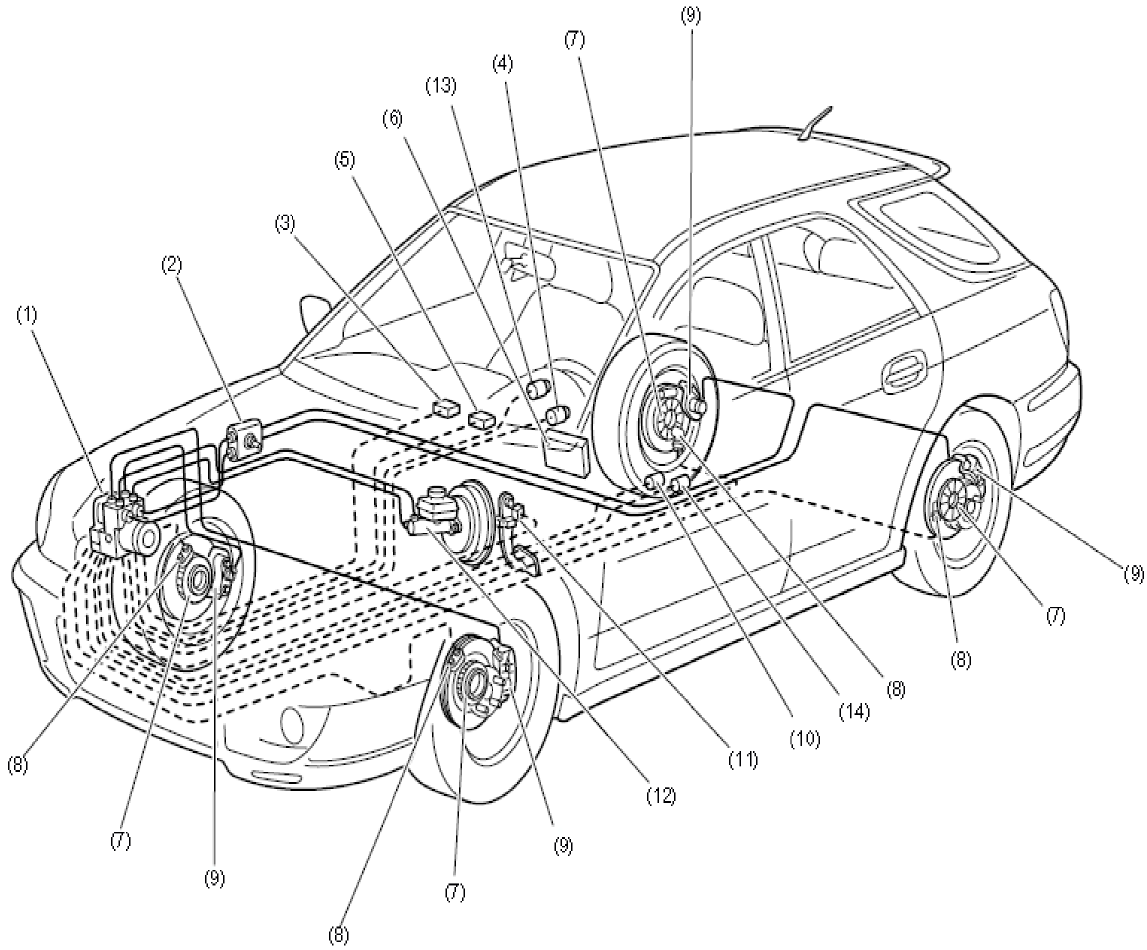
Needs three main parts: a means of telling when a wheel is about to lock; a means of releasing its brake; and a means of restoring the pressure to the brake line after release. The third feature is necessary because the anti-lock system has to work without the driver releasing and reapplying pressure on the brake pedal, and without the pedal sinking to the floor.

Automotive antilock braking systems (ABS) are designed to stop vehicles as safely and quickly as possible. Safety is achieved by maintaining lateral stability (and hence steering effectiveness) and trying to reduce braking distances over the case where the brakes are controlled by the driver. Current ABS designs typically use wheel speed

Compared to the velocity of the vehicle to measure when wheels lock (i.e., when there is “slip” between the tire and the road) and use this information to adjust the duration of brake signal pulses (i.e., to “pump” the brakes). Essentially, as the wheel slip increases past a critical point where it is possible that lateral stability (and hence our ability to steer the vehicle) could be lost, the controller releases the brakes. Then, once wheel slip has decreased to a point where lateral stability is increased and braking effectiveness is decreased, the brakes are reapplied. In this way the ABS cycles the brakes to try to achieve an optimum tradeoff between braking effectiveness and lateral stability. Inherent process nonlinearities, limitations on our abilities to sense certain variables, and uncertainties associated with process and environment (e.g., road conditions changing from wet asphalt to ice) make the ABS control problem challenging




1) ABS control module and hydraulic control unit (ABSCM & H/U)
2) Two-way connector
3) Diagnosis connector
4) ABS warning light
5) Data link connector (for SUBARU select monitor)
6) Transmission control module (AT models only)
7) Tone wheels
8) ABS wheel speed sensor
9) Wheel cylinder
10) G sensor
11) Stop light switch
12) Master cylinder
13) Brake & EBD warning light
14) Lateral G sensor (STi)

## II. Parts In ABS

### 1. State Variables

To accomplish the required control of longitudinal slip, the following state variables are monitored or calculated by the vehicle’s ABS control module:

. **Vehicle Velocity** - Linear velocity of the vehicle sprung Mass

. **Wheel Spin Velocity**. Angular velocity of each wheel (or axle on some systems)

. **Tire Longitudinal Slip** - Relative velocity between the tire and road, expressed as a fraction of vehicle velocity

. **Wheel Spin Acceleration** - Angular acceleration of each Wheel

. **Tire-Road Surface Friction**. Ratio of the maximum Braking force to the normal tire force

. **Brake System Pressure**. Pressure produced as a result of the driver’s brake pedal application (input variable)

. **Wheel Brake Pressure**. Pressure supplied to the wheel Brake assembly (output variable)

### 2. Typical Hardware

To monitor or calculate the above state variables, the Typical vehicle ABS system includes the following hardware components:

**. Electronic Control Unit (ECU).** This is one of the Vehicle’s microcomputers. It is programmed with the Algorithm that reads the current state variables, Determines the required pressure at each wheel and sends the appropriate signals to the brake pressure modulator.

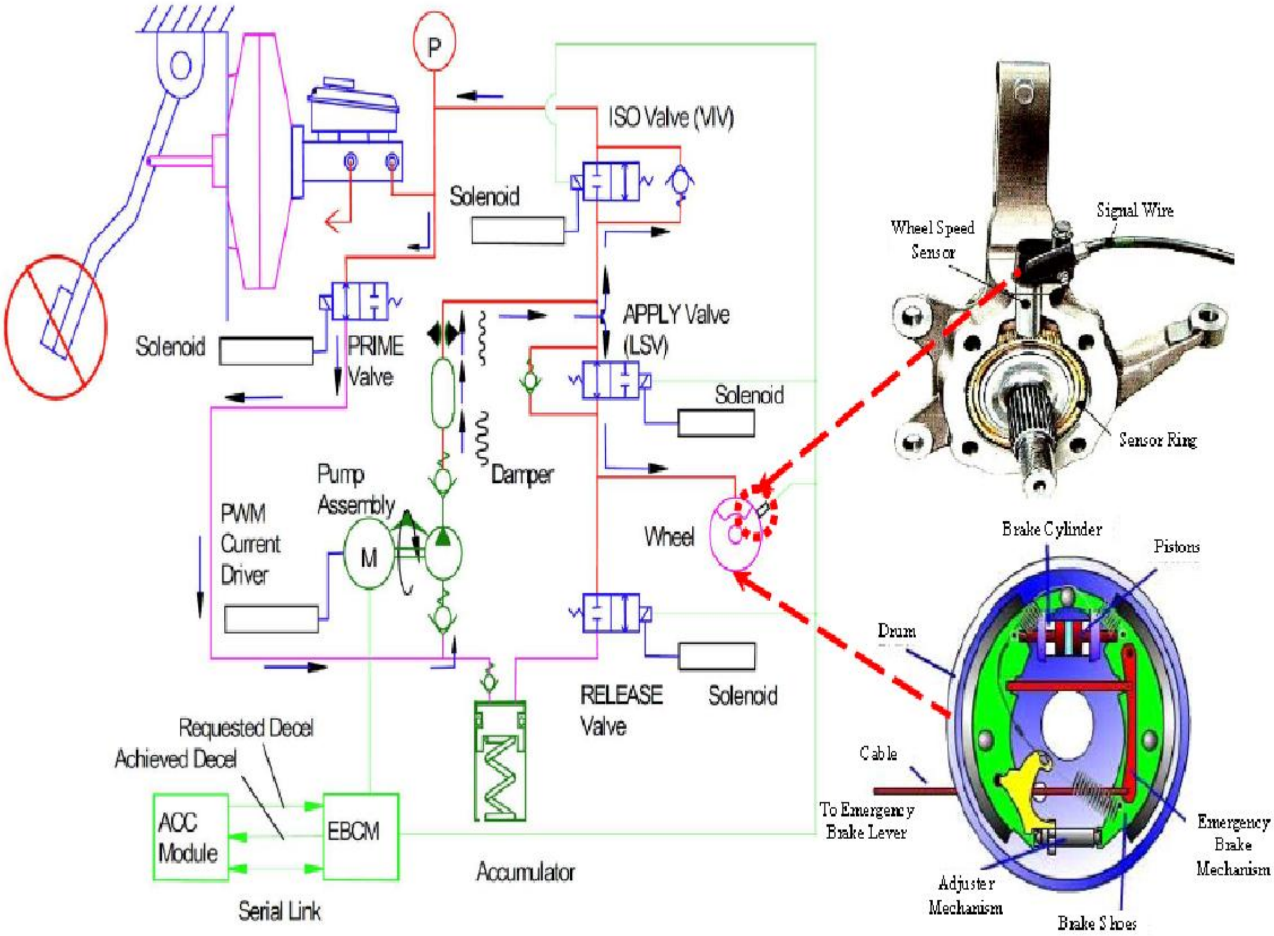
. **Wheel Speed Se** omponents directly Measure the wheel of each wheel using a Wheel-mounted pulse rotor (a notched metal ring) and a Fixed, magnetic sensor that measures the rotation of the Pulse rotor.

. **Brake Pressure Modulator**. This component (or Components, depending on the system) controls the wheel brake pressure according to the control conditions Specified by the ECU.

. **Brake Master Cylinder/Air Compressor**. This Component provides the fluid pressure source.

**. Wheel Brake Caliper/Cylinder/Chambers**. These Components apply the braking force at each wheel According to the wheel brake pressure.

The basic hardware requirements are generally the same for all vehicle types, ranging from passenger cars to On-highway trucks. Reference 10 provides a detailed Description of these required components.




## III. Principles of Antilock-Brake System

The reason for the development of antilock brakes is in essence very simple. Under braking, if one or more of a vehicle's wheels lock (begins to skid) then this has a number of consequences:

a) Braking distance increases,

b) Steering control is lost, and

c) Tire wear will be abnormal.

The obvious consequence is that an accident is far more likely to occur. The application of brakes generates a force that impedes a vehicles motion by applying a force in the opposite direction.

During severe braking scenarios, a point is obtained in which the tangential velocity of the tire surface and the velocity on road surface are not the same such that an optimal slip which corresponds to the maximum friction is obtained. The ABS controller must deal with the brake dynamics and the wheel dynamics as a whole plant.

$$s = \frac{V - \omega R}{V}$$

Where $\omega$, $R$, and $V$ denote the wheel angular velocity, the wheel rolling radius, and the vehicle forward velocity, respectively. In normal driving conditions, $V = \omega R$, therefore $S = 0$. In severe braking, it is common to have $\omega = 0$ while $S = 1$, which is called wheel lockup. Wheel lockup is undesirable since it prolongs the stopping distance and causes the loss of direction control

The relationship between braking co-efficient and wheel slip. It is shown that the slide values for stopping/traction force are proportionately higher than the slide values for cornering/steering force. A locked-up wheel provides low road handling force and minimal steering force. Consequently the main benefit from ABS operation is to maintain directional control of the vehicle during heavy braking. In rare circumstances the stopping distance may be increased however, the directional control of the vehicle is substantially greater than if the wheels are locked up.

The main difficulty in the design of ABS control arises from the strong nonlinearity and uncertainty of the problem. It is difficult and in many cases impossible to solve this problem by using classical linear, frequency domain methods. ABS systems are designed around system hydraulics, sensors and control electronics. These systems are dependent on each other and the different system components are interchangeable with minor changes in the controller software.

The wheel sensor feeds the wheel spin velocity to the electronic control unit, which based on some underlying control approach would give an output signal to the brake actuator control unit. The brake actuator control unit then controls the brake actuator based on the output from the electronic control unit. The control logic is based on the objective to keep the wheels from getting locked up and to maintain the traction between the tire and road surface at an optimal maximum. The task of keeping the wheels operating at maximum traction is complicated given that the friction-slip curve changes with vehicle, tire and road changes. The block representation of an antilock brake system. It shows the basic functionality of the various components in ABS systems and also shows the data/information flow.

The ABS consists of a conventional hydraulic brake system plus antilock components.

The conventional brake system includes a vacuum booster, master cylinder, front disc brakes, rear drum brakes, interconnecting hydraulic brake pipes and hoses, brake fluid level sensor and the brake indicator. The ABS components include a hydraulic unit, an electronic brake control module (EBCM), two system fuses, four wheel speed sensors (one at each wheel), interconnecting wiring, the ABS indicator, and the rear drum brake.

Most ABS systems employ hydraulic valve control to regulate the brake pressure during the anti-lock operation. Brake pressure is increased, decreased or held. The amount of time required to open, close or hold the hydraulic valve is the key point affecting the brake efficiency and steering controllability.

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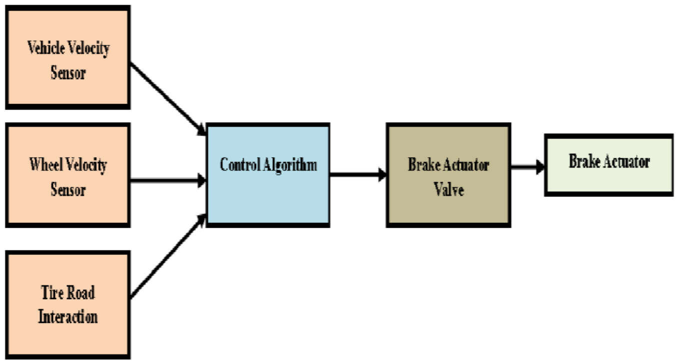
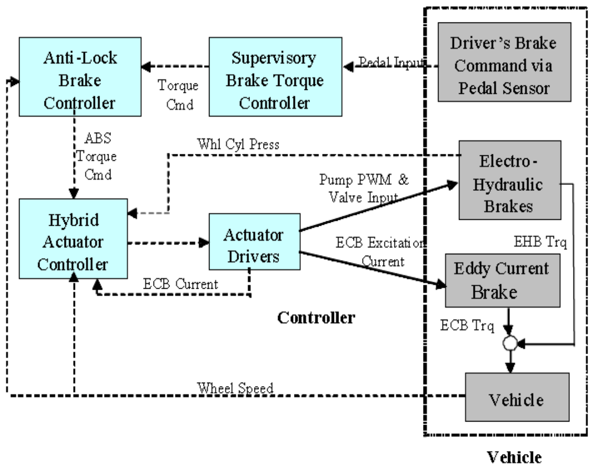



## IV. Working System

1. **DURING NORMAL BRAKING (ABS NOT ACTIVE)**

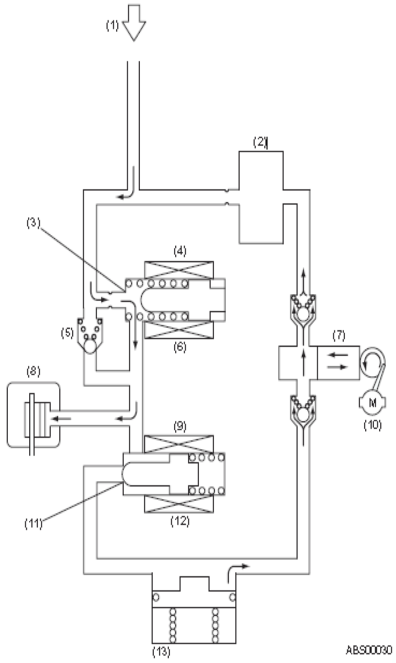
Both the inlet and outlet solenoid valves are not energized. This means that the inlet port of the inlet solenoid valve is open, whereas the outlet port of the outlet Solenoid valve is closed. So the fluid pressure generated in the master cylinder is transmitted to the Wheel cylinder, producing a brake force.

**2. PRESSURE "DECREASE" CONTROL (ABS ACTIVE)**

Both the inlet and outlet solenoid valves are energized, which means that the inlet port is closed and the outlet port is open.
In this state, the wheel cylinder is isolated from the master cylinder but open to the reservoir, so the brake fluid in it can be drained into the reservoir, decreasing its pressure and reducing the braking force of the wheel.
The brake fluid collected in the reservoir is forced into the master cylinder by the pump.
During this phase of ABS operation, the pump motor continues operating.

**3. PRESSURE "HOLD" CONTROL (ABS ACTIVE)**

The inlet solenoid valve is energized, so the inlet port is closed. On the other hand, the outlet solenoid valve is de-energized, so the output port is also closed. In this state, all the passages connecting the wheel cylinder, master cylinder and reservoir are blocked. As a result, the fluid pressure in the wheel cylinder is held unchanged.
During this phase of ABS operation, the pump motor continues operating.




(1) From master cylinder
(2) Damper chamber
(3) Inlet port open
(4) Inlet solenoid valve
(5) Check valve
(6) Deenergized
(7) Pump
(8) Wheel cylinder
(9) Outlet solenoid valve
(10) Motor
(11) Outlet port closed
(12) Deenergized
(13) Reservoir

**4. PRESSURE "INCREASE" CONTROL (ABS ACTIVE)**

Both the inlet and outlet solenoid valves are de-energized, which means that the inlet port of the inlet solenoid valve is open, whereas the outlet port of the outlet solenoid valve is closed. So the fluid pressure generated in the master cylinder is transmitted to the wheel cylinder and increased fluid pressure in the wheel cylinder applies the brake with a larger force.

## V. Advantage And Disadvantages

### a) Advantages of anti-lock brakes

- Shorter stopping distances: Anti-lock brakes reduce braking distances as the wheel does not waste distance skidding.
- Stopping on wet surface: ABS avoids wheel lock up and hence allows surefooted braking on wet sleety surfaces.

- Steer under braking: Anti lock brakes allow you to steer your car around objects if any as you still have grip on the wheels under intense braking.

### b) Disadvantages of anti-lock brakes

- The primary disadvantage of ABS brakes is the increased cost it adds to the overall cost of a vehicle. Also maintenance costs go up as the sensors on each wheel are expensive and get heavy on the pocket if they run out of calibration.
- The job of anti-lock brakes is to provide sure footed braking. But this also has a side effect that is the inconsistent stopping distances on various surfaces under variable conditions.
- Also a reason for concern is that these electronic systems are quiet delicate and adding more mechanics to your car increases the possibilities of system damages.

## VI. Break Types

Anti-lock braking systems use different schemes depending on the type of brakes in use. They can be differentiated by the number of channels: that is, how many valves that are individually controlled—and the number of speed sensors.[18]

### 1) Four-channel, four-sensor ABS

This is the best scheme. There is a speed sensor on all four wheels and a separate valve for all four wheels. With this setup, the controller monitors each wheel individually to make sure it is achieving maximum braking force.

### 2) Three-channel, four-sensor ABS

There is a speed sensor on all four wheels and a separate valve for each of the front wheels, but only one valve for both of the rear wheels. Older vehicles with four-wheel ABS usually use this type.

### 3) Three-channel, three-sensor ABS

This scheme, commonly found on pickup trucks with four-wheel ABS, has a speed sensor and a valve for each of the front wheels, with one valve and one sensor for both rear wheels. The speed sensor for the rear wheels is located in the rear axle. This system provides individual control of the front wheels, so they can both achieve maximum braking force. The rear wheels, however, are monitored together; they both have to start to lock up before the ABS will activate on the rear. With this system, it is possible that one of the rear wheels will lock during a stop, reducing brake effectiveness. This system is easy to identify, as there are no individual speed sensors for the rear wheels.

### 4) Two-channel, four sensor ABS

This system, commonly found on passenger cars from the late '80s through early 2000s (before government mandated stability control), uses a speed sensor at each wheel, with one control valve each for the front and rear wheels as a pair. If the speed sensor detects lock up at any individual wheel, the control module pulses the valve for both wheels on that end of the car.

### 5) One-channel, one-sensor ABS

This system is commonly found on pickup trucks with rear-wheel ABS. It has one valve, which controls both rear wheels, and one speed sensor, located in the rear axle. This system operates the same as the rear end of a three-channel system. The rear wheels are monitored together and they both have to start to lock up before the ABS kicks in. In this system it is also possible that one of the rear wheels will lock, reducing brake effectiveness. This system is also easy to identify, as there are no individual speed sensors for any of the wheels.

## VII. Conclusion

In this presentation we studied how ABS system works, all variables and sensors that are used for making of ABS system. All the parts that are used in vehicle’s brake. We studied its simple constructing as well as working principle.

The ABS system is very dependable and secure system in sudden situation of accident. Thus can be used in vehicles at very low amount only. ABS control sensors and computer chips. The circuit is used to control tires with various pressures on each base.

Thus ABS is very suitable for safety of vehicles and has very bright future in using it.

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