Anti-Lock Braking System (ABS)
Flow Of Presentation

- What is an ABS system?
- Simple Braking System in Automobiles
- Problems with simple braking System
- Architecture of ABS
- How does ABS Work?
- Installing of ABS system
- Video
What is an ABS?

- As its name suggests, prevents a vehicle’s break from locking up.

- **Anti-Lock Breaking System** is an electronic system which monitor and control the skidding of the vehicle during breaking or can say prevents the wheels from locking while braking.

- ABS allows the driver to maintain steering control while braking and shorten braking distances on slippery surfaces like wet or icy surfaces. But it increases the stopping distances in simple surfaces.
Anti-lock Braking System on any vehicle is simply an additional monitoring and controlling function superimposed on the existing vehicle brake system. ABS is neither a second brake system, nor replace the vehicle brake system.

It is a hard-real time system. It handles all events even in worst case in given time constraint.

Anti-lock braking systems were first developed for aircraft in 1929.
Breaking System

Simple Brake System

Apply Brake
Braking System in Automobile

- In an automobile System, the brakes are actuated by hydraulic pressure.
- In simple breaking system, your applied force by depressing the break pedal simply transmit to the wheel(break) through incompressible fluid.
- But a simple force applied by human seems to be difficult to stop a huge running vehicle.
- To multiply the applied force, a hydraulic system is used.
Hydraulic system contains glass cylinders filled with oil and connected to another with an oil filled pipe.

If we apply a downward force to one piston then the force is transmitted to another piston in the pipe through the incompressible oil.

Hydraulic system makes force multiplication by changing the size of one cylinder and piston relative to other.
Contd...
How Force multiply: If we take cylinders of different size like one is of radius x and another 3x.

Force applied at small cylinder is F and then force appear at big cylinder will be 9F (By using Bernoulli's theorem)
How break works

- When driver depress the break pedal in vehicle, it is pushing on the piston in the breaks master cylinder.
- In case of car four slaves pistons one at each wheel activate to press the brake pads against the break rotor to stop the car.
Why need ABS system

- While hard break is applied to stop the vehicle then friction of the breaks lock the wheels solidly and contact between wheel and road loses then wheels starts skidding across road.

- If traction between wheel and road goes down (In the cases when surface is wet, icy etc.) then wheel could slip and resulting in longer stopping distance.
If driver apply break forcefully and then try to use steer, but the steering doesn't work, because all the wheels are locked up while driver is holding down the brake pedal. As a result, he lose the ability to steer the vehicle.

To overcome these problems this new electronics system “ABS” is invented.
A Typical ABS System contains:

- Electronic Control Unit
- Speed Sensors
- Hydraulic Control Unit
- ABS Control Valves
- Control Algorithm
- CAN bus
Contd...
Type of an ABS systems

Basically there are two type of ABS systems: (in the context of four-wheel vehicle)

1. **Four channel ABS**: Four channel systems control the brake force on each wheel independently.

2. **Three channel ABS**: Three channel systems control the braking pressure on both front wheels independently, but control the rear wheels together as a single unit.
Operation of ABS

Wheel speed sensor:

- Electromagnetic device in conjunction with a rotating toothed wheel
- Constantly monitors wheel performance
- Transmit the information to the ECU after particular interval of time.
Operation of ABS

Electronic Control Unit (ECU):

- A microcomputer that functions as the "brain" of the ABS system.

- The ECU receives wheel performance data from each wheel sensor.

- When the wheels try to lock, the ECU delivers commands to the hydraulic valves to control brake pressure.
Operation of ABS

Hydraulic valve:

- Control valves that are actuated by the electronic control unit (ECU) to ensure each wheel is optimally braked.

- Depending on the control signal from ECU it
  - Increases pressure at the affected wheel, thus increasing the breaking force at the affected wheel
  - Decreases pressure at the affected wheel, thus reducing the braking force at the affected wheel
Operation of ABS

How Brakes Work  Antilock Brakes

Hydraulic unit
and booster

Brake lines

ABS warning
light

Speed sensors

ABS computer

Relays

Brake calliper

Speed sensors

Toothed
ring

Wheel hub

Speed sensor

Backing
plate

Brake rotor
or disc

Antilock Brake
Operation of ABS

- First of all wheel speed sensor detects speed based on speed of rotating toothed wheel
  - Increase in no. of pulses generated if wheel speed increases
  - Decrease in no. of pulses generated if wheel speed decreases
  - No change in no. of pulses generated if wheel speed remains same
Operation of ABS

- No. of pulses generated is sent to ECU
- ECU compares the inputs coming from different channels
- ECU generates suitable control signals
- Signals will be sent to hydraulic valves
- Normally valves are open and don’t interfere with breaking process
When the controller senses that a wheel is locking up while braking, it first activates a solenoid to close a valve in the affected wheel's brake line which prevents the pressure from increasing any further.
Operation of ABS

- If the locked wheel continues to lose speed, the controller activates a second solenoid which bleeds pressure off the affected brake line, in effect releasing the brake for that wheel regardless of whether the driver is still pushing on the brake pedal.

- As soon as the wheel regains traction and its speed increases, the solenoids are de-activated, and normal braking resumes.
Operation of ABS

- If the wheel starts to skid again, the brake will promptly begin to lock up, ABS will take over again. This cycle is repeated 12 to 15 times per second until either the road condition changes or the driver releases the brakes.

- The ABS will minimize the skid and will allow the driver to maintain directional control of the vehicle.
Installing the ABS

- In the automobile assembly plant, the steel tubing brake lines are installed in the framework of the body. They run from the partition between the engine compartment and the occupant compartment, called the firewall, to the vicinity of each wheel. The electrical wires for the ABS are also run from the vicinity of each wheel to the controller location and from the controller to the firewall.
Installing the ABS

- The brake master cylinder is bolted to the firewall in the engine compartment near the brake pedal. The brake lines are attached to the appropriate ports on the solenoid body, and the electrical wires are connected.
Installing the ABS

- The toothed wheels are pressed onto the outer constant velocity joints or the ends of the axle spindles so that they ride just inside the wheels. Once the axles are attached to the frame, the brake lines are attached and the pick-up coils are installed so that the end of the coils are close to the toothed wheels. The pick-up coils are then electrically connected to the wires to the controller.
## Features and Benefits of ABS

<table>
<thead>
<tr>
<th>Feature</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control of steering</td>
<td>Increase steering ability and vehicle stability during braking</td>
</tr>
<tr>
<td>Fail safe electrical/electronic system</td>
<td>If the electrical/electronic system fails, the ABS is shut off, returning the vehicle to normal braking.</td>
</tr>
<tr>
<td>Self-diagnosing system</td>
<td>Built-in system makes maintenance checks quick and easy.</td>
</tr>
<tr>
<td>Diagnostic tool compatibility</td>
<td>ABSs are compatible with industry standard hand-held and computer-based diagnostic tools</td>
</tr>
<tr>
<td>ABS Malfunction Indicator Lamp</td>
<td>Informs the driver or technician that an ABS fault has occurred.</td>
</tr>
</tbody>
</table>
Video

- [Video Link](http://www.youtube.com/watch?v=uq4DDMMoomU&vrl=http%3A%2F%2Fwww.drivingfast.net%2Ftechnology%2FABS.htm&feature=player_embedded)
References:

- http://www.tc.gc.ca/roadsafety/tp/tp13082/absind_e.htm
- http://www.answers.com/topic/antilock-brake-system
- http://www.drivingfast.net/technology/ABS.htm
Thank You 😊