ANTI-LOCK BRAKING SYSTEMS (ABS)

An anti-lock braking system (commonly known as ABS, from the German name "Anti blockier system" given to it by its inventors at Bosch) is a system on automobiles which prevents the wheels from locking whilebraking. The purpose of this is twofold: to allow the driver to maintain steering control and to shorten braking distances (by allowing the driver to fully hit the brake without the fear for skidding or the loss of control; the system itself does not contain miracle wonder technology to improve the tire quality).

Development

The German firm of Robert Bosch GmbH had been developing anti-lock braking technology since the 1930s, but the first production cars using Bosch's electronic system became available in 1978. They first appeared in trucks and German limousines from Mercedes-Benz. Systems were later introduced on motorcycles.

Anti-lock braking systems were first developed for aircraft. An early system was Dunlop's Maxaret system, introduced in the 1950s and still in use on some aircraft models. This was a fully mechanical system. It saw limited automobile use in the 1960s, but saw no further use; the system proved expensive and in automobile use somewhat unreliable. The first car (worldwide) to have ABS fitted as standard (across the entire range) was the Ford Granada Mk 3 (of 1985).

Operation

The anti-lock brake controller is also known as the CAB (Controller Anti-lock Brake).

A typical ABS is composed of a central electronic unit, four speed sensors (one for each wheel), and two or more hydraulic valves on the brake circuit. The electronic unit constantly monitors the rotation speed of each wheel. When it senses that any number of wheels are rotating considerably slower than the others (a condition that will bring it to lock1) it moves the valves to decrease the pressure on the braking circuit, effectively reducing the braking force on that wheel and causing a characteristic pulsing feel through the brake pedal.

The sensors can become contaminated with metallic dust and fail to detect wheel slip; this is not always picked up by the internal ABS controller diagnostics.

1 The electronic unit needs to determine when some of the wheels turn considerably slower than any of the others because when the car is turning the two wheels towards the center of the curve inherently move slightly slower than the other two -- which is the reason why adifferential is used in virtually all commercial cars.

Effectiveness

On high-traction surfaces such as bitumen, whether wet or dry, most ABS-equipped cars are able to attain braking distances better (i.e. shorter) than those that would be easily possible without the benefit of ABS. An alert skilled driver without ABS should be able, through the use of techniques like cadence braking or threshold braking, to match or improve on the performance of a typical driver with an ABS-equipped vehicle. However, for a majority of drivers, in most conditions, in typical states of alertness, ABS will reduce their chances of crashing, and/or the severity of impact. The recommended technique for non-expert drivers in an ABS-equipped car, in a typical full-braking emergency, is to press the brake pedal as firmly as possible and, where appropriate, to steer around obstructions. In such situations, ABS will significantly reduce the chances of a skid and subsequent loss of control.

In gravel and snow, ABS tends to increase braking distances. On these surfaces, locked wheels dig in and stop the vehicle more quickly. ABS prevents this from occurring. Some ABS calibrations reduce this problem by slowing the cycling time, thus letting the wheels repeatedly briefly lock and unlock. The primary benefit of ABS on such surfaces is to increase the ability of the driver to maintain control of the car rather than go into a skid—though loss of control remains more likely on soft surfaces like gravel or slippery surfaces like snow or ice. On a very slippery surface such as sheet ice or gravel it is possible to lock multiple wheels at once, and this can defeat ABS (which relies on detecting individual wheels skidding). Availability of ABS should not deter drivers from learning to master cadence braking.

Testing

A Finnish car magazine, Tekniikan Maailma, tested a VW Golf V fitted with non-studded Continental ContiVikingContact 3 tires.

	locked wheels	ABS
dry pavement	45m	32m
snow	53m	64m
ice	255m	404m

Braking distance from 80-0 km/h:

Note, however, that this somewhat simplistic test compares ABS with locked wheels.

In contrast to the above, glare ice is another situation where the driver must consider their own opinion on the use of ABS or "pumping" the brakes. Independent tests (cite?) shows results that difer from those above when braking on ice. An independent test (cite?), with a 1989 Dodge Omni, a small economy car, and a 1995 Pontiac Grand Am equipped with ABS (Mid Sized family Vehicle) The Pontiac matched or had shorter stopping distances on the glare ice, despite being heavier, so the ABS seems to have helped the stopping distances compared to the locked wheels of the Dodge Omni.

As noted above, maximum braking effect is achieved with the wheels on the limit of friction, whereas ABS works by releasing the brakes as the wheels break traction, so a skilled driver should be able to exceed the braking performance of an ABS system. Few drivers, however, have the skill and practice necessary to do this correctly or instinctively, and a common response to an emergency is to under-brake initially and then to over-brake, a situation in which ABS (and brake assist) will work well.

When activated, the ABS causes the brake pedal to pulse noticeably. As most drivers rarely or never brake hard enough to cause brake lockup, and a significant number rarely bother to read the car's manual, this may not be discovered until an emergency. When drivers do encounter an emergency that causes them to brake hard and thus encounter this pulsing for the first time, many are believed to reduce pedal pressure and thus lengthen braking distances, contributing to a higher level of accidents than the superior emergency stopping capabilities of ABS would otherwise promise. Some manufacturers have therefore implemented "brake assist" systems that determine the driver is attempting a crash stop and maintain braking force in this situation. Nevertheless, ABS significantly improves safety and control for drivers in on-road situations if they know not to release the brakes when they feel the pulsing of ABS.

It is worth noting that the heavier a vehicle is, the more it will benefit from ABS. This is particularly true of vehicles with less-sophisticated hydraulic braking systems where fine control is not as easy as with the more developed braking systems. Conversely, lighter vehicles, especially sports cars with highly-developed braking systems without ABS can outbrake comparable vehicles even with ABS.

Traction control

The ABS equipment may also be used to implement traction control on acceleration of the vehicle. If, when accelerating, the tire loses traction with the ground, the ABS controller can detect the situation and apply the brakes to reduce the acceleration so that traction is regained. Manufacturers often offer this as a separately priced option even though the infrastructure is largely shared with ABS. More sophisticated versions of this can also control throttle levels and brakes simultaneously, leading to what Bosch terms the "Electronic Stability Program" (ESP).

Source : http://engineering.wikia.com/wiki/Anti-lock_braking_systems_(ABS)