Electric Parking Brakes (EPB)

Electromechanical parking brakes have been around for a while now and the purpose of this article is to give the technician an understanding of how they work. Part 2 will look at testing procedures and fault diagnosis.

There are two distinct designs in use. The first uses an actuator which pulls cables which in turn are attached to conventional parking brake mechanisms. This system can be used with disc or drum handbrakes and it is often referred to as a ‘cable puller system’. It is fitted to Citroen, Renault and Toyota vehicles, among others.

The second system is called a caliper type and uses an actuator integrated into the brake caliper. This system reduces the problems associated with cables but does increase the un-sprung mass of the suspension.

Both systems use electric motors and reduction mechanisms to provide the high clamping force required by the handbrake mechanism. It is how this is done that separates the two systems.

The cable puller system
The electric parking brake actuator and ECU are integral and the assembly is fitted to the rear sub-frame between the rear wheels. The electric motor incorporates a stroke sensor – which counts the number of turns the motor makes in operation – and a cable tension sensor.

The pull effect is achieved when the motor turns the shaft. The spindle, which is prevented from turning, is pulled into the shaft by the helical grooves cut into the spindle and shaft (similar to some variable valve timing mechanisms and for those of you old enough to remember inertia starter motors, the quick start thread!).

The left-hand cable is connected to the spindle and the right-hand cable to the shaft. The shaft can move freely in the driven gear so...
Problem: A 2006 Vauxhall Zafira 1.6 is emitting a loud whistling noise from the engine at idle. Attempts to locate an air leak in the inlet system, which can cause this type of noise, have proved unsuccessful.

Solution: The noise is likely to be coming from inside the engine itself. The crankcase fumes are drawn into the inlet system, by vacuum from the engine, after passing through an oil separator which is inside the camshaft cover. There is a flap at one end of this plastic chamber that closes when there is a high vacuum in the inlet system. With the flap closed, the vacuum draws off the crankcase gases through the crack.

Problem: A 2002 Jaguar S Type 3.0 has some intermittent electrical problems. Periodically, and for no obvious reason, when the car is entered, the alarm siren triggers. Using the remote control switches the siren off and allows the car to start. Also, intermittently, the electric parking brake is stuck on and only releases itself after several attempts while the engine is running.

Solution: Most electrical system ECMS have a minimum voltage that they require to operate. If the vehicle voltage drops below a specific threshold then the ECM will shut down. In this case your vehicle

Caliper type

The caliper type uses an electric motor and a two stage reduction gear. Two pulleys and a toothed belt provide the first reduction of 3:1 and a swash plate gear provides a second reduction of 50:1.

The swash plate has 51 teeth and is prevented from turning by the lugs located in grooves in the caliper body. As the drive gear makes one turn, the swash plate oscillates, moving from position 1 to 2 and back again. The output gear has only 50 teeth and because in one oscillation the compensation effect (balanced braking force).

It can be seen from diagram 1 that two idler gears are used. This is to increase the surface area of tooth contact between the gears to improve strength and reliability. Note that the gear reduction mechanism (an epicyclic) is not shown on this diagram.

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Problem: A 2006 Audi A3 is showing trouble code 01565 in the body control module. The description of the code relates to 'load area lamp, short circuit to earth'. We have tested the system for a short circuit to earth. We have found a 3W bulb fitted instead of a 5W. When a bulb of a lower rating is mistakenly used in this instance will be to fit a new lamp or module.

Solution: Check the rating of the bulb in the load area lamp. From your description of the fault, it is likely that you will find a 3W bulb fitted instead of a 5W. When a bulb of a lower rating is mistakenly used in this system, the current draw is not great enough to allow the module to switch on the supply to the lamp.

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is intermittently dropping the voltage to less than the ECM’s minimum. The alarm is setting off the siren because it thinks that the vehicle battery has been disconnected. This of course is seen by the alarm ECM as a system attack. The parking brake is released after the engine has been running because the alternator increases the minimum system voltage above the ECM’s voltage threshold. As the vehicle starts correctly, I suspect that the battery is not holding a high enough charge to maintain the ECM’s minimum voltage during the cranking period. The solution in this instance will be to fit a new battery.

Functionality
It is easy to see that the parking brake can be applied and released by just using a switch on the control panel, but some of the functions of the parking brake require much more control than just on-off. The system programmers had to think of all the possible uses (and misuses) of the system.

Applying the brake
This can be done at any time with the ignition on or off by pushing the EPB button.

Emergency stop (caliper type)
If the vehicle is travelling at more than 7km/h and the EPB button is pressed and held, the system activates the Electronic Stability Programme which applies the hydraulic brakes to bring the vehicle to a controlled halt. The brake is released when the button is released. If the vehicle is travelling at less than 7km/h when the button is pressed, then the EPB is applied. This type of control and functionality cannot be achieved with a conventional parking brake. Here, you pull the lever at speed, the brake wheels can lock and control could be lost (the author recalls a time when his front seat passenger pulled himself upright in his seat by grabbing the nearest convenient lever……..)

Releasing the brake
This can only be done with the ignition switched on, the footbrake applied and the EPB button pressed (some manufacturers have a pull mechanism for the driver).

Drive away release
The brake will automatically release when you drive off. To do this correctly, certain conditions have to be analysed:
1. Gradient
This is provided by the longitudinal acceleration sensor which is part of the ESP/VSC control system.
2. Clutch position
The clutch is fitted with a sensor which provides information about the operating position of the clutch. It is used for the automatic hill start function and also provides information for cruise control and engine fuelling during gear changes.
3. Engine torque
This is a calculated value provided by the engine control unit.
4. Direction
Information on forward or reverse gear selection is provided by the reversing light switch.

Auto hold
This uses the ESP control valves to retain hydraulic braking pressure. When the vehicle is brought to rest using the footbrake, braking pressure is retained (regardless of brake pedal position) until the accelerator pedal is pressed.

So, it can be seen that these systems, although comparatively complex (when compared to a conventionally applied system), provide significant advantages to the driver.

These articles are contributed by ProAuto, an automotive technical training company based in Shrewsbury, Shropshire. The company runs courses from venues nationally, so a course is never too far away. For further details, visit www.proautotraining.com or email info@proautotraining.com or telephone 01743 762050.