BRAKING UP

Following on from recent articles about foundation brake systems (drum and disc brakes) this article from Roger Thorpe, Customer Services Manager at BPW, concentrates on issues a little further up the braking chain and outlines what happens within the trailer braking system.

The valves that comprise the trailer braking system have to provide five main functions:

1. Apply the trailer brakes according to the demand of the tractor unit.
2. Apportion the brake effort according to the load on the trailer.
3. Provide an emergency brake function in the event of trailer break away.
4. Provide an anti-lock braking function.
5. Provide a means of manually applying the brakes (parking brake).

ABS

About ten years ago the majority of trailers in the UK were built using an ABS braking system. This system comprised three main valves: the relay emergency valve, the load sensing valve and the ABS modulator valve. These three valves are shown in Fig 1a , Fig 1b and Fig 1c respectively.

The valves appear in the system in the order that I have mentioned them in the last paragraph. The relay emergency valve (REV) fulfils two main functions: It provides a boost to the pneumatic signal that comes down to the trailer from the towing vehicle (down the yellow service line) and then passes this signal down to the remainder of the trailer system. This valve also monitors the pressure in the air coming down the red line on its way to charge the trailer tanks. If the pressure in the red line is removed (perhaps in a trailer break away situation) then the valve opens fully and allows air at full tank pressure to apply the trailer brakes.

The load sensing valve (LSV) takes the signal pressure from the relay emergency valve and modulates it according to the load on the trailer. In a fully loaded situation the LSV allows the full signal pressure from the REV to continue down into the rest of the circuit but if the trailer is only partially loaded then the LSV reduces the signal pressure from the REV. This modulation is achieved by the LSV sensing the pressure in the suspension air bags. Don't forget that the pressure coming to the LSV will be in the range of 0.0 bar to 7.5 bar depending on the demand from the towing vehicle. 95% of all braking applications see a pressure on the yellow line of around 2.0 bar. It is this signal pressure that the LSV further modulates.

The modulator valve takes this modulated signal pressure from the LSV and without any further modification (in a normal situation) uses it to apply the brakes. The ABS modulator valve connects directly to the air chambers on the foundation braking system; it also takes an air supply directly from the trailer air tanks so in that respect it acts as a relay valve. The modulator valve is responsible for the anti-lock braking function and the valve has an electronic circuit built into it that measures the frequency of a pulse chain, which comes from the ABS sensors mounted on the trailer axle.

In a tri-axle semi-trailer for example it is common to have one axle fitted with ABS sensors (normally the centre axle). If the valve sees a sudden decrease in the frequency of the pulse chain then it assumes that the wheel is slipping and releases and re-applies the brake. This release – reapply cycle will continue until the rate of deceleration is restored to a normal value. Sometimes on these older systems the driver can hear the air escaping as the ABS system cycles.

The modulator valve is actually two valves in one body and the trailer braking system is split into two halves (left and right). It is possible to sense more than one axle and it is also possible to add a third, single modulator valve into the system when, for example, a self steering rear axle is fitted. You may have heard the term 2S2M used to describe a braking system, this means that there are two sensors (normally on the centre axle of a tri-axle trailer) and one twin modulator valve fitted. A full system would have sensors on three axles and a double and a single modulator making three in total and this would be described as 6S3M.

Fig 1a

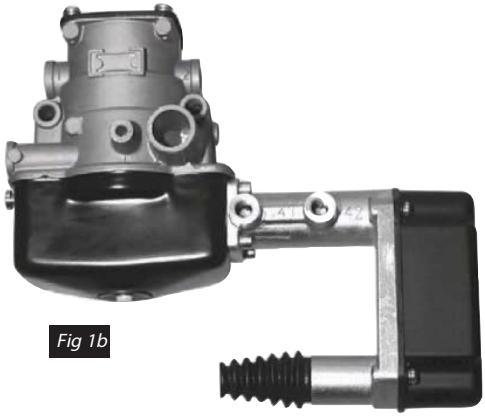

Fig 1b

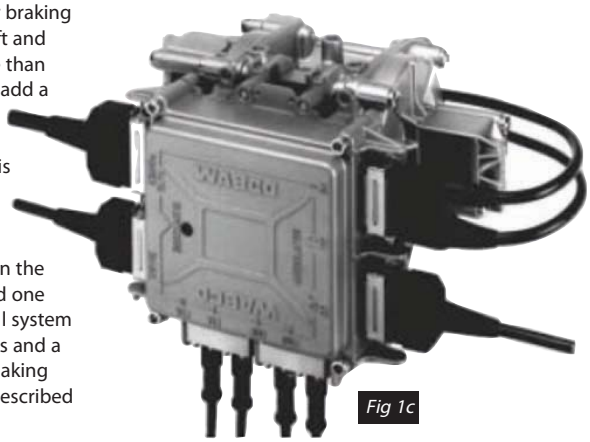

Fig 1c

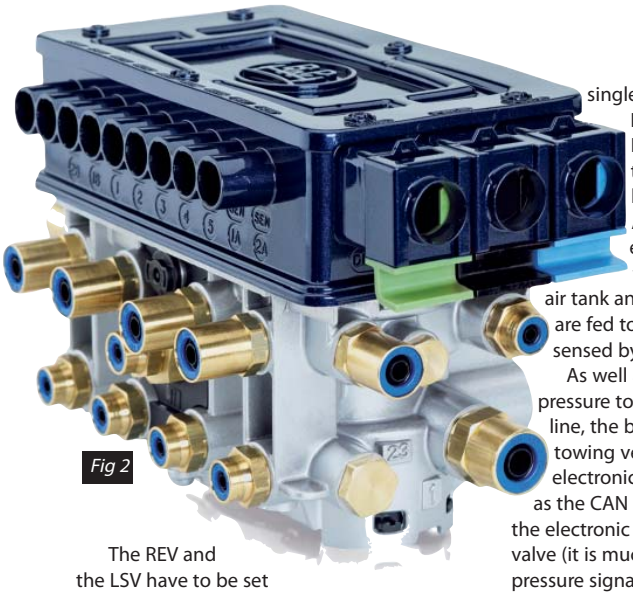

Fig 2

The REV and the LSV have to be set prior to use according to the figures produced by the output of a brake calculation. This brake calculation has to be provided for each trailer built. In the UK, BPW Limited will provide brake calculations for trailer builders that are using BPW axles.

NOTE:The parking brake on these systems is applied by a valve on the side of the trailer which exhausts the air from the spring brake portion of the brake cylinders.

EBS

In EBS, or electronic braking systems, all of the valves described in the ABS section above can now be combined into one single valve. A BPW ECO Tronic EBS modulator is shown in Fig 2 . These valves carry out the emergency function, the load sensing function and the ABS function all electronically. Pressures from the yellow service line, the air tank and the suspension air bags are fed to the valve where they are sensed by transducers.

As well as the conventional signal pressure to the valve via the yellow line, the braking demand from the towing vehicle is also provided electronically by a connection known as the CAN data bus. In practical terms the electronic signal is used by the EBS valve (it is much faster) with the air pressure signal used as backup in the event of the electronic signal failing. ABS modulation in the event of wheel slippage is more sophisticated and can be applied in stages instead of the release – reapply cycles of the old ABS systems.

The EBS valve has to be set with parameters provided by the output of a brake calculation in the same way that the ABS valve does. The difference is that instead of setting separate valves, all the settings are applied to the one EBS valve. It is possible to make finer adjustments to the EBS systems and the performance of the system is more accurate and repeatable.

NOTE:The valve is set by connecting its programming port to a computer.

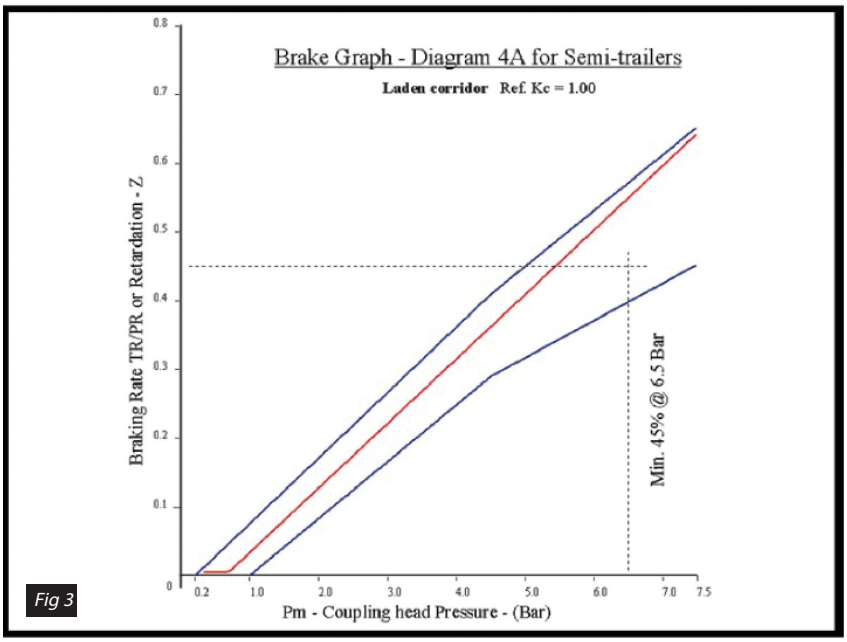

Fig 3

All EBS systems are capable of storing and giving back information, for example the number of brake applications, the braking demand pressures and the number of ABS interventions can all be accessed, which in turn makes diagnosis of problems simpler and less time consuming. Some of the more advanced EBS systems can also store data on how the vehicle is driven and how the brakes are performing. The BPW ECO Tronic system is one such system and is able to provide data useful to fleet operators. As processing power and memory increases then these systems are able to offer more and more features and perform tasks not limited to brake system functions.

In-service adjustments, compatibility and problems:

As mentioned previously the data with which to set these valves (ABS and EBS) is obtained from the output of a brake calculation. A typical laden brake performance curve is shown in Fig 3 . The actual brake performance line lies between two other lines which form a 'corridor' calculated from trailer parameters, such as wheelbase and centre of gravity. There is some scope to move the brake performance inside this corridor and at BPW the company use this scope to try and match up the performance of the trailer to the towing vehicle and the operator's requirements. This matching is much easier to do and to apply on EBS systems and, if need be, adjustments can easily be made in the field.

Compatibility, the matching of brake performance between towing vehicle and trailer, remains an issue with EBS as it was with ABS and BPW Limited have a team of Customer Service Engineers who work with customers to solve these issues both at specification time and in the field.

Field adjustments on ABS systems when the valves had been in service for a while were always very difficult, if not impossible, due to ageing and corrosion within the valves. This is not an issue with EBS systems but damaged or missing programming ports pose their own problems.

For anyone interested in looking deeper into braking technology BPW Limited offer a Braking Technology course, for details see www.bpw.co.uk