

Them's the BRAKES

Retarders augment the functions of a traditional braking system to lessen the speed of a vehicle, but they also help to cut costs and driver fatigue. Chris Tindall reports

The purpose of a retarder is to complement or replace certain functions of a friction-based braking system when a vehicle is moving at anything other than very slow speeds.

"From an efficiency point of view, the engine brake is preferred over any other device, since it is the most efficient way of slowing down a vehicle, using the existing engine itself as the braking device," says Hilko Schmitt, Europe business development manager of Jacobs Vehicle Systems. It is the maker of the 'Jake Brake', which, launched in 1961, is said to be the first mechanism for on-demand alteration of valve timing on a truck diesel (pictured, above and p12).

But a key benefit of any retarding device is not just in terms of safety. A Daimler Trucks spokesman states: "Retarders can significantly reduce an operator's cost, as their use reduces brake wear, preserves the liners and brake pads, as well as drums and brake discs. As a result, it is possible to reduce use of the service brake by between 50% and 80%, depending on the topographical conditions."

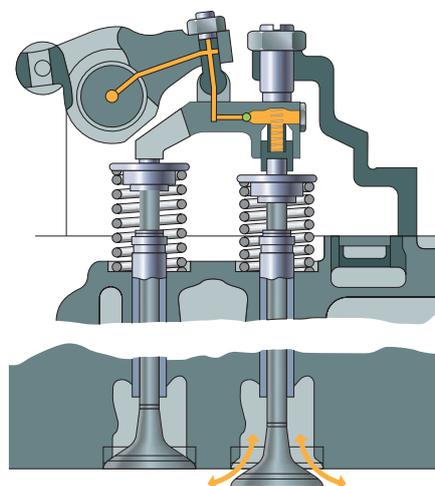
He continues: "The added benefit - aside from reducing the lifecycle and maintenance costs - is that it also reduces driver fatigue. The retarder also enables a higher downhill speed, and therefore a higher average

speed. Finally, braking performance is independent from the engine speed, so, with an integrated transmission, the input speed can be increased to gain suitable braking torque even when the vehicle is travelling at low speed."

TYPES

There are four main types of retarder used in commercial vehicles: engine brakes, exhaust brakes, hydraulic retarders and electronic - or clam magnetic - retarders. All types are used by different truck OEMs (see table).

Allison Transmission describes the function of an engine brake as a retarder that effectively part-suffocates the engine, to help slow the vehicle down.



When the piston reaches top dead centre, the accumulated compressed air in the cylinder is vented, before it can act like a spring to drive the piston back down. By doing this the engine slows the vehicle, and also acts as an air compressor.

DAF's MX engine brake, for example, works together with the standard exhaust brake to quicken engine and gearbox synchronisation. On the MX-11 engine, for example, a dedicated brake cam and rocker assembly controlling one exhaust valve per cylinder generates up to 340kW of braking force at 2,100rpm. (On the MX-13, the hydraulically-controlled system is integrated into the engine's own valve rockers.) Drivers select the engine brake mode on the right-hand instrument stalk (pictured, p12, inset). The system is standard for CF and XF tractors and four-axle rigs.

Exhaust brakes are simpler, but work in a similar way to engine brakes. They restrict the exhaust - typically by using a valve to create back pressure in the system - which forces the engine to work harder, hence slowing the vehicle down.

Volvo Trucks relies on a butterfly exhaust brake or an exhaust pressure



of Allison Transmissions, which are not offered with hydraulic retarders. Allison application engineer Gavin Bradwell says that it is based on the principle of the eddy current brake. This slows a vehicle by using an electromagnetic rotor to induce an eddy current that produces a magnetic field in a stator attached to the vehicle chassis. The two opposing fields create a drag force that slows the rotor and the axle or driveshaft to which it is attached. He adds: "As there is no friction involved, there is no wear and tear on the parts." Also, the system can be used for cruise control, via engine throttle signals transmitted through the CAN-Bus system.

Hydraulic retarders work by using the physical drag forces between dynamic and static vanes in a fluid-filled chamber mounted on the output shaft. Adds Bradwell: "Filling the chamber exerts drag on the output shaft, slowing the vehicle. The more oil there is in the chamber, the stronger the braking. With the Allison 3000 Series transmission, for example, the low-input torque retarder can be set at anything from 750 to 2,170Nm of torque. This type of system is very quiet and is quieter than a running engine."

In 2014, Scania announced the latest enhancement of the hydraulic retarder it uses in its trucks, which automatically disengages and freewheels when not

regulator as standard across its range. John Comer, Volvo Trucks' head of truck product management, says: "The major advantage is that you get a high retardation performance with no degeneration due to heat, for the additional weight of 6kg, at a fraction of the cost of a gearbox retarder. At 2,400rpm it can deliver 290-300kW, depending on engine size."

Exhaust brakes are also standard across all of MAN's large vehicle range. They are used in conjunction with the MAN EVBec (pictured, p10), which extends the normal exhaust valve brake function to enable continuously variable

brake output. When the exhaust throttle valve is closed, waves of pressure build up in the exhaust duct, which causes the exhaust valves to briefly open. A piston subjected to engine oil pressure in the exhaust valve block holds the valves open during the compression and subsequent expansion stroke. This means both the compression and expansion strokes can also be utilised for braking purposes. This improves the brake output compared to the exhaust-flap engine brake on its own.

Type three, the electronic retarder, is widely used on small buses equipped with fully-automatic 1000/2000 series

STANDARD (1) AND OPTIONAL (2) FITMENT OF ENGINE BRAKES, BY TRUCK TYPE AND BRAND

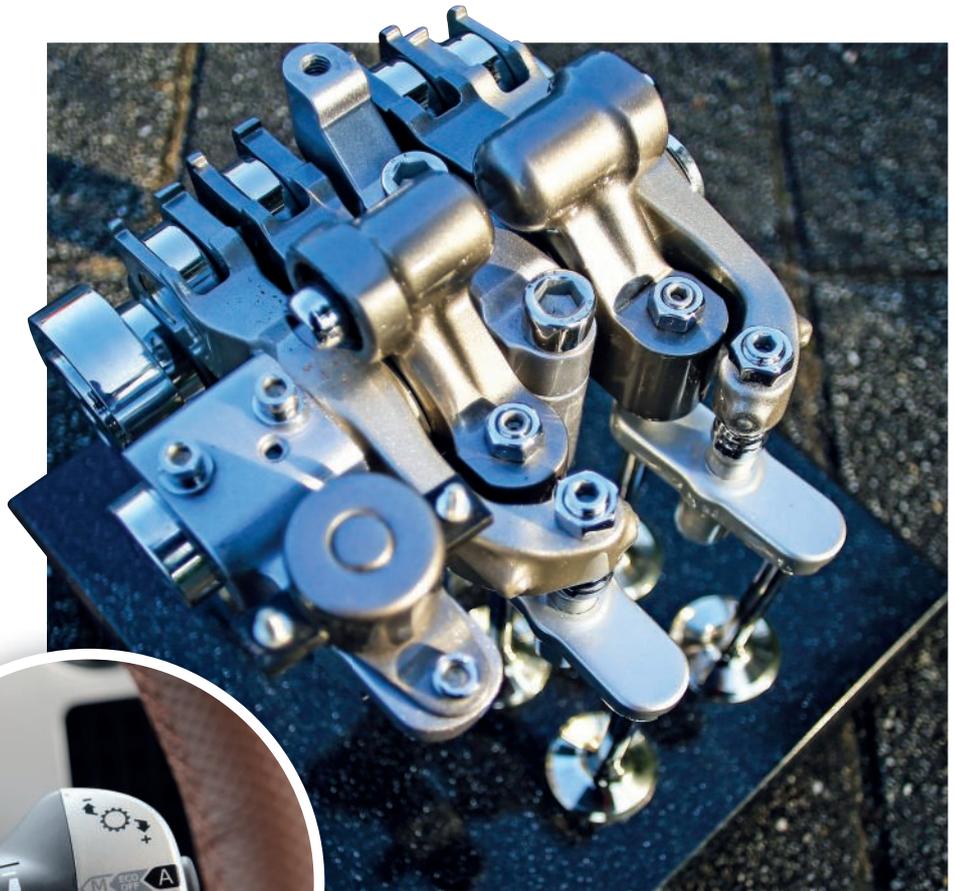
	DAF	MAN	Mercedes-Benz	Scania	Volvo
Engine brake	1**		1: Three-stage and high-performance		2
Exhaust brake	1	1 (large vehicles)	1*		1: 'VEB'
Hydraulic retarding				1	
Electromagnetic retarding					
Intarder	2	2	2		2
Other		1: 'PriTarder'			
*For Fuso Canter **But optional on DAF CF 4x2s (Renault did not respond to requests for information)					

in use, saving on fuel. According to Scania pre-sales technical manager Phil Rootham, the R4100D provides higher braking effect - 4,100Nm instead of 3,500Nm - and increased braking at lower engine rpm, as well as cutting down on drag. Rootham says: "[There are] benefits in terms of efficiency, in terms of the way that it's activated. Most development work now is how you blend it with all the other systems: how to reduce drag, reduce weight, reduce penalties, the amount of oil required and how you integrate it more."

INTARDERS

Several of the truck OEMs mount hydraulic retarders not to the engine, but to the gearbox; that is known as an intarder. DAF supplies one as an option for DAF XF and CF vehicles with MX-11 or MX-13 engines. The braking effect is obtained by allowing oil to enter the retarder circuit. Braking torque - up to 4,000Nm maximum with automated TraXon gearbox, or 3,500Nm with manual gearbox - is determined by the quantity of oil in the retarder circuit. The intarder includes an integrated cooler, which is connected to the engine's cooling system. To avoid overheating, an ECU reduces the retarding effect automatically at a pre-set temperature. That means that the engine needs to run at high speeds, for maximum cooling effect, to maintain a maximum retarding effect during prolonged retarder operation. Partly for that reason, Comer points out that its main applications in the UK are in international trucks running on alpine routes, or heavy haulage.

Also, installation can get complicated. "The additional weight is around 105kg and the system requires additional gearbox cooling, and the fitment in the



chassis can be difficult when it comes to packaging space around the gearbox." Finally, intarders cost nearly four times as much as engine brakes.

For operating at lower speeds, MAN recommends not an intarder but a system called PriTarder, developed by Voith. It uses two opposing forces: an impeller in the cooling system driven by the propshaft circulates coolant; it is slowed by a stator, generating a degree of drag on the engine, to create a braking resistance. The heat generated from the braking energy directly acts on the engine coolant. According to a MAN spokesman, the PriTarder is a combination of a water retarder with an electronically controlled and enhanced MAN engine brake. He adds: "The effect of the MAN PriTarder depends on the engine speed and not the driving speed, as is the case for the secondary retarder."

MAINTENANCE

As far as maintenance is concerned, looking after the oil is the most

important factor in preserving engine brake performance.

Schmitt at Jacobs says that service schedules for engine brakes always align with service intervals for the engine. So a new, or newish, brake needs very little work: "Usually it's just a case of checking the brake rocker lash and clearance at the same time that the engine gets its first oil change and lash setting check, typically at around 150,000km (93,000 miles)."

Comer agrees: "Engine oil is used by the hydraulic rocker to take up the clearance on the camshaft for the engine brake, so quality and maintenance of the engine oil to the scheduled intervals is vital. The VEB rockers also need to be checked and adjusted regularly in line with the manufacturer's recommendation. Similarly, the hydraulic oil on a gearbox retarder needs to be changed to match the schedule, which is dependent on application and annual driven mileage."

Concludes Schmitt: "System checks include oil-to-water radiator capacity and cooling fan operation, which are all additions to a normal engine's cooling system maintenance." 