Australian Road Transport Suppliers Association

Session on commercial vehicle brake technology
Greg Byrne, Air Brake Corporation
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Summary by
Robert Di Cristoforo, Roaduser Systems Pty Ltd

The large number of attendees were treated to a very informative presentation and discussion which highlighted the many intricacies surrounding the application and regulation of emerging commercial brake technologies. Greg did a great job of presenting all of these issues to the attendees in a way that they could all understand. A number of attendees contributed valuable information based on their extensive practical experience and expertise.

The main topics covered by were:

- Compatibility of disc- and drum-braked axle groups in a combination
- Managing brake force distribution for different vehicle load conditions
- The ins and outs of EBS and TEBS

Compatibility issues
Compatibility of braking systems in a combination vehicle has implications for both safety and maintenance costs. This is particularly important when mixing disc and drum brakes in a combination vehicle. Three areas requiring compatibility in a combination vehicle were discussed:

- *Adhesion balance*
  Controlling the amount of brake force exerted by each axle group so that all axle groups utilise the same percentage of total available road friction. This really comes down to making sure that the brake force at each axle group is proportional to the axle group vertical load. A well balanced vehicle in this regard will have a lower propensity to wheel lock.
- *Thermal balance*
  Selecting appropriately-sized components for each axle group so that energy dissipation matches braking capacity. This requires careful selection of disc and drum sizes to reduce the risk of cooking the brakes on one axle group while another runs cool as a cucumber.
- *Wear balance*
  Setting up the brake system so that shoes and pads wear evenly on all axle groups. This is difficult to achieve when mixing disc and drum brakes.

The most important of these issues is adhesion balance, which is controlled by the "compatibility envelope" in the ADRs. The compatibility envelope basically requires

that the characteristic of deceleration produced by each axle group versus brake application pressure must lie within a certain envelope. A drawback of the ADR is that it is only valid at high levels of brake application: the envelope begins at a brake application pressure near the high end of the range of normal day-to-day braking, but the majority of the envelope is in the emergency braking range. The problem with this is that a prime mover and semi-trailer could be fairly well matched for emergency conditions, but be mismatched by a factor of two or three under normal operating conditions.

Another compatibility issue regarding mixed disc and drum brakes is the characteristic of brake torque versus brake application pressure. While disc brakes provide a fairly linear increase in torque as pressure is increased, drum brakes lose responsiveness at high pressures and tend to fade off. Given that the two systems begin to operate at different pressures, it is difficult to design the system for even brake wear and adhesion balance.

Load sensing

By monitoring the vertical load acting on an axle group, the brake system can be designed to adjust the brake force distribution to provide consistent feel at the brake pedal for varying vehicle load conditions. While this type of system reduces the propensity to wheel lock, it does not prevent it.

Load sensing systems have the disadvantage that they need to operate in a combination that has a load sensing system on all axle groups. If one or more axle groups are not load sensing, these groups will be over-braked in comparison with the load-sensed axle groups and produce an unstable combination under heavy braking. A driver override capability needs to be included to cater for non-load-sensing trailers, which cannot be guaranteed to be used by all drivers.

When travelling empty, the trailer axle group of a prime mover and semi-trailer combination experiences a great reduction in its gross mass relative to the prime mover drive axle group. A “halfway” method of load sensing was described in which the drive axle group load is sensed to control the brake torque at the trailer axle group. This provides brake force levels at the trailer axle group that are in between load-sensed and non-load-sensed brake forces.

While load sensing brake systems are commonplace in Europe, the technology has not been adopted by the US, where some of the world’s largest truck fleets operate. There is no evidence to suggest that these systems will be adopted in the near future.

EBS and TEBS

EBS (Electronic Braking System) and TEBS (Trailer Electronic Braking System) are two systems that were described in some detail. EBS uses “brake-by-wire” technology to send control signals to the brake components instead of airlines. This reduces the effects of pneumatic lag, which improves brake response, application times, stopping distances and feel at the brake pedal. TEBS is an extension of the EBS system that can be fitted to trailers in the same way: electronics send the brake control signal from the prime mover

to the trailer brakes. For operation with non-EBS prime movers, the electronic signal can be converted from an air input at the front of the trailer and sent to the back by wire.

Other features of commercially-available EBS/TEBS systems are integrated ABS and RSS (Roll Stability System). The RSS works by sensing impending rollover conditions and applying the trailer brakes (sometimes asymmetrically) to bring the vehicle back under control or to at least slow it down considerably before rollover. Some of the smaller features of these systems include warnings for low air supply and brake lining wear.

The Mercedes-Benz EBS system that was discussed also features "compatibility control", which senses adhesion compatibility between prime mover and trailer and adjusts the trailer brakes accordingly. If the trailer cannot be adjusted to within the compatibility envelope, the truck has the smarts to adjust itself and meet the performance of the trailer, as long as it remains within a small tolerance band of the original envelope. This system only works when fitted to load-sensing trailers, which are common in Europe.

While the introduction of ABS systems in Australia has been stifled by negative attitudes towards cost/benefit of the systems, the EBS experience in Europe has seen reductions in brake component maintenance costs of between 28 and 36%.

ADR Status

The ADR system has difficulty keeping up with brake technology developments and compatibility has been an endemic issue for many years. There is currently a debate about mandating load sensing and issues concerning the requirements for 12 V trailer ABS systems.

ARTSA Working Group

An ARTSA working group was formed to further develop positions on these issues. ARTSA will raise the issue with TOSA with a view to using the wide industry coverage of TOSA to ensure that the most effective braking technologies are used in Australia.