Global trailer

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A SMOOTH RIDE

THE TRAILER INDUSTRY IS ABOUT TO CHANGE WITH THE APPLICATION OF THE TYPE OF AERODYNAMIC EQUIPMENT MORE COMMON IN THE AVIATION SECTOR. IT WILL BE USED FOR ESSENTIALLY THE SAME PURPOSE - TO REDUCE TURBULENCE AND DRAG AND THUS CUTTING BACK ON FUEL CONSUMPTION.

[Story by Tim Giles]

In the face of severe regulations and the endless drive to improve fuel consumption and cut carbon emissions, the commercial road transport industry is placing increased emphasis on innovative technology. As opposed to a prime mover, though, a trailer can only improve the industry's carbon footprint by indirectly reducing fuel usage – by applying improved aerodynamics, for example.

All playing a role in conserving fuel are electronics, material science, tyre technology and weight reduction, but jet plane-inspired re-designing is the dernier cri on a global scale. Researchers working on reducing the drag at the rear of a semi- trailer have come up with promising results, using a tapered tail at the rear of the trailer to reduce fuel consumption. Designed with attention to the dynamics of the passing wind, the tail is able to reshape the vortex left behind, thus minimising it.

Focusing on the rear of a trailer is a new trend. Many aerodynamic features that affected the road transport industry in the past have concentrated on the front of a combination, making the airflow slip quickly and easily over the front surfaces of truck and trailer. Other aerodynamic devices, such as side skirts, manage the flow as it travels down the side of the trailer.

Yet, little attention has been paid to the rear. It has remained rectangular and flat although studies have shown that air flowing down the side, top and bottom of the trailer at highway speed spins off to form a vortex behind the rear door. Scientists describe the airflow as "detached" as it creates a large volume of low air pressure just behind the trailer. This vacuum produces a suction drag, holding the trailer back and forcing the engine to use more fuel to pull the trailer against a wall of air.

> "THIS KIND OF AERODYNAMIC IMPROVEMENT IS POSITIVE FOR INDUSTRY PROFITABILITY AS WELL AS THE ENVIRONMENT."
>
> Anders Gustavsson
> Managing Director Scania
> Transport Laboratory

As a result, the latest developments to improve aerodynamics at the rear of a trailer have been attempting to reduce that area of low pressure and consequently reduce drag. The basic principle has been to get rid of the 90° angle at the rear and make the shape taper towards the rear, "cleaning up" the airflow to minimise the volume of reduced air pressure at the trailer's back door.

However, a limiting factor slowing down the implementation of the new technology is political resistance. Strict length regulations often make it hard to use the new equipment on public roads.

Noth America is one exception. In the US, dimension rules are more relaxed, which has given local developers the opportunity to experiment with much larger boat tails than those used on European roads.

Start-up company, ATDynamics, for instance, has developed a product called Trailertail, which is available in various lengths - from two feet (60 cm) to four feet (1.2 m) of tapering tail fixed to the rear doors of a box trailer. The

Trailertail is based on DOT regulation CFR 658.16 (b) (4), which allows for a 5 foot (1.5 m) extension for non-cargo carrying aerodynamic purposes to be added to any truck.

The 70kg device is made of ordinary-looking plastic composite, metal tubing and springs, but on close examination, it is quite a clever solution able to overcome the operational constraints of rear door configurations. When loading and unloading, the tail can be folded flat against the rear doors to enable the normal operation of the trailer. If the door is swung all the way open so that it lies flush against the side of the truck, the origami-like tail will fold automatically.

According to ATDynamics, the Trailertail reduces the aerodynamic drag on the rear by over 12 per cent, equating to over 6.6 per cent fuel efficiency gains. US company Solus invented a similar frame extension promising comparable savings. The two side panels and top panel of the Solus device are inset from the outer edge of the frame less than three inches whereas the bottom panel is structurally designed to support loading and off-loading operations.Solus says this technology can increase fuel economy up to 6 per cent.

In Europe, meanwhile, results have shown that even boat tails of a relatively limited length are quite effective in reducing fuel consumption on long haul truck routes.

The Scania Transport Laboratory is testing a rear air deflector on a number of trucks being used to haul truck components between the company's two main European truck manufacturing plants in Sodertalje, Sweden and Zwolle, Holland. The vehicles, part of a fleet of 20 trucks and 70 trailers, are working in a real-world environment as part of the Scania

TECH FACT

Vehicle drag is a costly problem for a long-distance, heavy-duty truck. A modern prime mover can weigh up to 40 tonnes and have a wind-averaged drag coefficient around 0.60. The average modern car achieves a drag coefficient of between 0.30 and 0.35. As speed increases, so too does the energy required to overcome aerodynamic drag. At 70 mph, overcoming this drag represents about 65 per cent of the total energy expenditure for a typical heavy truck.

distribution fleet and also as part of a fuel consumption testing program for the Swedish truck manufacturer.

The boat tails fitted to the rear of the Scania trailers extend 30cm beyond the rear. The tails can be made of either aluminium or glass fibre and taper inwards by between 12° and 15°. They are shaped in such a way as to increase the air pressure behind the moving truck and decreasing the cross-sectional area of the turbulence.

Scania are using a European Union regulation, Directive 97/27 EC, which was intended to allow truck operators to exceed the 16.5 m length rule for a semi-trailer. The extra allowance has been put in place to allow trucking operators to fit equipment like tail lifts to the rear of their trailers.

Scania's Chief Aerodynamics Engineer, Per Elofsson, contends that fitting a larger cone to the rear of a trailer will eliminate the turbulence altogether and could cut fuel consumption by as much as 15 to 20 per cent, even more than the US experiments predict.

"But of course this isn't feasible," says Elofsson. "Due to current pallet sizes, interior layouts and sheer cargo capacity, it isn't possible to taper the whole truck either. This solution we have used does not encroach on cargo space and can also be retrofitted on existing semi-trailers. It makes economic as well as environmental sense."

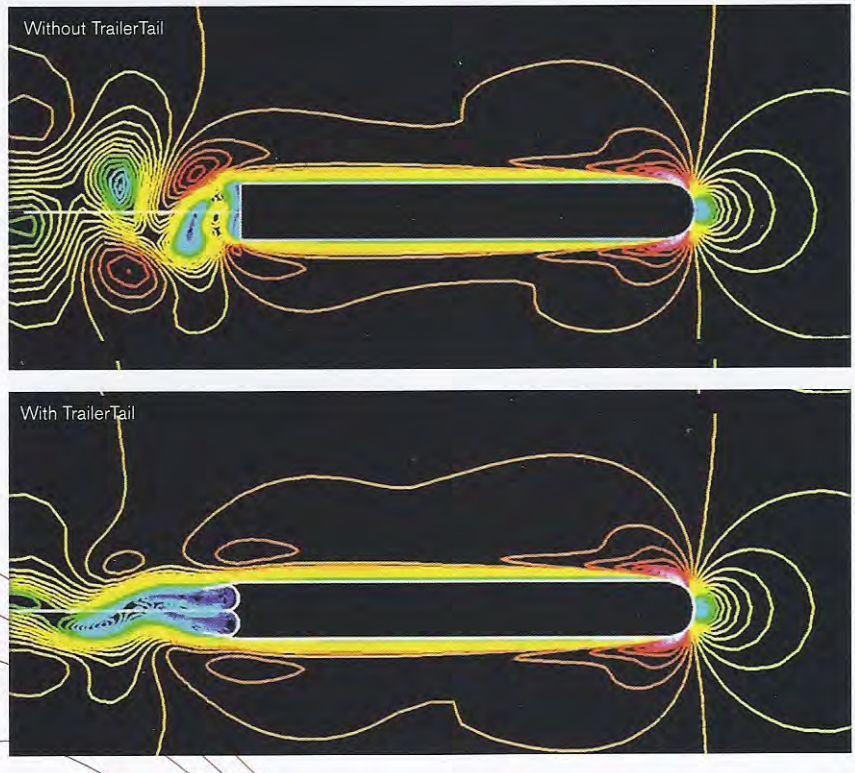
Currently, the testing of the new boat tails is limited to Sweden and Denmark, while Scania await word from German and Dutch authorities that they agree with the interpretation by Scania of the European Union directive. All of the test running done so far on the limited routes suggests the boat tails will produce an overall fuel consumption reduction of 2 per cent.

"For the Laboratory vehicles, which run 360,000 km a year and consume an average 26 litres of fuel per 100 kilometres, it represents an annual saving of almost 1900 litres of diesel and five tonnes of carbon dioxide emitted per truck," says Anders Gustavsson, Managing Director of the Scania Transport Laboratory. "This kind of aerodynamic improvement is positive for industry profitability as well as the environment and is equivalent to the results of several years of engine and chassis development work."

THEIR WIND TUNNEL TESTS HAVE SHOWN THAT USING A TAPERING, HOLLOW REAR END CAN PRODUCE A DRAG REDUCTION OF 12 PER CENT, WHICH EQUATES TO A FUEL SAVING OF ABOUT 6 PER CENT.

Gustavsson says it involves a simple technical solution that can help in the reduction of transport costs and environmental impact and do it quickly.

Scania's field experience is underscored by independent studies. The Technical University at Delft, in the Netherlands, operates a facility to study aerodynamics in the transport industry. Their wind tunnel tests have shown that using a tapering, hollow rear end can produce a drag reduction of 12 per cent, which equates to a fuel saving of about 6 per cent. In 2008, the University tested a number of boat tail configurations on the highway and came back with figures of a 7.5 per cent fuel saving when using a two-metre long boat tail and running at 85 kmh.



A 1.5 m long boat tail achieved a 6 per cent saving and a one-metre tail saved 3 per cent.

ATDynamics's research has shown similar results. Running at 65 mph (104 kmh) the AT Dynamics system has been independently verified as delivering a 6.6 per cent fuel efficiency gain in testing validated by the US Environmental Protection Agency (EPA). The company also claims that a full aerodynamic trailer package, including side skirts and other under body trailer enhancements, can achieve fuel savings of over 12 per cent.

Experience in the US has also found that the streamlining provided by the boat tail improves the stability of the overall vehicle on the highway. Drivers say they notice improved visibility when using their rear view mirrors during rain or snow and; car drivers following the trucks record a reduction in buffeting from the turbulence caused by the rear of the trailer and a reduction in road spray limiting their visibility.

If independent studies continue finding positive results, the industry is likely to see an increasing number of technical variations to reduce fuel consumption and improve the carbon footprint of the trucking industry in the future.

For the equipment manufacturers, it is a matter of working out a method of reducing the volume of low pressure air at the rear of the trailer without compromising safety or productivity and, for now, keeping within the dimension rules applying to the combinations. As more and more data becomes available pressure is likely to mount on traffic authorities around the world to amend dimension rules to take account of the advantages boat tails can bring. **GT**

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HISTORY

In 2005, Clarkson University published a study to confirm the viability of the open cavity concept on the aft end of a trailer. Wind tunnel testing was conducted on over 100 different design geometries using a 1:15 scale model. Model drag increments carried out indicated drag coefficient reductions of about nine per cent of the baseline model trailer drag for the optimum geometry of a 1.2m device with a boat tail angle of 10° and no inset. Five years earlier, in 2000, the NASA Ames Research Centre and the Lawrence Livermore National Laboratory also examined the "influence of boattail plates" on an integrated trailer, paving the way for today's aerodynamic devices.