BTAC
The British Transport Advisory Consortium

Representing leading UK Fleet operators

Technical Trials 2008 Report

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INTRODUCTION

This report covers the BTAC - British Transport Advisory Consortium - Technical Trials held at the Motor Industry Research Association's (MIRA) test facilities on the 28th and 29th June 2008.

With fuel prices at a sky-high record, it was no surprise that almost all the tests at this year's trials weekend were designed to assess fuel-saving potential. Accordingly, the event was this year labelled *Fuel Efficiency And Technical Evaluation*.

BTAC's sheer determination to put on the trials this year when the event was in danger of disappearing altogether was rewarded by a number of entrants with a variety of test needs. The organisation's usual insistence on running strict test types was adapted to current market needs to allow entrants to run tests that they required for their organisations' individual needs.

None the less, each test was carefully monitored throughout the process to give the usual exacting standards of results. It is envisaged the BTAC will offer companies the opportunity in 2009 to perform tests that allow individuality and industry comparative results, sharing the information as always for improvement in the industry

It should be noted that only the facilities of MIRA were used. At no time was any employee of MIRA involved in the technical trials. Particular thanks go to the MIRA control room staff led by Neil Bradley for their assistance over the two days that the trials were run.

BACKGROUND

BTAC was founded in 1972. Its aim is to promote a liaison between senior transport and logistics personnel so that by design, management skills and technical innovation, they may improve the cost effectiveness of the whole distribution chain. This is achieved by sharing knowledge, experience and skills thereby introducing new ideas.

BTAC is a non-profit making organisation. The BTAC Technical Trials have been run over the last 25 years at MIRA, the motor industry's proving ground near Nuneaton.

A test procedure has been developed that simulates both long distance and stop start conditions and is adaptable to represent other operational profiles if so desired. The results are independently monitored. The procedure was published some years ago in ***Fuel Consumption Evaluation*** through the Department of the Environment's Energy Efficiency Best practice programme in conjunction with BTAC and IRTE which is now part of the Society of Operations Engineers from whom copies are available.

The results are available from the BTAC web site www.btac.org.uk as a PDF download.

In addition other performance measures have been developed such as:

- vehicle payload-earning factor;
- road holding and braking;
- noise (in-cab and drive-by);
- exhaust gas emissions;
- turning circles;

In the main the evaluation is of devices and interventions claimed to enhance the fuel efficiency and cost effectiveness of the vehicle. This can range from different tyre types, lubricants, aerodynamics manual versus automatic transmissions systems increased weights and lengths and load volumes.

The results of evaluations are reported in the trade press and also quoted in many government papers concerning fuel efficiency and safety, both in the UK and around the world.

The BTAC trials provide a quite exceptional source for gaining fleet performance data under controlled conditions at a very competitive cost.

ACKNOWLEDGEMENTS

1 SPONSORS

This year BTAC had a considerable number of sponsors, without whose generous support the trials would not have been held.

Catering	Don Bur (Bodies and Trailers) Ltd, Mossfield Road, Stoke on Trent – contact: Richard Owen
Weighing equipment	Central Weighing Ltd, Unit 142 Hartlebury Trading Estate, Kidderminster – contact: Martin Parrack
DAF Hospitality Unit	Ford & Slater DAF Leicester, Narborough Road South, Leicester – contact: Chris Hutt
Commentary production	Transport Engineer (David Wilcox and Tim Blakemore) and Transport News Digest (John Dickson-Simpson)
Financial sponsorship and Scrutineers	Freight Transport Association (FTA) – contact: Lawrie Alford
Mobile technician	Thomas Hardie Commercials Ltd

2 MARSHALLS & SUPPORT

A number of BTAC members and non-members gave their time freely to carry out various tasks at the event. Without these people, the event could not have been held. Our thanks to:

Clerk of the Course	Andrew Davis * BTAC Chairman
Results Marshall	David Payne *
Tachograph Analyst	Nick Matthews * BTAC Vice-Chairman
Registration Co-ordinator	Gordon Spooner * BTAC Secretary
Chief Scrutineer	Ron Rider
Scrutineers	FTA – Matt Winkle, Steve Hunter, Wayne Jackson
Weighing Marshall	Martin Parrack
Start Line Marshalls	John Eastman & Ray Denton
Gatehouse Marshall	Roger Denniss
Pad Control Marshalls	Fred Richardson & Alan Parker
Results Co-ordinators	Kevin Atkins, Peter Macleod *
Risk Assessment Marshall	Eddie Farley
Catering	Tony Vandome
Technical Support	David Batty*
Coastdown tests	Paul Bailey (SOE) & Mike Kenefeck
Fuel Weighing	Ray Denton, David Fullwood, & Jamie Boocock
Fuel Issues Marshall	Mick West

* BTAC Executive Member

THE ENTRANTS

1 SOMI TRAILERS

Somi Trailers of Scunthorpe attended the BTAC event in 2004 in order to test its theory that its high-cube (but low-height) trailer provided not only extra internal volume but had better-than-average aerodynamic performance too. This belief is based on the premise that the dropped well in the centre of the trailer prevents the ingress of air underneath it, reducing turbulence and drag.

The 2004 testing suggested that the Somi trailer could improve fuel consumption by eight per cent. But, reported at the time (*Transport Engineer* July 2004), there were a number of factors that undermined that result, including poorly controlled running speeds and the fact that the smooth-sided refrigerated Somi trailer was up against with a curtain-sided trailer – hardly a fair comparison.

So Somi Trailers managing director Pauline Dawes was back at MIRA this year determined to conduct a more objective and accurate test of her trailer. The benchmark this year was another refrigerated trailer, borrowed from Ocado and built, like the Somi trailer, by Paneltex. Both trailers are 4m-high and both have the same edge-capping radii, so neither had an unfair advantage this time. The Ocado trailer also sports side-skirts that taper in neatly at the rear. "We set out to get the most aerodynamic trailer we could find," says Mrs Dawes.

Both trailers were loaded identically to achieve a gross vehicle weight of 39.6-tonnes when pulled by the same 400hp Volvo FM 4x 2 tractor unit, driven by Volvo Trucks' experienced demonstration driver Rod Collett. This had all the makings of a fair trial.

Following BTAC's steady-speed test procedure (five laps at 60kph, five at 80kph and five at 90kph, a total of 73.13km) the Volvo's fuel consumption was 7.76mpg with the Ocado trailer and 7.83mpg with the Somi trailer. The average speeds were identical, so the results look credible.

"An operator would look at those figures and say there is little difference," says Mrs Dawes. But 0.07 mpg improvement is still worthwhile "I'm quite happy with that". I think they're pretty good results, considering that we were testing against the best trailer we could find and that the Somi trailer offers all that extra volume."

Somi's next step is to try some aerodynamic tweaks to see if it can do even better. Mrs Dawes suspects the key areas for attention are in front and behind the trailer's central well and right at the back end.

2 DENBY TRANSPORT/CARLSBERG

Outright rejection of trials of longer heavier vehicles (LHV) by transport secretary Ruth Kelly (Transport Engineer July) came barely three weeks before this year's BTAC event but stalwart proponent of such trucks, Dick Denby, is not so easily defeated. He and his 60-tonne gtw, 25.25m-long B-double rig (tractor unit, steered interlink trailer and conventional semi-trailer) were back at MIRA yet again.

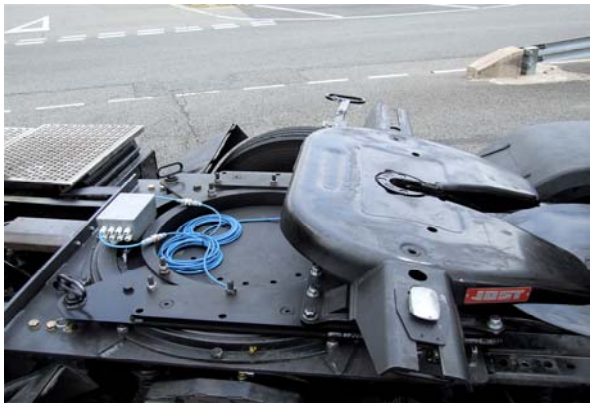
This was one LHV trial that Ms. Kelley could not stop Says Mr Denby of Ms Kelly's decision, "I was disappointed but not surprised. I had a pretty good idea that she was minded to reject LHV soon after she was appointed last summer." He struggles to reconcile her refusal to even sanction trials of LHV with the TRL's report ignoring the potential emissions benefits. "It is a criminal dereliction of duty," declares Mr Denby.

The Denby B-double rig was back at MIRA to see if a change of tractor unit could enhance its productivity. In the 2004 event it had run at a shade over 59 tonnes gtw and during the steady-speed BTAC test procedure recorded 6.42mpg, pulled by a Euro-3 Scania 164 6x2 tractor with a 16-litre, 480hp vee-eight engine. The tractor alone weighs around 8.5-tonnes. What would happen to fuel economy and productivity if the same trial was repeated in 2008 with a lighter, Euro-5 tractor with a more modestly-sized engine? Carlsberg supplied a Volvo FM 6x2 tractor, with its 12.8-litre in-line six-cylinder engine rated at a nominal 440hp. It was giving away fully 2.8-litres in displacement but in terms of peak output was only 39hp and 100Nm below the Scania.

The result did not go the way that many would expect. Carlsberg's Volvo recorded 5.89mpg, half-a-mile per gallon worse than the Scania's figure four years previous. In its defence, the Volvo is a brand new unit, not run-in. Carlsberg's National Fleet Engineer (and BTAC chairman) Andrew Davis says his operational fuel records suggest that consumption will improve by around five per cent within the first six months. It was also grossing 60.17 tonnes, a tonne more than the Scania rig. The Volvo weighed 7.8 tonnes, at least half-a-tonne less than the Scania, so there was an extra 1.5-tonnes of payload on board this year. And we are comparing Euro-5 with Euro-3.

Both the Volvo and Scania consumption figures are better than the average assumed for this 60-tonne B-double configuration in the recent LHV report – 5.17mpg. For comparison, the report took the average 44-tonner's fuel consumption to be 6.91mpg. The Carlsberg Volvo FM ran at MIRA on the steady speed test and averaged 7.64mpg at 43.5-tonnes gcw. Four years ago, the Scania 164 achieved 8.33mpg at 42.5 tonnes gcw.

3 SILVERTIP DESIGN



Carl Henderson, the talented engineer who runs Richmond, North Yorkshire-based engineering consultancy Silvertip Design, has already chalked up considerable success at the BTAC trials. In 2005 his steering correction mechanism (SCM), a self-steering system for semi-trailers, demonstrated that it could enable a 16m-long trailer to stay comfortably in the existing steering corridor regulations governing our current 13.6m-long trailers.

Mr Henderson proved that it is possible to achieve a manoeuvrable and stable 18.75m-long articulated outfit that offers 18 per cent more deck length than the current configuration. Mr Henderson's SCM went on to win the concept prize in Trailer Innovation awards at the 2006 Hanover commercial vehicle show (*Transport Engineer* October 2006).

At this year's BTAC event Mr Henderson set out to explore the potential for improving an articulated vehicle's roll stability. Research carried in the US, Australia and New Zealand suggests typical tractor/semi-trailer outfits have a roll threshold of between 0.35 and 0.4g of lateral acceleration. A rule of thumb suggests that any truck with a roll threshold lower than 0.3g is unacceptable. Analysis of truck rollover accidents shows an indisputable correlation between theoretical rollover threshold values and involvement in real-life accidents, hence Mr Henderson's interest. Supermarket chain Morrisons had lent him a tractor and trailer for test work; Jost had provided a modified fifth wheel and turntable.

Mr Henderson's focus is on the fifth wheel coupling and its contribution in the outfit's overall rollover threshold. His proposal is an adaptation of the conventional kingpin and fifth-wheel coupling. Both those components remain as the mechanical link between the two parts of the outfit, but they are relieved of their articulation duty – a turntable does that. The turntable straddles the tractor unit's main chassis members, just ahead of where the fifth wheel would normally sit. There is a tail on the turntable on which is mounted the fifth-wheel, positioned so that it sits in pretty much the same point on the chassis as usual, complying with the overall length limit. The fifth wheel has a pair of wing-like extensions, slotted to take some twist locks on the Mr Henderson's working prototype. After the trailer is coupled up in the normal way, the twist locks are slid into place so that they clamp the fifth-wheel to the trailer's main rails. Thus, the fifth wheel is now turning with the trailer, not the tractor. The coupling's forward-aft pitching movements between the top plate and the pedestals are still possible, but the normal lateral roll due to kingpin "lash" – the free play before the kingpin's flange prevents the trailer pulled upwards and outwards from the fifth wheel during cornering – is no longer there.

Mr Henderson explains that he is trying to improve the outfit's roll stability in two ways. "We are stiffening up the trailer with the tractor unit, by eliminating the lash in the fifth wheel." Not only does the tractor add some extra stability, but stiffening the connection means that more of the trailer's roll movement is transmitted through to the tractor, so that the driver is more aware of the trailer's behaviour. One of the common observations made by drivers involved in rollover accidents is that they had little sensation or forewarning that their trailer was about to overturn.

The second roll stability benefit from Mr Henderson's set-up is less easy to grasp. It stems from the fact that the fifth wheel's pedestals (and hence pitch axis) are some 400mm behind the turntable centre. This becomes a sideways offset during cornering. Mr Henderson says the combination of the offset and the vertical forces imposed on the pitch axis produces an inwards roll moment when cornering, countering the normal outwards roll.

All in all, Mr Henderson believes this turntable system is capable of improving the vehicle's roll threshold by 20 to 30 per cent. The removable locks on both the fifth wheel and the turntable allowed comparison of the vehicle with its normal coupling and with the turntable, running on MIRA's ride and handling track. "It generally felt smoother and more comfortable with the turntable, particularly as we went into and out of the dips in the track," commented Mr Henderson. On the key question of roll, there was very little difference in the feeling felt by the driver. "That's because we have less roll, but the driver feels more of it, so on balance it feels much the same as usual, but there is an extra margin of safety," explains Mr Henderson. He expects the data recorded from the accelerometers and strain gauges fitted to the vehicle to support his hypothesis.

Mr Henderson now plans to do more track testing using a trailer with safety outriggers so that he is able to explore the roll threshold. He believes that the turntable coupling offers more than just better roll stability. "It makes automatic coupling possible as well," he says, explaining how the clamping wings on the fifth wheel could also carry the electrical and air connectors that would spring up to engage in corresponding sockets in the trailer's running plate. "That would eliminate the suzies and you can close up the cab gap because you don't have to leave room for the driver to get onto the catwalk," he points out.

4 GIST

Logistics operator Gist came to MIRA to see if a prototype trailer sporting an array of aerodynamic refinements is likely to generate sufficient fuel savings to recoup its extra cost. The temperature-controlled tri-axle trailer was built by Scottish manufacturer Gray & Adams, with AB Airflow of Sandy, Bedfordshire providing the aerodynamic expertise. Drag-reducing measures comprise large radius corner cappings, side skirts with flexible extensions to take them as close to the ground as possible and a downward sloping rear roof section incorporating vortex generators and a wing section.

The roof slope is more pronounced than Gray & Adams has used in the past, says Andy Bacon of AB Airflow. The vortex generators – three vee-shaped sections that protrude from the roof slope – encourage the air to stick to the slope, delaying the separation the cause's turbulence and drag. "The wing is an extruded aluminium section at the same angle as the roof, "explains Mr Bacon, "and it should capture a bit more of the air that might become detached from the roof."

According to Gist's engineering director Sam de Beaux, the whole aerodynamic package added about £3,000 to the price of the trailer. "That was for this, the first one, so there are some development costs to be considered" adds Mr de Beaux. "I have to find out what the real price will be if we buy any more."

Judging by the result, further purchases may well be on the cards. Running 15 laps of the MIRA track at a steady 90kph (56mph) the DAF XF105.410 tractor unit averaged 28.1 lit/100km (10.05mpg) when pulling a Gist standard Gray & Adams trailer. Consumption improved to 24.6 lit/100km (11.48mpg) when the aerodynamic trailer was used. In other words, use of the slippery trailer reduced the amount of fuel consumed by 12.5 per cent.

There are a few caveats that need to be added. First, the consumption figures are from the DAF's on-board computer because Gist was not using BTAC's customary gravimetric fuel measurement procedure that involves weighing detachable fuel tanks before and after the trial. "I don't necessarily believe the absolute figure from the on-board computer," admits Mr de Beaux, "but DAF tells me that it is accurate to within two per cent in terms of its repeatability, so the comparison should be valid." The trailer was also unladen, so the wind resistance accounted for a greater proportion of the overall energy consumption than would be the case in normal operation. And running the test at the maximum speed also emphasises the contribution of aerodynamics. "The trailers in our primary trunking fleet are not always at 56mph but they will spend at 70 to 80 per cent of their time above 40mph," estimates Mr de Beaux,

"The result sounds about right to me," says Andy Bacon, comparing it with other similar aerodynamic trailer designs he has produced. "The best improvement I have seen is just over nine per cent in a night trunking operation from Exeter to the midlands at 28 tonnes gcw."

While acknowledging that the trailer's real-world fuel savings are unlikely to be as good as the MIRA results, Mr de Beaux nevertheless describes the test outcome as "very positive." Adds Mr de Beaux, "The trailers may not be suitable for everything because the roof slope restricts the loading height. It's horses for courses." With another 18 trailers currently on order with Gray & Adams, he will do some cost calculations to decide whether it is worth upgrading them to the new aerodynamic specification. Gist's primary trunking trailers cover between 200-250,000 km each year and they are kept for 12 years, so they have ample opportunity to generate a payback.

5 SOMERFIELD

Is going slow a quick fix for rising fuel prices? Supermarket group Somerfield was at MIRA to exploring the potential for saving fuel by pegging back the top speed of its trucks. The trial was run for Somerfield's distribution director Andy Monk by David Batty, the company's former engineering controller who now operates his own consultancy company, Batneec Development Services. The trial comprised measuring the fuel consumption while running at three different steady speeds on the MIRA track; 90kph (56mph); 85kph (53mph) and 80kph (50mph).

Two different 4x2 tractor units were used; one a 400hp Volvo FM from the Somerfield fleet, the other a Scania R420 demonstrator. Both were pulling Schmitz Cargobull tandem-axle trailers, laden so that the vehicles grossed 27 tonnes gcw, close to Somerfield's typical operating weight.

Setting the benchmark for the normal 90kph speed-limiter setting, the Volvo recorded 8.72mpg. Consumption improved to 9.42mpg when the speed was cut to 85kph but was virtually the same (9.44mpg) at 80kph. "The on-board computer read higher than that," says Mr Batty, "but also showed a step-change between 90 and 85kph and very little difference between 85 and 80kph." The BTAC fuel measurements indicate that the volume of fuel consumed at 85kph was 7.4 per cent less than the volume at 90kph but there was next to nothing to be gained by dropping to 80kph.

The fuel system in the Scania tractor unit refused to play ball with the BTAC detachable fuel tank, so the Somerfield team had to rely on the on-board computer's fuel figures for this comparison. It indicated that cutting speed from 90 to 85kph produced a fuel saving of 4.6 per cent, but that once again there was no further saving when the speed was cut back to 80kph.

A 5kph speed cut is expected to produce more fuel savings at a higher speed than low speeds, by virtue of the fact that the vehicle speed is squared in the formula used to calculate power losses due to air resistance. This explains why the cut from 90 to 85kph was more beneficial. The reason for the lack of any real improvement when moving from 85 to 80kph is less apparent. The most obvious answer is that the drop in road speed took the engine speed out of the "sweet spot" in the engine's part-load fuel map. However, Mr Batty says both the tractor units had an automated gearbox – I-shift in the Volvo, Opticruise in the Scania – and that both systems opted to remain in top gear during the steady running, even at the lowest of the three speeds.

"My recommendation to Somerfield would be first to consider setting any new units coming into the fleet at 85kph," says Mr Batty. "Then I would interrogate the Dynafleet Online system to find out how much time each truck in the fleet spends at 80, 85 and 90kph. When you know which depot has the most trucks running at 90kph for most of the time I would shut them down to 85kph, or maybe do that in blocks of 10 trucks, and then do some on-road fuel measurements."

Somerfield also asked Mr Batty to run a trial to establish whether or not its current tyre pressure policy is correct and test the impact of below-par pressure maintenance. In keeping with the fleet's relatively low gross weights, Somerfield's preferred drive-axle tyre pressure is just 75psi; steer-axle and trailer tyres are set at 125psi. These pressures are those advised by Michelin. Running BTAC's standard steady-speed test procedure (five laps at 60kph, five at 80kph and five at 90kph) the Volvo tractor and trailer at 27 tonnes gcw recorded 9.96mpg with all the tyres set to the correct pressures. After allowing the tyres to cool their pressures were dropped by 10psi - a reduction of eight per cent on steer and trailer axles, 13 per cent on the drive-axle - and the trial repeated. Consumption deteriorated to 9.82mpg, a 1.5 per cent increase on the fuel bill.

This result is in line with tyre manufacturers' data about the relationship between tyre pressure and fuel consumption. Potentially more interesting was the increase in tyre temperatures and pressures during the two runs. While running at the lower pressures, their temperatures climbed by eight degrees Celsius during the 73km run; pressures rose by between 11 and 19psi across the four axles. When the pressures were set according to Somerfield's policy, their post-run temperatures were up by only two or three degrees Celsius, triggering a pressure rise of no more than 2psi. This result would seem to support the view that Somerfield's tyre pressures are well chosen.

The repercussions of severely under-inflated tyres are well publicised. Somerfield's BTAC tests underline this in that far smaller pressure deficits of the scale found in poorly managed fleets have a measurable impact too.

6 AIRMAX

Airmax's business is predominantly in the market sector of vehicle telematics and telecommunications. It specialises in the wholesale supply of in-vehicle telematics systems to large fleets, in addition it has been closely involved in advanced engine remapping as opposed to "Chipping"

Airmax entered a Ford Transit that was equipped with a gravimetric tank but no calibrated speedometer.

The test profile that they set was one high-speed run at 70mph with the engine as supplied, one run at 70 mph with the engine remapped, and a repeat test at 56 mph both in standard and modified format.

The results showed that at 70 MPH in modified format the fuel consumption improved by 16% and at 56 MPH in modified format it improved by 19%.

Long term trials would be required to ensure that this is obtainable in real life operating conditions.

7 AUTOKONTROL

AutoKontrol carried out tests on a 1700Kgs GVW Combo van with the speed limited. Due to the fact that the method of measuring both the fuel used and the distance covered could not be verified, the results are not published. Despite this, savings between a variable speed and 56MPH were believed to be considerable. This type of saving by reducing speed mirrors those results achieved in the Somerfield trials.

RESULTS 2008

Report Page No	Entrant	Intervention	MPG
8	SOMI Trailers	SOMI Trailer type one & 2 test	7.83
8	SOMI Trailers	Conventional Trailer type one & two test	7.76
7	Denby Transport	Type one & two test using a Carlsberg tractor unit. Grossing 60.17 tonnes	5.89
10 /11	GIST	Gray & Adams trailer with full aerodynamic package , High speed test only using On-Board Fuel recording	11.48
10 /11	GIST	Gray & Adams trailer Standard trailer , High speed test only using On-Board Fuel recording	10.05
12	Somerfield	High speed test only running at 90 Kmh using gravimetric testing and a Volvo tractor unit	8.72
12	Somerfield	High speed test only running at 85Kmh using gravimetric testing and a Volvo tractor unit	9.42
12/	Somerfield	High speed test only running at 80Kmh using gravimetric testing and a Volvo tractor unit	9.44
12	Somerfield	High speed test only running at both 90 & 85 Kmh using on board fuel recording and a Scania Tractor unit. Savings of 4.6% produced at the lower speed.	NA
13	Somerfield	High speed test only running at 90 Kmh using gravimetric testing and a Volvo tractor unit. With tyre pressures set at norm.	9.96
13	Somerfield	High speed test only, type one test, using gravimetric testing and a Volvo tractor unit. With tyre pressures reduced by 10 psi	9.82
14	Airmax	Variation in engine outputs at both 70 & 56 MPH using gravimetric fuel weighing showed an improvement in MPG of 16 & 19% respectively	NA