Aerodynamicists

Plenty of bodybuilders argue that improving fuel returns is at least as much about the

Aerodynamicists know that the drag force on a body is defined as half the air density, multiplied by velocity squared, the drag coefficient (a dimensionless figure related to its precise shape and smoothness), and the frontal area. For commercial vehicles running along real roads, there are other variables that make this equation approximate only. We might include vortices, created by other vehicles, and yaw, due to wind direction, but not tyre rolling resistance or weight – these are important, but entirely separate issues, along with drivetrain friction and parasitic losses that devour engine power.

Nevertheless, thinking about this key formula's implications is very revealing. The main points to take away are twofold. One, total frontal area and shape have big, but potentially counteracting impacts on total drag force. And two, the contribution due to speed increases non-linearly, from a little to a lot, as velocity rises, simply because of the exponent.

So the first, fairly well-accepted observation is that, if your vehicles' duty cycles are essentially stop-start and low speed, any benefit from aerodynamic interventions will necessarily be limited, possibly negligible. If, however, you're trunking up and down motorways, then there's the potential for outstanding results. However, just how good depends on the percentage of time – or, if you like, how many motorway miles – your trucks travel at, say, 56mph. Depending on who you talk to, anything less than 65–80% is sub optimal and you might be better off saving your money.

However, assuming your operations are in that bracket, the two aspects you can influence are frontal area (and, since width is fixed, that's overall vehicle height, not just the leading edge of the cab) and the drag coefficient. That matters more than many realise, because, while it intuitively makes sense to reduce the drag coefficient by going for 'slippery shapes', if those also increase the frontal area – maximum vehicle height – then you just shot yourself in the foot.

Not that simple

Admittedly, it's not quite that simple: if you're using all that vertical space, then you can clearly argue your corner. However, if you're not, then you are very likely to find that simply reducing your overall trailer or box body height (not just dropping it closer to the road) may be just as effective as profiling the roof – and cheaper. As Schmitz Cargobull technical director Paul Avery puts it: "If your beautifully profiled trailer is 400–500mm taller than average, then, unless you're filling it, yes, you have improved the drag coefficient but you've also increased the overall height. So you've achieved nothing."

You might say, 'he would, wouldn't he', given Schmitz's preference for low box trailers. But the

From top clockwise: Henred Fruehauf South Africa DHL Superlink Teardrop; Marks and Spencer Teardrop Mk 2 aerodynamic trailer (front and rear); rear trailer roof spoiler vortex generators; Wabco's new aerodynamic trailer side-skirts

or airheads?

aerodynamics as it is about engine technology. Brian Tinham examines the claims

maths remain incontrovertible. And there's another important point that operators convinced of the whole shape thing should know. While some manufacturers' aerodynamic shapes have the weight of science behind them – being founded on solid CFD (computational fluid dynamics) and/or wind tunnel research – others have not. They just 'look right'. So, caveat emptor: buyer beware.

That said, for Don-Bur, of Teardrop trailer fame (which certainly has done its R&D), the roof profile is your number-one potential for reducing drag. "We have enough data behind us now to say that quite comfortably," comments Richard Owens, group marketing manager. "This is a mature product and our customers' own data is on our website for anyone to see. It shows fuel economy figures from 4.03% up to 19.82% – although from a CFD point of view, the maximum is 16% at 56mph, so there must have been some other intervention."

Skirts and tails

Beyond the roof shape, however, he suggests that side-skirts, underskirts and 'boat tails' (rear wing extensions) should be next on the priority list – although he adds that, while aerodynamic interventions' improvements can be additive, they can also be "detrimental". Nevertheless, for him the best benefit is achieved through full-wrap skirts, including under-skinning.

"The problem with wrap-only is that the airflow hits the skirt front, the landing legs, under-run bracing and the axles, and creates turbulence. So, while cheap and cheerful side-skirts are better than nothing, improvements are likely to be marginal. But full-wraps are around £2,000 more and the extra weight. So we support 180 degrees wrap skirts, not under-skinned. We've seen 3–4% difference with these, when scooped over the wheels."

Everyone is in that ballpark. Dr Christian Wiehen, chief technical officer at braking and stability systems specialist Wabco, which last year acquired Delft Technical University aerodynamics offshoot Ephicas, says 4% and 1.6 litres per 100km savings are being achieved by TNT and Peter Appel respectively, in the Netherlands. That's using its semi-trailer side wing.

"The product has a wing profile at the front, which conducts air flow underneath the semi-trailer in a way that also generates a forward component of force, through the Bernoulli effect," explains Wiehen. "Payback for a retrofit would be less than two years, assuming 150,000–170,000 miles per annum, but even faster, if it was integrated into the trailer build."

But again, beware: while agreeing that 3% or more fuel saving is achievable with side-skirts, Avery suggests that the potential negative impact on maintenance and residuals can see paybacks escalate to "nine years, unless you're doing 100% motorway mileage". That improves, he says, if you go for ABS instead of GRP – but they cost more.

Owens believes that, as take-up increases, prices will fall, just as they did for Teardrops. And he says that Don-Bur is currently at the prototype stage with a full-wrap skirt design – and another for the 500mm boat tails now allowed under European law. It's early days for the latter, but operators can expect curved rear fins that retract into the bodywork on box vans – although curtainsiders remain a stumbling block – to deliver up to 5% fuel saving, he says.

That may be a tad high: Wiehen settles on a more conservative 2–3% for boat tails, following wind tunnel and test track trials. He says Wabco's will appear on box bodies and reefers first, with curtainsiders next.

Just as interesting, he confirms that Wabco is also researching a solution to the tractor-trailer turbulence gap. "If that all becomes available, then improvements could be 10%," he claims, adding that Wabco's approach is around "improving the nose design of the semi-trailer, rather than introducing anything to bridge the gap". With others working on alternatives, it can't be much longer before another well known problem is overcome.

But the last word goes to Schmitz's Avery: "We've got a calculator that looks at aerodynamics, and takes into account weight and residual values, showing total costs and predicted CO_2 savings. But often what happens is, even when the figures show [an operator is] better off going low and light, they still choose higher 'aerodynamic' trailers, because they 'want to look green'."

Time for homework. Should you strut your stuff with logic, or with the green image? Or both?