CHEATING THE WIND

Mike Riley, *Rileys Cycles*

Back in February 2019 I wrote about weight-saving on performance bicycles and in September we looked at wheels and friction. Another factor affecting bike speed is aerodynamics.

When you read this you may be carrying around the effects of too many mince pies, so how can you achieve a performance gain to compensate? If everything is running smoothly the biggest resistance over about 12mph is aerodynamic drag. A graph of drag versus speed shows a cubed relationship; this means if speed increases two times, drag increases eight times. The drag of an object is determined by frontal area and how 'slippery' the shape is. This affects how cleanly air flows over the object.

While working as a technician testing drag of underwater vehicles, my company hired BMT Teddington wind tunnel. This facility was in high demand; Maclaren used it for testing new designs, and not only cars. Once when we arrived, Maclaren were testing a downhill racer ski suit and helmet. The helmet was a teardrop shape and I was not surprised later to see time trial cycle helmets adopt this shape. This highlights the point that cycle designers are not inventing something new when they proclaim a breakthrough in technology; they are adopting a principle from another sport or technology area. High-performance race bikes are like Maclaren's race cars in that technology trickles down from the race teams to the products we can buy. Wilier bikes are ridden by Team Direct Energie in World Series events, so are tested at the highest level of competition and must keep pace with or exceed the best performance available to remain competitive.

Marginal gain is a buzzword coined by Dave Brailsford, the Sky cycling team manager. It is a philosophy of seeking every small gain possible such as diet, mental attitude and, of course, fast bikes. This scientific approach was preceded over 60 years ago by legendary bike racer Fausto Coppi, who explored vegetarian diets, alternative training methods and who organised his team like a general, however his bike shape was restricted by the materials available.

Another area cycling borrows from is aerospace. With the introduction of carbon fibre, frame designers had the freedom to create complex shapes instead of being restricted to round tubes. Wing shapes are chosen from National Advisory Committee for Aeronautics (NACA) profiles which are selected to give the best trade-off of lift and drag, and a designer will choose one to suit his application. Racing's governing body, the Union Cycliste Internationale (UCI) sets rules so bike shapes cannot be too extreme and the depth of a frame member is limited. This means the trailing edge of the profile tube is blunt instead of tapering to a point, however the air flow over and behind the shape is still smoothed, thus reducing drag. This is why you may read in the specs that a frame has a truncated NACA profile or a Kamm tail.

The biggest impact on the frontal area is the rider. This is why racers have their handlebars low compared to their saddle. In triathlon and time trials they may use handlebar extensions to keep their arms close together to further reduce their frontal area. I get a buzz from overtaking riders who are not aware of this secret weapon on a descent. My technique is to drop my head and raise my bottom a little off the saddle, this flattens my back and means my knees can absorb bumps, my pedals are horizontal and I tuck my knees and elbows in. On an aero-framed bike I can gain a significant advantage.

You may have read about Adam Anstey's epic Race Across America last year. Adam had the best aerodynamic set up that could be achieved because his compact body shape is ideal. His Wilier NDR bike has a slippery aero-frame shape and his wheels were selected as the best trade-off between climbing and aero-performance. This saved him many watts of effort on the long plains and allowed him to fly downhill.

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I wrote earlier about wheels and there is a fashion now for extremely deep rims which reduce drag. You can visualise the flow of air over an object using computer modelling or coloured smoke in a wind tunnel, and what you will see are whorls and eddies as the air flow detaches from an object. As a sailor, this air flow is important and I trim my sails to achieve the cleanest air flow, using streaming tell-tales to see it. If you viewed the air flow around a rotating bike wheel you would see spokes cause air turbulence and likewise rim and tyre. A solid wheel is an extreme solution and is used in track racing where cross-winds are not a problem. For road riding, the effect of side winds is a consideration and riders with deep section rims are at risk of being blown sideways when passing a field gate or being passed by a lorry. The deeper rim also adds weight, however they do look very cool and pro! My preference is for a less deep rim with bladed spokes and a tyre size that matches the rim so they form a smooth oval shape.

The latest Wilier high-performance models such as the Zero have an aerodynamic cockpit; this is achieved by a one-piece carbon handlebar and stem where the shape of the bars is flattened. Even spacers on the steerer tube and the seat post are aero-profiled and cables are tucked away in the frame so the bike looks sleek and purposeful.

If you want to gain any more you will need yoga classes to adopt the crouched position Chris Froome adopts on long, fast alpine descents, but you will need to shed the mince pies first!

rileyscycles.co.uk