

F-one's Contribution to Lance's 2004 and 2005 Tour Victories

Len Brownlie January 16, 2006

The real contributions of the F-1 group were:

- (i) the confidence boost Lance received from knowing that a group of world experts were turning over every stone and peering into every corner to find ways to make his equipment the lightest, strongest, most aerodynamic and fastest on the planet; and
- (ii) the confidence lost by his opponents who did not have the sponsor resources available to keep up with the "Armstrong race".

Before Lance, very few cyclists or Tour de France teams bothered entering a wind tunnel as preparation for the tour. Now, most of the major contenders spend several days in a tunnel, monitoring their position and equipment.

The unprecedented collaboration of TREK Bikes, HED Wheels, GIRO Sport Design, Shimano, AMD and NIKE led to the interdisciplinary development of new NIKE race stage specific clothing, a new Giro TT helmet, three new bikes (TREK TTX; TREK SSL, TREK SSLx), new TT bars and a new TT wheel (TREK/HED Aeolus). Lance's TT position was refined for the 2004 and 2005 Tours. Math models of power and drag were developed by cycling aerodynamics guru Dr. Chet Kyle and applied, by Dr. Len Brownlie, to the results of preliminary race and prologue results, allowing Lance's team to estimate the power output and predicted finishing times of his major rivals in all subsequent ITT. For example, in the 2004 Stage 16 ITT to l'Alpe d'Huez the math model predicted a victory for Armstrong and provided an estimated finishing time for Jan Ullrich within 13 seconds (0.53%) of his actual time.

So, how did the F-1 group's development efforts lead to race time savings?

F-1 determined that a 500 gm weight saving would take 10.43 seconds off the 2004 l'Alpe d'Huez ITT. NIKE responded with a special SWIFT Spin Suit that was 22% lighter than a standard Tour-issue short sleeve time trial suit, shaving over 50 grams off the weight of the clothing and limiting sweat retention as well. TREK developed the Madone SSL bike – a super stiff, super light mountain climbing special that barely passed the UCI minimum weight limit. TREK engineers used new stronger and lighter carbon fiber formulations and drilled holes in non-structural metallic bits of the frame to achieve these weight savings.

Despite the grueling climb and high heat, Lance, unlike his rivals, wore shoe covers at l'Alpe d'Huez, saving 65 grams of drag and 4 seconds on the arduous 15 km climb.

F-1 wind tunnel research at the University of Washington and Allied Aerospace Low Speed Wind Tunnels determined that the new Giro Rev6 TT helmets sacrificed no

aerodynamic advantage, despite being wider and higher (due to the UCI mandated insertion of protective foam) than the previous Rev5.

Repositioning Lance’s time trial position shaved nearly 100 gm of drag from his 2004 ITT position – equivalent to a 36 second time saving in a 55 km time trial. Various modifications to the NIKE SWIFT Spin Time trial suit reduced the 2004/2005 suit drag by 100 gm, equivalent to another 36 second time saving.

Under some intermediate wind conditions, the new Bontrager/TREK/HED Aeolus deep front wheel was found to provide up to 30 gm less drag than the TT standard HED3 (worth 15 seconds in a 55 km TT), providing Armstrong with 2 wheel options for the ITT.

In 2004, we tested Ullrich’s Walser TT bike and found it to create 112 gm more drag than the TREK TTT bike at a 20 degree yaw angle (a 40 second disadvantage), providing Armstrong with additional confidence that his bike was the fastest. In May, 2005, TREK wind tunnel tested a new Time Trial bike, the TTX, and reported it to provide 10% less drag than its predecessor. Armstrong rode the TTX to victory in the Stage 20 ITT of the 2005 Tour.

To reduce drag and energy consumption in the long, flat stages of the 2005 Tour, where extended group riding in the Peloton is occasionally punctuated by break-away sprints, NIKE developed a new Peloton bib and jersey. Wind tunnel measurements and mathematical modeling determined that the new SWIFT Peloton kit shaved 150 gm of drag, equivalent to a 3 minute time saving in a 190 km stage (if the rider rode the entire race solo) and 136 Kcal of energy expenditure. Over 10 flat stages of a Grande Tour, this energy saving would be the equivalent of riding for 54 km without pedaling.

While shoe covers are standard issue equipment for ITT, NIKE’s June , 2005 wind tunnel tests showed that a particular type of NIKE sock reduced the drag of each foot by 69 gm – equivalent to a 50 second advantage in a time trial. Rapid production of these prototype socks – distinctive in black with a yellow top band – led to their use by Lance at the end of the 2005 Tour .

Perhaps the easiest way to quantify the benefit provided to Lance by the F-1 group is to look at his margin of victory in the Tour from the pre-F-1 race of 2003 to 2004 and 2005’s F-1 supported victories:

Year	Margin of Victory (min:sec)	Margin of victory %	Change from 2003 %	Equivalent margin of Victory if Tour was a 10.0 second, 100 m sprint*
2003	61 seconds	0.020%	-	0.002 seconds
2004	6:19	0.1259%	521%	0.0126 seconds
2005	4:40	0.090%	359%	0.009 seconds

* Sprint running races are timed to the 1/100 of a second, so the 2003 and 2005 Tour de France victories would have been “photo finishes”

F-1 support also led to unprecedented Team Time Trial victories by U.S. Postal and Discovery Channel in the 2003, 2004 and 2005 Tour de France races – the 2005 margin of victory being a mere 2 seconds. As Chet Kyle, noted, in cycling, “Everything is significant”.