

August, 2002

To: The Editor, BIKE.COM

Dear Sir:

We would like to compliment Kraig Willett on his in-depth technical primer on some of the aerodynamic principles behind the U.S. Postal team's new SWIFT-SPIN time trial suit ("What Do Skinsuits Have to Do with Boundary Layers" - BIKE.COM, July 16, 2002). We would also like to further explain the design of the Swift-Spin suit. The new NIKE Swift-Spin time trial suit utilizes design features which have been developed in extensive wind tunnel tests at Texas A&M, University of Washington, and the University of British Columbia. Comparative drag measurements of various suit designs were combined with wool tuft, helium bubble and smoke flow visualization to identify flow patterns and areas of flow separation around the cyclist in a time trial position. This testing (also performed for Nike's USA, Netherlands, and Australia Swift Skin speed skating suits prior to the Salt Lake City Games) is extremely accurate and repeatable.

As noted by Mr. Willett, two types of air drag determine the overall aero performance of a cycling suit. Pressure drag is overwhelmingly dominant on regions of the body which approximate cylinders in cross flow such as the upper arms and the thighs. On the Swift-Spin suit, a material that will trip the boundary layer is used to decrease the size of the wake and consequently minimize pressure drag.

Surface friction (shear forces) would be more important on portions of the body in which flow is attached and parallel to the surface. Here, materials that either keep flow laminar or minimize turbulent boundary layer friction are beneficial, and are used in the Swift-Spin suit.

To optimize the suit design, it is necessary to choose fabric textures that minimize either pressure drag or friction drag depending on the flow regime that exists on that body segment.

Mr. Willett mentions that traditional cycling wisdom believed that smooth suit materials were best for skin suits. This statement is generally true. However, in 1992, Len Brownlie showed in wind tunnel tests at the University of British Columbia, that a slightly rougher fabric was superior to traditional skin suit fabric for cycling. And, in 1996, as part of USA Cycling's Project 96, Chester Kyle and others showed in wind tunnel tests at the General Motors facility, that a rougher woven fabric was superior to smooth coated fabrics and stretch knit fabrics that we were testing at the time. The textured woven fabric was used in the USA team skin suits for the Atlanta Olympics. In both Brownlie's 1992 tests and in 1996, we used only a single material for the entire suit, whereas the Nike suit uses a zoned aerodynamic fabric design (this concept is patent pending).

By the way, in the 1996 Atlanta Olympics or in the later World Championships, all of the members of the USA cycling team set personal bests wearing the woven skin suit, and using the Project 96 aero Super Bike. One USA cyclist surpassed the Olympic 4000 meter record in the 1996 World Championships. All of the USA cyclists were amateurs in contrast to mostly professionals on other major teams.

Currently, as noted by Mr. Willett, the Nike Swift-Spin cycling suits incorporate design features which control the boundary layer through the careful placement of appropriate textured fabrics on zones of the shoulders, arms, torso and thighs. The combination of rough and smooth textures permits boundary layer control while minimizing both pressure and frictional drag. On some portions of the body, such as the hands and feet, where limb geometry precludes boundary layer control, a very smooth, coated fabric is utilized to reduce frictional drag.

To provide ventilation and cooling, panels of fine, breathable mesh have been placed in areas of separated flow, such as behind the upper arms and at the back of the neck. In addition, seam orientation has been engineered to minimize the number of seams crossing the airflow, with the majority of seams orientated parallel to the airflow.

In our wind tunnel tests, we found that loose clothing flutters and provides an inordinately high drag. As a result, our suit pattern is cut to fit a cyclist in the time trial position and is maximally stretched, wrinkle free and comfortable. For the US Postal Service team, suits were fit very carefully to ensure each rider's comfort.

Through the combination of these design features, the new Swift-Spin time trial suit provides over 200 gm less drag at 30 mph, than last year's suit. Mathematical modeling suggests a time saving of 79 seconds is possible in a 55 km time trial with the Swift-Spin suit. Lance Armstrong clearly didn't need this time savings to take his 4th Tour, but he and his USPS team may need it next year, as they attempt their 5th consecutive Tour de France victory.

Sincerely,

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to NIKE Inc.

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