

Reducing the aerodynamic drag of sports apparel: development of the Nike Swift sprint running and SwiftSkin speed skating suits

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ABSTRACT: This paper documents the development of aerodynamic apparel for sprint running and speed skating. **Methods:** Wind tunnel measurements of drag force (F_d) and air velocity (V) were made on cylinders, limb models, an articulated mannequin and a live sprinter clad in suits of one or more of 39 stretch fabrics. Non-dimensional drag coefficient (C_d) and Reynolds numbers (Re) were used to characterize the ability of the various assemblies and fabrics to generate flow transition (FT). FT defines a critical air velocity over the moving segments of the body at which the air flow changes from laminar to turbulent, resulting in a smaller wake behind the body segment and a corresponding decrease in F_d . Scale photographs of 15 elite sprinters and 16 speed skaters were measured by planimetry to determine mean body segment widths. Maximum segment velocities were determined by kinematic analysis of elite sprint and speed skating performances. To maximize FT on each body segment, fabrics were matched to Re values calculated from the body segment and velocity data. **Results:** Several fabrics were found to trigger FT on single cylinders, reducing cylinder C_d by up to 45%. At the maximum lower leg (ankle) velocity of a sprinter ($V=19.7 \text{ m}\cdot\text{s}^{-1}$), a leg model covered with the best-matched fabric reduced F_d by 20.2% (from 766 to 611 gm) and C_d by 40% (from 1.0 to 0.6), compared to a bare leg. On the basis of aerodynamic and ergonomic considerations, a zoned suit, composed of five different stretch fabrics (the "SWIFT" suit), was constructed and supplied to several national sprint teams at the 2000 Summer Olympics. Three gold or silver medallists wore the SWIFT suit. A similar speed skating suit reduced F_d by 10.1% and was worn by 16 of 30 long track speed skating medallists at the 2002 Winter Olympics, including 8 who set world records.

Reference:

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