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Fluid Mechanics of Cricket and Tennis Balls

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Aerodynamics plays a prominent role in defining the flight of a ball that is struck or thrown through the air in almost all ball sports. The main interest is in the fact that the ball can often deviate from its initial straight path, resulting in a curved, or sometimes an unpredictable, flight path. It is particularly fascinating that that not all the parameters that affect the flight of a ball are always under human influence. Lateral deflection in flight, commonly known as swing, swerve or curve, is well recognized in cricket and tennis. In tennis, the lateral deflection is produced by spinning the ball about an axis perpendicular to the line of flight, which gives rise to what is commonly known as the *Magnus effect.* It is now well recognized that the aerodynamics of sports balls are strongly dependent on the detailed development and behavior of the boundary layer on the ball's surface. A side force, which makes a ball curve through the air, can also be generated in the absence of the Magnus effect. In one of the cricket deliveries, the ball is released with the seam angled, which trips the laminar boundary layer into a turbulent state on that side. The turbulent boundary layer separates relatively late compared to the laminar layer on the other side, thereby creating a pressure difference and hence side force. The fluid mechanics of a cricket ball become very interesting at the higher Reynolds numbers and this will be discussed in detail. Of all the round sports balls, a tennis ball has the highest drag coefficient. This will be explained in terms of the contribution of the "fuzz" drag and how that changes with Reynolds number and ball surface wear. It is particularly fascinating that, purely through historical accidents, small disturbances on the ball surface, such as the stitching on cricket balls and the felt cover on tennis balls are all about the right size to affect boundary layer transition and development in the Reynolds numbers of interest. The fluid mechanics of cricket and tennis balls will be discussed in detail with the help of latest test data, analyses and video clips.