CAN YOU

# Believe it?

WITH ASSOCIATE PROFESSOR DEREK LEINWEBER

# Turbulent times

HAVE you seen the new ball approved for this year's World Cup? It's called the "Teamgeist", or Team Spirit, and represents a radical departure from the classic buckey-ball design.

Science has unlocked the physics secrets surrounding soccer-ball aerodynamics. And these findings are changing both soccer ball design and team tactics.

Gone are the traditional 20 hexagonal and 12 pentagonal pillowed panels. Gone are the coarsely stitched seams and their 60 vertices.

Gone are the days of water-saturated leather.

Gone are the black spots used by goalkeepers to perceive spin on the ball.

Instead, Adidas's Teamgeist gleams with smoothness. And it will still be gleaming as the teams leave the pitch.

It's manufactured to within 1 per cent of a perfect sphere, offering unprecedented accuracy in its motion. The ball is waterproof, scarcely gaining any weight, even in heavy rain.

The number of sections is reduced from 32 to 14. Fewer seam edges and corners and more roundness mean the ball will perform more uniformly. There is a better chance a kick will contact a smooth surface, increasing the player's chance of hitting the "sweet spot".

Constructed with materials designed to rebound faster, the ball will quickly return to its original round shape after deforming in a kick. This again ensures the predictability of its flight.

And while international authorities publish weight and dimensional tolerances for soccer balls, there are no specifications for the surface finish or manufacturing techniques.

It is the smoothness of the surface that will have a huge impact on the aerodynamics of the Teamgeist. Indeed, the scientific predictions for the motion of the Teamgeist reveal several surprises for unsuspecting goalkeepers.

The smoothness means the ball will experience very low drag when kicked hard and fast. Turbulent air flow will hug the ball, leaving only a small wake and relatively little drag.

Goalkeepers used to seeing the ball slow will be under the illusion that it is speeding up.

But they're in for another shock when the ball drops below the critical speed for turbulent flow. The flow will become smooth or laminar, separate early from the ball's surface and create a large wake and huge drag.

And the speed at which the airflow changes is higher, stressing the goalkeeper further.

Because the drag is so low for turbulent flow around the smooth ball, the increase in the drag is huge – almost four times as much. The ball will slow suddenly, surprising the goalkeeper.

This is the opposite to what Puma did with ball design a few years ago. Puma recognised the problems of the turbulent to laminar flow transition and developed a ball surface designed to delay this aerodynamic change. They argued the traditional ball encounters problems because of its round shape and smooth surface.

Puma's design incorporated small dimples on the surface inspired by golf-ball dynamics. The dimples trip the air flow into turbulence, delaying boundary layer separation and reducing drag at lower speeds. The dimples are complemented by deep seams that make the buckey-ball panels of the ball look like pillows, again tripping slower flows into turbulence.

But at high speeds the roughness of the ball deflects air flow. Anything disrupting the boundary layer tends to straighten the trajectory.

Thus while the dimpled soccer ball has less drag at low speeds, it also resists bending. And while most players will be grinning with anticipation, I suspect a few goalkeepers might be losing some sleep over the Teamgeist.

As Beckham says: "With this ball, you can put in perfect crosses for your forwards. And for me as free-kick specialist, it means I can curl the ball around the wall with amazing accuracy."


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