STANDARDS IN SPORT: SPEED SKATING

Speed skating teams are focused on February 2014's Winter Olympics in the Russian town of Sochi, with suit manufacturers hoping their latest developments will offer a less turbulent path towards the medal podium.



Blades of glory

US speed skater JR Celski was lucky to have escaped with his life when a collision in the build-up to the Vancouver Winter Olympics in 2010 left him bleeding profusely on the ice. His left thigh had been sliced to the bone by his right skate, requiring emergency surgery and 60 stitches to sew up three layers of muscle and outer skin. He was lucky—the gash had been a mere 1 inch from his femoral artery. "I am a little scared of racing," he said shortly afterwards. "It brings back memories, but it's nothing I can't handle." In what was described as one of the best comebacks in skating history, he stood on the podium with an Olympic bronze for the short track 1,500 metres a mere five months later.

This potential for serious injury informs the apparel and equipment rules laid down for the sport by the International Skating Union (ISU), the Switzerland-headquartered industry body. As with many sports, the apparel has undergone a number advances over the past 10 to 15 years, buoyed by funding from national associations, but at the forefront of the regulations are concerns over safety. Rules dictating that cut-resistant fabric must be used in specific sections of the suits that cover those areas which expose major arteries or are the most likely to bleed have been introduced following a number of nasty collisions.

"There is a minimum cut-proof level that covers behind the knees, on the inside of the arms and across the wrists, the armpits and around the groin," explains former British Olympic speed skater Tom Iveson, who runs an apparel and equipment retailer. "The suits will protect you to a minimum standard – it's the question of flexibility versus safety versus weight which is always a compromise for the fearless athlete who's got no objection to going out there in relatively little protection if it means they've got a slight advantage and a potential winning margin."

Two-time Olympic champion Charles Hamelin, wearing a suit developed by Apogee, will lead Canada's short-track speedskating team to the 2014 Sochi Winter Games.

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For short track, one of the few winter events where competitors race directly against each other rather than against the clock, skaters must have a skin suit, protective helmet, protective eye wear, shin pads, knee pads and neck guard. For long track, the helmet, shin pads, knee pads and neck guard are not required, as falls are less common on individual starts.

The ISU requires suits to have a cut-resistance equivalent to at least level two according to European standard EN 388:2003. Suits should be skin tight, with hoods to reduce air resistance. They must conform to the natural shape of the skater's body and insertions or attachments that create a different shape are not permitted. Cut-resistant protection can be integrated in the actual competition uniforms, or be worn as special underwear. Testing body SATRA has suggested the rules are extended by insisting cut resistance is measured both before and after the maximum number of cleaning cycles specified in the manufacturer's recommendations, as well as laying down suggestions for abrasion resistance, strength, dimensional change, breathability and ergonomics.

Games-driven advances

Alongside the introduction of the clap skate, which significantly boosted athletes' times when it was adopted in the mid-1990s, the one-piece skin suit has been the most important development. Since the first full body suits, designed by Swiss skater Franz Krienbühl, appeared in 1974, the focus has been on making them lighter, more flexible and more aerodynamic, as while 25% of a skater's energy is spent combatting the friction of the ice, the rest is spent overcoming air resistance. Early pioneers based suits on sharkskin-mimicking technologies, previously used for swim suits, or added zigzag stripes, thought to reduce drag.

Nike, Descente, Mizuno and Hunter brought out innovative suits in time for the 2002 Games in Salt Lake City. Nike launched the Swift Skin for the US, Dutch and Australian teams, using six fabrics to address specific aerodynamic properties of different body parts. Smooth surfaces were used on large, horizontal areas such as the torso, but on cylindrical body parts like arms and legs a textured surface was deemed more appropriate as it reduces pressure drag by reducing the wake. US-based 3M's Scotchlite reflective material, made with powder-like beads, was found to reduce friction by up to 55% and was used under the arm and on the inner thigh. For the gloves, Nike used 3M's Greptile gripping material comprised of thousands of microscopic 'fingers', which allowed for a better push-off and faster start.

Japanese group Descente clothed athletes from Canada, Spain and Switzerland in versions of its Vortex suits, which had raised rubber ridges to channel the airflow to reduce drag, in a similar manner to the dimples that break up turbulence as air flows around a golf ball.

At the Games' conclusion, Nike claimed the Swift Skin improved athletes' speed by more than 1%, an advantage of just over one second in a 1,500-metre race. Researchers from the University of Groningen in the Netherlands verified the claim, adding that the suit increased speed by up to 0.2-0.3 seconds per lap on a 400-metre oval – and Nike's Advanced Innovation Team has been working on modifications ever since.

For the 2006 Olympics in Turin, it had developed a suit with better aerodynamics and with an increased focus on thermoregulation, fit and freedom of movement. Based on testing 64 materials in the wind tunnel, Nike refabricated the Swift Skin using four new materials which offered lower drag. Whereas past efforts used unbreathable rubber-coated materials for the smooth sections, the updated suit used a high-stretch, high-recovery, highly breathable fabric. Improved textures using Nike Sphere thermal technology were incorporated in the forearm and lower leg areas. Seams were eliminated or relocated to already-turbulent body zones such as behind the arm, and the back of the legs. This time, national teams from The Netherlands, China, United States, Belgium, South Korea and Ukraine wore Nike. Again, performance benefits were claimed.



South Korea's Seung-Hi Park, sporting Nike at the 2010 ISU World Short Track Speed Skating Championships.

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Four years later, Swiss knitwear specialist Christian Eschler supplied high-tech fabrics to both Nike - for the US, Dutch and South Korean teams - and Descente, which kitted out Japanese and Canadian squads. Four Eschler fabrics were used in each suit, using durable and cut-resistant fabric in the critical zones specified by the ISU. Compression material on the thighs reduced muscle vibration and supported movement, while behind the knee and on the inner thigh, thin yet durable fabric was used. Mesh inserts improved moisture management and ventilation. Athletes from The Netherlands, Romania, Bulgaria and Italy wore Cutex cut-resistant apparel containing Coolmax freshFX to inhibit the growth of bacteria. The fabric was developed by German manufacturer Fuchshuber Techno-Tex.

Medal ambitions

With the 2014 Winter Olympics around the corner, manufacturers and designers are in their busiest periods. "Any of the associations with a new type of race suit won't have their athletes out in it yet because they wouldn't want it known that there are potential benefits out there," says Mr Iveson. "So you might find that some of them will only come to light one or two months before the Olympics as a bit of a testing ground; the testing will have been done mostly in training sessions."

One of the manufacturers that collaborates with the British team also works with its cycling team, as there are crossovers in terms of aerodynamics. "It's about looking at what's out there and choosing the best from available technologies, because you've got a couple of different approaches from a safety and a speed point of view, and then also looking at which advancements the British team could make themselves," explains Mr Iveson.

The Dutch team have gone a step further by printing the undersuit in their national colours so they can race wearing it as an oversuit. Produced by Swedish sports apparel brand Craft, it uses nylon and Dyneema, an ultra-strong polyethylene fibre. "The suits do look like they're in a thicker-gauge material than any of the pure Lycra suits," adds Mr Iveson. "It's purely a safety feature, but they've got the trade-off that it's not particularly aerodynamic."

The president and chief designer at Apogee, a 15-year-old Canadian company that began by making alpine jackets and pants, is working closely with Speed Skating Canada. "When we started with researcher Guy Larose and the National Research Council Canada we had a different approach towards laminated fabrics, we also presented another way to build the speed suits by eliminating some lines that were slowing the athlete down," says Stephane Roy.



Dutch speed skater Margot Boer in action at the 2013 ISU World Cup.
CRAFT

The collaboration has led to increasingly sophisticated designs, particularly in cut-resistant tricots, and the company has completely reviewed its programmes for both short and long track for the upcoming Games. "The wind tunnel testing was able to give several positive results from new fabrics and different assemblies that together reached higher levels of aerodynamic performance never equalled before. Our goal is to surpass ourselves in every aspect of production."

Apogee has good relationships with mills in Europe, which invest in R&D to help create faster suits. "Speed skating is not just a question of supplying the fastest fabrics but it is also about the fit and design for each athlete," adds Mr Roy. "Our relationship with the athletes is very important."

The Olympic torch began its 123-day journey at the start of October, weaving its way across 65,000km of Russian countryside towards Sochi in time for February's Games. While athletes are putting in the final months of training on the ice, designers and manufacturers will be adding their finishing touches to their most technically advanced suits in the hope that they can help to shave off precious milliseconds – as well as keep their owners safe.

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