

## STANDARDS IN SPORT: COMPETITION SKI SUITS

With strict guidelines set down by the International Ski Federation for the race suits worn by skiers in international competitions, textile and garment manufacturers tread a fine line between safety and speed to comply with the norms while addressing athletes' insatiable yearning for performance-enhancing materials.

# Safety versus speed

The International Ski Federation's (FIS) specifications for ski-suits and protections worn by athletes in competitions are extremely detailed. They include standards for the fabrics themselves, garment construction and sizing, down to seam allowance and zipper placement, to name but a few. Their intent is to ensure fairness and safety. However restrictive, they are revised in April of each year, at the close of the season, and this is what fuels constant research into new designs and materials.

The FIS keeps a close eye on race equipment, testing some 800 suits, including underwear, before each season. "On average, ten to 20 suits don't conform to the standards," says Sepp Gratzer, equipment controller in charge of Ski Jumping at the FIS. One of the key elements measured is the fabric's conformity to a certain degree of air permeability, which depends on the discipline. The unstretched fabric must show a medium air permeability of 30 litres per m<sup>2</sup>/second for alpine skiing, a threshold thought to reduce speed, and of 40 litres/m<sup>2</sup>/second for ski jumping; the higher air passage is said to increase athlete's sensations.

The professional ski suit business is a small world in which a few textile and garment manufacturers operate in close collaboration with national teams, sports federations and sponsors. Ski jumping standards are conceivably the strictest of all the ski disciplines. The rules for the fabric used in ski jumping suits are so precise that only two companies provide regulation fabric: Meiningen in Germany and Eschler in Switzerland. "The norms are so detailed there is no room for any kind of individual adaptation," says Peter Eschler, chief executive of the latter. On the upside, this situation guarantees little competition. "We control about 65% to 70% of the market in the special five-layer materials used to make ski jump suits."

One could argue that the FIS rules limit innovation. For instance, while seam-welding is spreading in commercial skiwear, seam-sealing is

not allowed in competition suits. In ski jumping, for instance, seam-taping is forbidden because the FIS rules specify that seam allowance must be 1.5 cm, from the beginning to the end of each seam. The FIS further stipulates that the thickness of the suit may not exceed 5.0 mm, nor be less than 4.0 mm, which also rules out welding. Then again, it is difficult to seam-seal a textile made of five different layers of materials.

Sizing is another feature that has made race suits manufacturers revert to traditional methods. The French national ski jump team has recently decided to improve the fit of its suits by switching from the usual S-M-L sizing system to made-to-measure suits that are assembled in an in-house sewing workshop and individually tested in wind-tunnels. "It takes four to five hours to make each suit, and requires special sewing machines due to the fabric's thickness," says Nicolas Michaud, in charge of Nordic ski at the French Ski Federation.

The Jonathan & Fletcher design bureau, based in Annecy, France, is one of the few companies to make competition ski suits and works for many of the top-level national ski teams, including Sweden, Finland, Norway, Germany, France, Slovenia, Bulgaria and China. George Pessey, head of the company, is proud to export his goods to China. The design bureau makes the suits from start to finish and is equipped with a porosimeter to test them. Once measured and certified, each racing suit is fitted with a metallic tag.

Recent evolutions in lamination techniques have made it easier to treat small quantities of fabrics, says George Pessey, opening up possibilities to experiment with different types of face fabrics. His company has been testing different knit-textures in wind-tunnels to determine if they can improve a skier's aerodynamics. Dotted, ribbed or striated surface effects could modify air drag. "We have found that a knit fabric with a pocked, golf-ball-like texture shows reduced drag in speeds of 0

*The Swiss ski jumper Simon Ammann. FIS rules for ski jumping suits specify that the fabric is made of five separate layers of materials. The outer fabric, foam, elastic membrane, foam and lining fabric are laminated together in four separate acts. The outer fabric for the ski jump laminate is a bi-elastic warp-knit fabric, called charmeuse, produced on a two-thread system warp-knitting machine. Air permeability, of 40 l/m<sup>2</sup>/sec, is obtained by perforation.*

*Tyler Olson/Shutterstock.com*



to 80 km per hour, but increased drag over 80 kph," says George Pessey. In the fastest alpine disciplines, such as super-giant slalom and downhill, skiers often reach speeds of 100 km/h and exceed 140 km/h in downhill, considered the fastest race.

As one of the leading suppliers of regulation fabrics, Eschler has developed many of the textured knits tested by Jonathan & Fletcher. The suits of many national ski alpine teams and Nordic squads come from the Swiss company's factories. Regrettably, the company recently ceased fabric production in its two Swiss

factories, located in Bühler and Münchwilen, and shifted manufacturing to Balingen, Germany, and Thailand. The historic Bühler site has been turned into a technology and innovation centre. "The competition from Asia and pressure on margins, rendered even more critical with the strength of the Swiss Franc, made the move unavoidable. Now more than ever, we have to concentrate on niche markets in apparel and technical textiles," says Peter Eschler. The company's strategy is to build its credibility in elite sports fabrics, and transpose this know-how to other areas.

## Aerodynamics and protection

The race to shave off a few hundredths of a second has become a matter of fine-tuning the athlete's entire kit. Among the factors that influence aerodynamics, the skier's position is the most important, says Nicolas Coulmy, in charge of the scientific and athletic department of the French Ski Federation. Equipment (skis, shoes and helmet) and the fabric and cut of the suits come next in line. "In all cases, we seek to find the best combination of equipment for each athlete," he says. This implies finding the best combination of fabrics for outerwear and underwear, which both need to comply to the 30-litre limit, to improve overall aerodynamics.

Among these options, Eschler is currently working on padding built into the underwear layer, a compound currently forbidden. "If the research is validated, the FIS will change the rules," says Mr Eschler. The French national team skiers already wear padding for training sessions, says Nicolas Coulmy.

Dainese is working with the FIS on a protective airbag based on the company's airbag protection designed for motorcycling. The prototype recently presented combines electronics, the system's "brain" says Dainese, a set of sensors and a patented pneumatic vest. The system's performance depends on a sophisticated activation algorithm that analyses data provided by the sensors to decide when to inflate the airbag, which is said to open in 50 milliseconds, reaching maximum protection in 100 milliseconds. Distinguishing between conditions of incipient fall and normal use is one of the main difficulties, says Dainese. Testing and fine-tuning are programmed to extend to the Olympic Games in Sochi, Russia, in 2014. Adding protective equipment or an airbag will modify the skier's shape, which means a new



*Croatian skier Ivica Kostelic wearing a suit made in a fabric by Eschler.*

Eschler

series of specifications for equipment suppliers.

Performance-enhancing underwear is another area of intense research and development. Jonathan & Fletcher has studied various types of compression underwear. "It's a complex issue because the effect of this type of garment depends on how each individual reacts to compression," says George Pessey. For Markus Lutz, a textile engineer in charge of the Elite Sports business unit at Eschler, compression apparel helps the athlete stay in an ideal position throughout the race.

A number of national teams are currently testing underwear made with a ceramic additive of the type developed by Eschler, Schoeller (energier) and HT Concept (Gold Reflect Line). The hypothesis is that the mineral alloy incorporated into the fabric, which is said to accelerate blood flow, will improve the athlete's energy and endurance. Two hundred skiers on the French national ski team are currently engaged in testing ceramic underwear. Two hundred underwear sets have been produced, 100 with the ceramic coating and 100 without. The French Ski Federation is specifically looking to draw the line between the material's possible placebo effect and actual performance. "Elite



*Dainese is currently testing an airbag made for professional skiers, in conjunction with the International Ski Federation.*

Dainese

## Ski and boarder cross: the elements of style

Ski cross and boardercross are fairly recent additions in competition snow sports and the regulations defined by the International Ski Federation (FIS) stipulate non close-fitting apparel in a move to make the athletes look more like “normal” skiers and boost the discipline’s popularity and overall appeal. The FIS has sought to avoid the situation that alpine and Nordic disciplines are in, specifically that the suits worn by professional skiers are far removed from what average skiers wear, or would want to wear. “Downhill skiing is comparable to Formula 1 racing; the equipment looks nothing like what is sold on the market, whereas ski cross resembles rally racing, which is based on a form of standard equipment. This gives the sport a more modern image because competitors wear apparel that is closer to what non professional skiers wear,” says Nicolas Coulmy, in charge of the scientific and athletic department of the French Ski Federation.

FIS regulations impose a specific looseness to the two-piece suits (measured and controlled), but this doesn’t stop the pros from trying to improve the garments’ aerodynamics. A tricky, but not impossible, goal to achieve. The French Ski Federation says it has found a material that keeps its shape during the race using a fabric that has shape-memory characteristics. 



 Lionel Calzi

skiers are known to try anything that can improve performance, concentration, endurance and so on. They also wear all those power bracelet type products that are not endorsed by any federation,” says Nicolas Coulmy.

## Rumour and ruse

Before each Olympiad, dozens of ‘magic’ energy-enhancing products and accessories are presented to athletes. “The placebo effect can have an influence on performance in the short term, but it is problematic in the long term if the athlete trains less and relies more on the often bogus accessory,” says Mr Coulmy.

Every year or so, a new controversy linked to non-regulation or “mysterious” equipment arises in elite skiing circles. In 2011, the Austrian national team’s whistling suits drew headlines. George Pessey suspects the shape of the back protection worn by the skiers had depressions that made the fabric vibrate and emit a high-pitched noise.

Plastified underwear is another subject of heated debate in professional ski spheres. They are forbidden by the FIS because they do not abide by the sacrosanct 30-litre rule. The issue arose earlier this year when a Slovenian skier, Tina Maze, who finished second in the Super G race at Cortina d’Ampezzo, was suspected of wearing non-standard underwear. Peter Eschler speculates that the fabric was plastified and perforated to meet the 30-litre limit. “The 30-litre air permeability threshold can be obtained through mechanical or physical means. If less air is trapped inside the suit, the skier will be faster,”

he says. The situation is similar to professional swimming and the controversy generated by the now banned polyurethane-coated swimsuits.

Nicolas Coulmy downplays the issue by pointing out that skin is naturally non-permeable to air. “I don’t believe it’s useful to add another airproof layer over the skin,” he says. These manoeuvres however can provide an athlete with a psychological edge, making rivals believe he or she has - finally, truly - discovered something new and improved.

## Safety issues

“Athletes tend to complain that regulations limit their performances,” says Peter Eschler. The FIS regulations are based on safety issues, and the federation is more than strict on these matters. In ski jumping, for example, specifications were recently modified to address a problem of anorexia. Apparently, once the athletes were weighed, they would stop eating to be as light as possible. One kilo of weight gain can reduce a jump’s length by two metres, indicates Nicolas Coulmy.

The FIS focuses on ways to reduce risk, most often speed, which is exactly the opposite of what professional skiers want. Athletes are constantly trying to find ways to increase performance without contravening the norm. This raises the question of fairness and ethics in competition skiing, and the option of making all skiers wear the same equipment. “Ideally,” says Nicolas Coulmy, “an athlete’s performance is due to his or her talent and training, not to some technological gimmick.” 