The Inflatable Suit That's Protecting Ski Racers in 90 MPH Crashes

BY JOE LINDSEY 02.06.15 | 5:01 PM | PERMALINK

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When ski racers glide away from the start house on the Birds of Prey Downhill World Cup at Beaver Creek, Colorado, they launch up to 200 feet off jumps and reach speeds close to 90 mph, all with just an open-face helmet, goggles and a semi-rigid back protector for safety.

But at this week's World Alpine Ski Championships, held on the same course, the pro racers competing for podium spots may get a little more help: a wearable airbag from motorsports company Dainese that inflates automatically in a crash.

The system, called the D-air Ski, is based on an existing airbag system Dainese developed for motorcycle racing. Ski racing's governing body, the International Ski Federation, approached Dainese in 2012 about adapting the suit for ski racing. The ski version covers a racer's torso and shoulders and uses an array of sensors to monitor velocity and position; it fully inflates in 100 milliseconds if it senses a crash.

After missing its initial approval target of last February's Sochi Olympics, the FIS gave it a thumbs-up on January 1. Racers from several countries, including the US Ski Team, will have access to it at the World Championships.

Alpine ski racers crash a lot; Dr. Tonje Wåle Florenes of the Oslo Sports Trauma Research Center has published several studies on crashes in World Cup racing, alpine skiing's top circuit. A 2010 paper in the Scandinavian Journal of Sports Medicine found that in a given season an alpine racer has a nearly 30 percent chance of being injured, often in crashes. One in ten injuries is serious enough to require more than a month of recovery.

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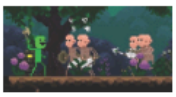
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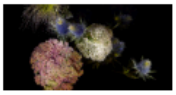
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The halting progress of safety "is one of the downfalls of our sport," says Bode Miller, the most successful male US ski racer ever and a three-time winner on the Birds of Prey course. "Many of the injuries that happen are preventable." The World Championships was Miller's first race of the season, after surgery to repair a herniated disc suffered in a crash last March. It may also have been the last of the 37-year-old's career; a crash in the Super-G event led to a severed right hamstring tendon; he won't race the downhill.

Birds of Prey isn't the longest downhill course on the World Cup circuit, but it is steep and unrelenting. "You're thinking, 'How am I going to pretty much fall down this mountain with as much speed as possible'?" says US racer Steve Nyman, twice a podium finisher here. "There are a lot of turns where you're half off the snow. You're flying through the air and have to make a quick landing and adjust to the terrain."

"ON A MOTORCYCLE THERE ARE A FEW FIXED ELEMENTS IN PLAY. IN SKIING THERE ARE MORE LIKE 30." —US SKI RACER BODE MILLER

When things go bad, they go bad quickly. In 2007, Norwegian great Aksel Lund Svindal was having the run of his life on Birds of Prey when a small compression right before the Golden Eagle jump sent him hurtling off the lip falling backward on his skis. He flew 200 feet before smashing back-first into the slope at more than 70 mph.

Svindal's list of injuries included several broken ribs, five facial fractures and a four-inch deep laceration in his left glute and groin. He spent three weeks in a hospital and didn't race again for almost a year.

Dainese's airbag isn't a panacea. And adapting it from the motorsports version was tricky. In both sports, the biggest issue was figuring out how to accurately predict crashes, but skiing is a challenge; a racer can be weightless because he's about to crash, or just going off a jump.

"On a motorcycle there are a few fixed elements in play," says Miller. "In skiing there are more like 30."

The D-air Ski has three gyroscopes, three accelerometers and a GPS unit. A replaceable cold-gas canister provides the near-instant inflation. A rechargeable lithium-ion battery powers the system. Except for the airbag itself, it's all tucked into a hardened pocket on the back protector.

There's even a USB port to download run data. Dainese spent two years collecting data from test runs, using skiers from the Canadian and Italian national teams.

That data let Dainese's engineers code an algorithm that can tell, based on a racer's acceleration and body position, whether he's about to crash or just at the bottom of a post-jump compression. The algorithm is smart enough that it won't inflate even in some crash situations, such as when a racer loses an edge and slides to a stop. "But if he starts to tumble," says Dainese product manager Giovanni Fogal, "the suit inflates." While car airbags deflate almost immediately, the D-air Ski stays inflated for up to 10 seconds, to protect the racer until he comes to a stop. Dainese says the system can absorb up to 60 percent of a crash impact.

Fogal said that Dainese worked to ensure the suit wouldn't affect aerodynamics, and that while they've never had a false positive inflation, the suit won't obstruct a racer if it did malfunction and inflate. To test that, Fogal said the company triggered inflations in some test runs to make sure the skier could remain in control.

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Since FIS only approved the suit on January 1, it's not widely adopted yet. And Dainese officials stress that it's completely up to the athletes to use in training and competition.

As it happens, the system deployed successfully this week in a training situation in Europe. Jan Farrell, a speed skier who's been clocked at more than 120 mph, was wearing the suit in a test run when he crashed at roughly 50 mph. "Before the first

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impact, I heard a boom and instantly felt how the airbag inflated," he said in a press statement. "It was like being inside a shell."

Even if it covered a racer's whole body, the suit couldn't protect against all injuries—Flørenes' research found that more than 80 percent of lower body injuries in racing occur independent of crashes, like when a racer catches a ski edge on the snow and tears a knee ligament. Miller wasn't wearing the D-air Ski when he clipped a gate in Thursday's men's Super G and crashed, but in any event it wouldn't protect against injuries like his severed tendon, which likely came when he landed heavily on one of his ski edges.

But the same research by Flørenes found that 96 percent of upper body injuries do occur in crashes. From the first successful test deployment of a D-Air suit in motorsports in 2006, it took three years they were widely used. They're now sold to the public. Miller, for one, thinks that the suit could be a catalyst for similar adoption.

"I've been around long enough that we didn't even wear helmets for some events," he says. "I've seen safety become more relevant, but companies haven't pounced on it." That could change now, he suspects.

"As soon as one company starts going beyond (the status quo), they take market share because they're the only ones doing what needs to be done. Everyone else is playing catch-up."

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