It's about the ice:
This team's focus on the details keeps bobsled racing competitive

Application Note

Testing Functions
Case Study

Tools: Fluke 50 Series II Contact Thermometers, Fluke 80PK-26 Tapered Temperature Probe and 80PK-27 Surface Temperature Probe

Operator: The maintenance crew and officials at Park City's Utah Olympic Park

Applications: Testing temperatures of air, track, and bobsled runners

Think your job demands strength, energy, and a meticulous concern for temperature? Try racing on a four-man bobsled.

Before the start there's a deceptive calm. You and three teammates slide your 210 kilogram (almost 500 pound) sled gently back and forth to keep the runners free on the ice. Then the starter gives the signal, and…it's all downhill from there.

You push with all you've got to get the heavy sled moving—races can be won or lost in the first few feet. Then scramble aboard to barrel down the eight-tenths of a mile course and careen around the 15 curves as the driver aims for the exact fastest line—not too high on the banking (that's the long way) and not too low (that costs momentum). Less than 60 seconds later the sled brakes to a halt in a cloud of ice shavings. Add up the time for this and other runs and you'll know which team has won.

From the starting line down the entire track, keeping the races fair and competitive is a team effort.

Racing rules are written to ensure races are won by strength and skill, and to rule out any advantage gained from weather or the environment. The rules of the international bobsleigh and tobogganing federation (FIBT) have been fine-tuned since the organization was formed in 1923. They govern sled design, the weight of the sleds and teams, and many other factors. Tracks should be 1,650 meters in length, with a downhill slope length of 1,200 meters. Sleds should achieve a minimum finishing speed of 80 kilometers per hour (50 mph). Turns can impose a centrifugal force of 4 G for three seconds and 5 G for two seconds, but not exceed 5 G.

Keeping track of the track

When racing bobsled, luge, or skeleton (a one-person sled on which the rider descends head-first), track condition is key. If a sled crashes and damages the track surface, and judges decide the damage might slow competitors, racing may be held up while track crews repair the ice.

Rose Blonigen and the maintenance crew at Park City's Utah Olympic Park, site of the 2002 Winter Olympics, are dedicated to maintaining ideal conditions for racers and trainees who flash down its $25 million race course at more than 60 miles (97 km) per hour. Ted Bartkoski and other officials focus on the all-important temperature of the track and race gear at the starting line.

Racing, or "sliding," starts in early November, after a week or so preparing the steel-reinforced concrete track by applying hundreds of layers of ice. The powerful track refrigeration system can chill nearly a mile of track to below freezing in just a few hours. "We start the cooling process a couple hours early and drop the temperature of the track," said Blonigen. "They'll go out and start making ice a couple hours after we drop the temperature."

Power in the plant

The power behind the operation is the refrigeration plant, located at the bottom of the track, which pumps 110,000 pounds (50,000 kg) of liquefied ammonia refrigerant up through 54 miles (87 km) of piping along the course. Powered by four massive Frick compressors, two driven by 500-hp motors, the plant can keep the track cooled to −26 °C (-14 °F), even in warm weather. The track surface is normally held slightly below freezing at about -6 °C (21 °F) because the ice becomes brittle at lower temperatures, and the sleds are more likely to chip it.

It takes five to seven days, working 24/7, to apply ice thick and smooth enough for a winter of sliding. The crews leapfrog each other down the track every 20 minutes, plugging hoses into 62 hydrants placed along the course and spraying the track with hundreds of layers of ice. "They'll start misting it like you'd mist a garden with a hose," said Blonigen. "They'll walk all the way down the track doing that, and when they get to the bottom they head back up to the top and do the same thing." It takes four days just to shape and hone the ice, using handheld shavers just four to six inches (10 to 15 cm) wide. "At the bottom of the track it could be anywhere from two to four inches (5 to 10 cm) on the floor," Blonigen said, "and then as it goes up into a curve or up on the short wall, it'll thin up to millimeters."

Adjusting to changes

"And then—hopefully," she laughed, "we just maintain it, depending on what the weather is like. The temperature in Utah can vary greatly."

It's a big job: a nine-person crew works every day to maintain the racing surface. Along the track are 59 permanent temperature probes that enable Blonigen to monitor and respond to ice temperature changes. More input comes directly from the track crews. "They call and tell me what they're seeing, and I try to help them through refrigeration." They might see frost, sweating, softening, and pooling, which is checked with a non-contact infrared thermometer. During competitions such temperature data is kept under wraps, and track temperature changes are minimized to ensure all competitors have an equal chance.

In humid conditions, excessively cold track temperatures can frost the track. Like rain on the track, that damages the racing surface. "Like your freezer in your home, that would all have to be scraped off by hand," Blonigen adds. "It's very tedious, and very hard work."

"Since it's obviously all outdoors, sun is our big problem," she said. "As the sun starts to rise and hit the track, we'll start dropping the temperature throughout the day. Then as the sun sinks behind the other ridge, we'll start backing things off and letting the track coast." The track also has a $1 million system of retractable shades that cut energy usage by 25 percent and reduce the need to clear the track of snow, which can slow the racers and damage the track surface.

This is how you do it:

As Ted Bartkoski demonstrates, temperature readings start by testing the reference runner at room temperature early in the day.

Next, check track ice and air temperature.

Then check the reference runner temperature outdoors.

Finally, after entering the data in the record book, post the temperatures for competing teams to see.

The challenge: "100 percent equal"

It's all part of the effort to maintain a track that fairly challenges all competitors. "In the competitions we try to be 100 percent equal," said Bartkoski. "We don't give any unfair advantage or disadvantage to anybody."

No detail is too small. Warm runners are faster, so the rules are written to keep temperatures among competing sleds essentially equal, to prevent runner temperature from influencing who wins.

When racers gather at Utah Olympic Park, the team will be there at the start with their Fluke tools, checking to make sure no racers gain from sled runners that are too warm.

Waiting for the start, sleds are stored upside down in the open, their runners exposed to the weather. Sun, clouds, wind, and air temperature all can affect runner temperature. Officials use Fluke contact thermometers to check the temperature of the runners before the race and compare it to a reference runner, set in the open at an angle like that of the sleds, that's been exposed in the competition environment for exactly one hour. Temperature is measured on the side of the runner in the middle of the supporting bracket. A competition cannot measure more than 4 °C warmer than the reference runner, or the racer will be disqualified.

"We check the ice temperature and post that on the board. We check the air temperature and post that, and we always check a reference runner," Bartkoski said. Runner, air, and ice temperatures are measured and posted at 60, 45, and 10 minutes before the race and every 15 minutes thereafter.

"Before they go down we do a reference check on the sleds themselves. If it's too warm, that will give the sliders an unfair advantage, because a warmer piece of steel will go down the track faster."

In addition to matching the reference runner, sled runners must be close to the temperature of the track ice. Certain weather conditions, such as direct sun, can cause the runners to become significantly warmer than the ice temperature. If that happens, race officials may order sleds placed on an "ice box" or pad of ice before racing to cool the runners. Temperature differences are so critical that some teams keep detailed records of temperature and other conditions for every run they make.

Once the sleds push off they have to contend with conditions that may change throughout the twists and turns of a concrete track nearly a mile long. The track crew stands ready to chill warm spots with blasts of CO_2, shave rough spots, or fill gouges to maintain optimum racing conditions.

For air, ice, and steel—one tool

To gather their measurements, whether they're checking air temperature, ice temperature, or the sled runners, the Park City team relies on Fluke 50 II and 52 II contact thermometers, equipped with Fluke 80PK-26 SureGrip™ Tapered Temperature Probes (type-K thermocouple with tapered tip for use in air, non-caustic gas and surface applications, with a measurement range of 140 to 816 °C). Before each race they match readings from two thermometers. The extra instrument is available for use by race teams that don't have their own.

A veteran official at Olympic events, Don Banford checks and records ice and air temperatures using the Fluke 52 Series II Contact Thermometer and 80PK-27 Surface Temperature Probe.

Using the Fluke 52 Series II Contact Thermometer and 80PK-27 Surface Temperature Probe, Sue Kapis measures the reference runner temperature.

Sled runner temperatures must closely match those of a standard reference runner.

Utah Olympic Park:
By the numbers

Track construction—cost and duration	$25 million, 30 months
Grand opening	January 25, 1997
Length and contour	1335 meters (8/10 of a mile); 15 curves
Vertical drop to finish; slope	103 m/340 ft (bobsled); 7.8 percent
Start houses	5 (bobsled start, skeleton start, men's start, women's start, and junior start)
Timing points	49
Time for one run (bobsled)	47 to 48 seconds
Top speed	80 mph
Cameras	24
Track lighting	297,000 watts
Fixed temperature sensors	59
Ammonia refrigerant	50,000 kg/110,000 lbs
Coolant piping	87 km/54 miles
Hydrants for icing the track	62
Retractable sun/snow shade	$1 million

"At the beginning of the race—it all depends on the day, how much snow we've had, my access to the track—I pick one spot where I take my temperature on the ice," Bartkoski said. "I try never to vary where I'm taking that temperature. Every 15 minutes, right here. To take air temperatures I go off to the side a little bit, raise my arm up in the air and wait for 15 to 20 seconds for everything to settle down. The Fluke stuff is very responsive," he added—readings reach equilibrium in five or six seconds.

It's easy enough to see the athletes working together for great results. Less visible are the other team players at the track, who create optimum race conditions—with camaraderie.

Very—and precisely—cool.

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