How Gore's research lab puts the world's most technical clothing to the test.

BY SCOTT YORKO

INSIDE THE TORTURE CHAMBER

PHOTOGRAPHY BY EMILIANO GRANADO

ABOVE: THE RAIN ROOM IS CAPABLE OF REPLICATING UP TO THREE INCHES OF PRECIPITATION PER HOUR. LEFT: RAY DAVIS IS IN CHARGE OF GORE'S TEST LABS.

INSIDE GORE'S ENVIRONMENTAL TESTING CHAMBER, THE AMBIENT AIR temperature is a balmy 95 degrees Fahrenheit. Huge lights on the 22-foot-high domed ceiling beat down. Near one of the treadmills, a tester named Walter is running in place. He's an integral part of the research team, who's there every day, helping scientists test new outdoor apparel. He's got sensors on his body measuring sweat rate, skin temperature, and range of motion. There are also hoses coming out of his eye sockets.

Walter, as you may have guessed, is not actually a human. He's a $400,000 mannequin, to be exact, with more than 100 sweating pores on his fiberglass and carbon fiber body. And he's just one of the high-tech tools in the fabric and manufacturing company's $5 million biophysics lab at their Elkton, Maryland, R&D facility.

Next to Walter a college student from nearby University of Delaware jogs on an inclined treadmill, wearing sunglasses and a lightweight wind shell. He's strapped with a heart rate monitor and has swallowed a thermometer the size of two Advil gel capsules that's measuring his core temperature and sending real-time readings to the lab's computers through a radio signal. Gore's lab technicians will use this and other data to develop some of the most technologically advanced outdoor apparel on the market.

The company has been innovating like this since the 1950s, and is best known for its namesake fabric, Gore-Tex, invented accidentally in 1969 by Bob Gore, the son of the company's founder, when he discovered that stretching a piece of polytetrafluoroethylene created tiny air pockets in the material. The resulting breathable waterproof textile went on to transform the outerwear industry. And it's in this lab that the company builds on that legacy, testing fabric innovations for apparel used in industrial and recreational settings—like fighting fires, cleaning up chemical spills, running through the desert, or riding a bike in the rain. The process involves highly proprietary systems and methodology, many details of which the company won't divulge. But we got a peek behind the curtain to see how Gore puts its apparel to the test.

PUSHING THE BOUNDARIES OF COMFORT

"My job is to make sure no one is ever truly comfortable," says 40-year-old Ray Davis, the Comfort Technician in charge of the test lab. When it comes to developing outdoor gear, he regularly pushes testers close to their physical limits.

In fact, the Environmental Chamber where Walter and his human counterpart are running is capable of replicating 85 percent of the earth's weather. The lights on the ceiling can mimic a full solar cycle from sunrise to sunset, while humidity can go from 5 to 98 percent. Wondering how a garment will fare in the rainforest in peak rainy season? The chamber can show you. How about in the solar radiation reflecting off snow on Mt. Everest? Just let Davis crank up the 72 lights overhead. It only takes two hours to go between its maximum and minimum temperatures—122°F to –58°F (wind chill –85°F) in full blizzard conditions—although it uses about two thirds of the entire building's power capacity to make this drastic temperature change.

Perhaps the most surprising aspect of the lab is that it tests for something we only notice the absence of. "The body doesn't know when it's comfortable," Davis says. "It only knows when it's uncomfortable. We don't even have the ability to sense when we're wet—we just notice the loss of heat."

The best outdoor gear is actually the stuff you don't even think about while you're wearing it. That's why input from both Walter and human test subjects is so important. "Mannequins give more reliable info than human subjects," Davis says. But feedback on how things feel is important, too. "We might have the most waterproof and durable garment in the world," Davis says. "But if it feels like sandpaper, you're not going to want to wear it again."

9,000,000,000
Pores per square inch in a Gore-Tex membrane

6
Number of rain rooms Gore has in Maryland, Germany, the United Kingdom, and China

72
Number of overhead lights in the Environmental Chamber

$7,200
Cost of each Environmental Chamber light

-85°F
Lowest wind chill temperature replicated in the Environmental Chamber

2
Hours it takes to go from –55°F to 122°F in the Environmental Chamber

$400,000
Cost of Walter the apparel-testing mannequin

138
Number of washing machines testing fabric durability

500-1,500
Hours a garment fabric will spend in a washing machine

$76
Cost of a single-use Core Temperature Pill

700
Number of water vapor molecules that could fit inside a single Gore-Tex membrane pore

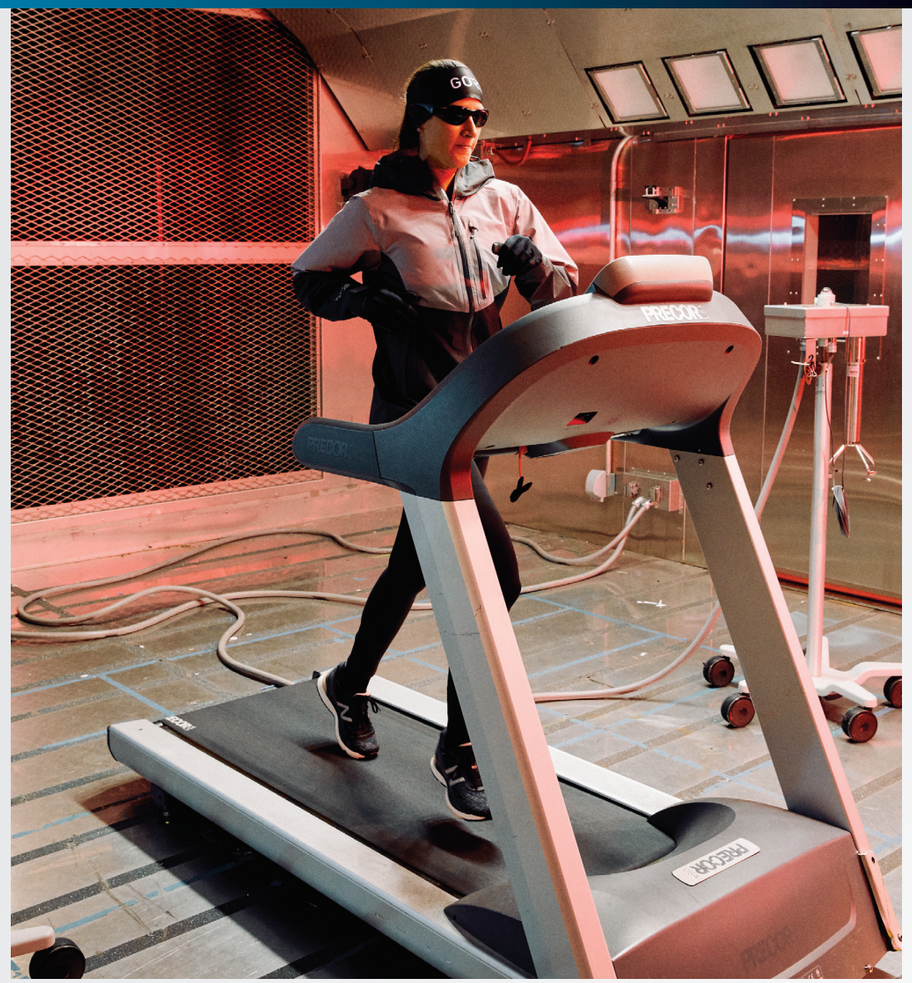
$5,000,000+
Cost of the entire Biophysics Lab

TURNS OUT, DRYNESS INVOLVES A LOT OF WATER

If you're wondering how Gore-Tex keeps rain from getting into a jacket while also allowing moisture to escape, it has to do with the fabric's pore sizes—they're large enough to let heat and water vapor out but small enough to keep external moisture, like raindrops and snow, from getting in. "If a water vapor molecule is the size of a soccer ball," Davis says, "the pores are the size of a soccer stadium, and a raindrop is the size of the earth."

Inside the wind-driven Rain Tower, Gore's lab techs run garments through a series of tests that determine how much water they keep out as well as how much vapor they allow (or don't allow) to evaporate. When a piece of apparel holds moisture, it has what's known as evaporative resistance, and it's one of the most significant readings the lab measures. The more water vapor that stays inside a jacket from sweat and other moisture, the clammier you'll feel. So, the lower the evaporative resistance of the test subjects' garments—meaning, the more vapor they allow to get out—the more breathable they will be and the longer it will take subjects to overheat.

"Nothing goes to market until it passes the rain test," Davis says, walking through the Rain Tower. With six different overhead water nozzles positioned 30 feet high, this approximately 10x10-foot glass and stainless steel room is capable of replicating any rainfall on earth that occurs between 40°F and 80°F at up to three inches per hour, from a light mist to peak Hurricane Florence making landfall in 2018.



GORE'S ENVIRONMENTAL CHAMBER CAN MIMIC 85 PERCENT OF THE EARTH'S WEATHER CONDITIONS.

Davis can even bend the direction of the water to simulate rain in wind speeds up to five meters per second. In the rain test, both human subjects and mannequins wear a gray cotton T-shirt or long johns beneath rain garments while walking or standing in simulated downpours. The amount of visible moisture on the undergarments indicates not just the membrane's effectiveness in sealing out water, but also how seam tape, pockets, zippers, and design all work to keep water out. To simulate extreme conditions like open-water sailing and riding a motorcycle in driving rain, there's an additional rain room in which technicians can set up a horizontal spray that douses test subjects head-on with the equivalent of up to 22 inches of rainfall per hour while they ride a stationary bike.

The floor of the Rain Tower is dotted with several drains and measured into 25 square sections that all receive different rainfall velocities and raindrop sizes—values that Davis mapped out with a laser disdrometer. ("That's two months of my life I'll never get back," he says.)

DURABILITY EQUALS COMFORT

When you have to worry about whether your paper-thin outerwear layer will rip on a tree branch or wear out in the wash, you'll feel distracted wearing it—not to mention uncomfortable, should a tear in your shell let in rain. Durability is an underappreciated factor of comfort, Davis says. And that's where Gore's Wash Machine Area comes into play. On a large factory floor, 138 standard washing machines are rumbling like the engine bay of a transatlantic cargo ship.

This is where Gore simulates the real-life wear and tear that its performance garments go through in everyday use. None of the machines have lids or use detergent, and they're all modified to run the agitate cycle in eight-hour intervals, which is tracked by a computer for each machine and piece of material. Only fabric—no actual garments—goes into these machines because buttons, zippers, and other features can damage the equipment over time. Fabrics go through various tests in other parts of the lab, then get washed in the machines in tap water for 500 to 1,500 hours and, if they're not frayed or worn out by then, go back through the original tests again. Gore has 40 years' worth of data using this method to compare with the results of newly developed fabrics.

Balancing all the factors that make outdoor apparel more effective and comfortable is a tricky proposition—but one that Davis enjoys. "When I see a large performance difference in one of our new products, that's when we really start to get excited and nerd out." And the more that Davis and his colleagues nerd out, the better the technology gets.

FABRICS GET WASHED IN TAP WATER FOR 500 TO 1,500 HOURS TO TEST DURABILITY.

And so the washers spin. Down the hall, Walter runs on his treadmill. The lights in the Environmental Chamber pump up the temperature for another round of tests. The data keeps pouring in. Together, these unique testing facilities work to push fabrics to their limits, and help scientists find out what makes even better outdoor apparel. Because the more that Gore understands what makes us wet and cold and uncomfortable, the more we can forget about what we're wearing—and the more we can accomplish. PM