



# AERO IS EVERYTHING

The wind. Sometimes it's your friend; other times nothing would give it greater pleasure than to push you and your bike into a ditch. You might not know what to do about that, but that's OK. We do. Our team of aerodynamic experts are bona-fide wind tricksters, wielding the tools of their trade—Computational Fluid Dynamics (CFD), on-bike Data Acquisition (DAQ), and wind tunnel testing—with authority. They want nothing more than to push the wind right back, to harness its power and turn it into your best time ever.

This is the science of air manipulation, and it affects everything. The bike you ride, the gear you wear, and even your position as you ride. Drag is the single biggest force affecting a cyclist, and since the only way to turn it off is to stop moving completely, eliminating every bit of it is critically important. In fact, it's so important to us we've taken the next step in the evolution of our aerodynamics program.

## WE'VE BUILT A WIND TUNNEL.

Why? Because now our team controls everything. By bringing all aspects of the aerodynamics process in-house—the CFD, on-bike DAQ, and now the wind tunnel as the final piece of that puzzle—we're empowering our team to drive aero forward, in new and innovative directions.

Aero is everything. And because of that, it's everything to us.



# LOOKING BACK



MARCH 2012 • The S-Works + McLaren TT helmet, getting prepped for testing

1989 • Mike Simyard and the revolutionary Tri-Spoke wheel

HOW GOOD IS A BROTHER BIKER? F.I. CAN'T HANDLE A...  
LATE 80's • Specialized's first aero ad appeared

2012 • Holy Shiv! Craig Alexander shaves 15 minutes off his best ever bike leg and sets the course record at Ironman Worlds

JAN 2013 • Construction underway at the Specialized Wind Tunnel

2013 • Athlete DAQ testing. Christ Van Dijk, Specialized + lululemon in Montecatini, Italy

2010 • The first Shiv enters the fray

# THE "A" TEAM



FROM LEFT • Chris Yu, Mark Cote, Chuck Teixeira, Chris D'Aluisio

**HERE'S THE THING:** You can have access to all the aerodynamic technology in the world but the data and testing is only as good as the people who interpret and apply it. Our aero team has worked with some of the most experienced names in the aerospace and tech industry, and is a true aerodynamic tour-de-force. Their pedigree, history, experience, and expertise are second to none.

Between them, Chris Yu, Mark Cote, Chris D'Aluisio, and Chuck Teixeira have 50 years of aero experience, with over 20,000 hours in wind tunnels. Their presence at Specialized is unique, and a key component in continuing to move the science forward for us in incredibly innovative ways. They think it, they build it, they test it, and they make it better. The smartest people in one place, with the passion, insight and vision to vanquish every ounce of drag out there. We'd be lucky not to give them access to everything they need to give riders free speed.

**CHRIS YU** • With a Master's degree from Stanford already under his belt, Specialized Aerodynamicist Chris Yu is currently a Doctoral candidate in High Fidelity Flow Simulation. But he's not just a computer geek. Chris has also been involved in several wind tunnel studies of high performance aerodynamics in the past, and with just under two years at Specialized has played a starring role in some of our most innovative aero products to date, with the S-Works + McLaren TT helmet as a prime example. He's particularly interested in applying real science to the process, ensuring no watt is wasted with gimmicky, non-validated, aero-tinsel on products. Or to put it another way — he's all about providing riders with working watts, not style watts.

**MARK COTE** • Having spent four years running the wind tunnel at MIT as an undergrad, Mark graduated with a degree in Mechanical Engineering, and proceeded to spend countless hours in seven other facilities after. Affectionately called "The Aero Pharaoh" by those trying to get him to bite, the name is actually quite fitting. The energy, dedication and expertise he puts towards refining and making products better, plus his focus on turning Specialized's aerodynamic programme into an industry leader, could generate enough watts to build a pyramid. Although, knowing Cote, he'd test that structure in the wind tunnel to see if that really was the most efficient shape.

**CHUCK TEIXEIRA** • People throw the word "pioneer" around a lot these days, but you should know, Chuck T happens to be a guy who actually deserves the moniker. Working in advanced R&D here at Specialized, Chuck brings his long history of wind tunnel development to the table—he was one of the first to be part of wind tunnel testing in the 1980s and is an industry leader, particularly in the field of aero wheel development. He's also built more bikes than you'll ever dream of owning.

**CHRIS D'ALUISIO** • That Shiv you're riding, the Venge you see Cavendish crushing on? They exist because of the vision of D'Aluisio. He's been developing aero bikes since early 2000, starting with the E5, moving through the Transition, Shiv and Shiv TT, Venge, and who knows what the future will bring? Chris is a direct connection between our R&D team and road athletes like Tony Martin, and works closely with them to ensure they're getting as much free speed from their bikes and equipment as they can. For Chris, aerodynamics is the art of balance: minimize drag without sacrificing critical attributes of the ride, such as stiffness and control.



# TEAM + TOOLS

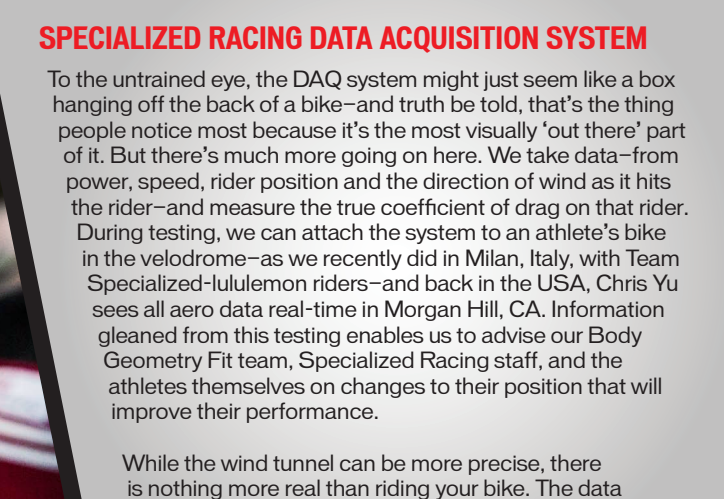
When we look in the aero toolbox—the one our team has complete, unfettered access to, right here in Morgan Hill—we see three tools of the trade. CFD, on-bike DAQ, and the wind tunnel. To put it simply, these are the instruments and systems used to collect data, crunch numbers, test theories, and take some very sensitive measurements.

But it's not the tools themselves that are the news, as most bike companies have access, and may have one of these tools in-house. No, the news is that ALL three are within reach of our team. And because they're in-house, we control the entire process: the hardware, the software, the whole shebang. We're the first cycling brand to do this.

While the wind tunnel may seem the biggest of these due to its sheer physical footprint, it's important to recognize the role and importance each of these tools play in defining, developing, and innovating our bikes and equipment, now and in the future.

## COMPUTATIONAL FLUID DYNAMICS (CFD)

CFD is a true, virtual playground and encompasses all the juicy stuff—physics, mathematics, engineering, and computer science. It allows aerodynamicists like Chris Yu to play in virtual space with a range of shapes and surfaces, and then simulate the flow of various fluids across those shapes to test their aerodynamic performance. CFD allows you to see, through simulation, things you can't see in the real world, like tiny 'bits' of drag on a frame. It's an extremely handy way of predicting aero behaviors, discarding designs that are total duds before prototyping, or modifying shapes that have already seen time in the wind tunnel.



## SPECIALIZED RACING DATA ACQUISITION SYSTEM

To the untrained eye, the DAQ system might just seem like a box hanging off the back of a bike—and truth be told, that's the thing people notice most because it's the most visually 'out there' part of it. But there's much more going on here. We take data—power, speed, rider position and the direction of wind as it hits the rider—and measure the true coefficient of drag on that rider. During testing, we can attach the system to an athlete's bike in the velodrome—as we recently did in Milan, Italy—with Team Specialized-lululemon riders—and back in the USA, Chris Yu sees all aero data real-time in Morgan Hill, CA. Information gleaned from this testing enables us to advise our Body Geometry Fit team, Specialized Racing staff, and the athletes themselves on changes to their position that will improve their performance.

While the wind tunnel can be more precise, there is nothing more real than riding your bike. The data collected while riding in the velodrome or outside allows us to measure actual wind conditions and rider movements. This is as real as testing gets, but we need our other tools to measure the small aero differences.

## THE WIND TUNNEL

If anything proves we're serious about delivering the most aerodynamic advantage to riders, it's the giant wind tunnel in our backyard. OK, we can't deny that it's pretty cool to say 'we built our own wind tunnel' but the benefits of having this facility right here in Morgan Hill are more than being able to say we have one.

Again, we control the software and hardware. We can test, tweak, and re-test products and equipment in-house; we can make our riders and athletes faster, and not just through fit and analysis, but by teaching them to ride faster on specific courses; and we can use it as a teaching tool at SBCU to better educate our dealers and fitters to the importance of aero.

We needed a tool. We built it. And it's an investment that will pay off in spades in the future. Here's why:



**BUILT FOR CYCLING** • Most wind tunnels are built for the motor or aerospace industry, and while we've always been able to adapt to these tunnels to run our tests, a bike is not a car. It's not the same shape, nor does it typically go the same speeds. We've designed and built our wind tunnel as we dreamed it—to be the perfect, cycling-specific wind tunnel. It's optimized for humans, not cars, so we can test with more accurate and precise conditions that are more representative of bike speed. And not just for one bike at a time, either. The size of the tunnel means we can test multiple riders at once, determining how different crosswind angles affect those riding in a group. Since it will also be used as an educational facility, there's room for our SBCU classes to observe testing in progress and learn. To put it bluntly, it's also a nice place to hang out when testing. When pro athletes come in, we can be comfortable and professional, and get the best experience for everyone.

**CURIOSITIES ARE ANSWERED EVERY NIGHT** • Dream it up one afternoon, test it the next. One of the biggest drawbacks to using third-party wind tunnels is one of time and convenience. With our own wind tunnel, there's no need to plan and book a week at a facility. No need to scramble to get the most value from a limited time, prioritizing what gets tested based on how many minutes we have left. With access 24/7, literally right across the parking lot, now we can test things we wouldn't normally have time to test in an outside facility. Now someone like Chuck can come up with an idea on Monday morning, have it CAD'd by the lunch ride, rapid prototyped by Tuesday, tested in the tunnel that afternoon to see if it's valid, and then have a working prototype done by the Wednesday lunch ride.

**THE THIRD PIECE OF A COMPLEX PUZZLE** • Apart from being the most advanced, sports-specific aero facility in the world, our wind tunnel incorporates data from CFD and on-bike DAQ to simulate and repeatedly produce wind conditions consistent with the real world. The result? Three tools utilized in a constant cycle of testing, re-testing and perfecting, with an exceptional team to control them all.

**AERO IS EVERYTHING (AND EVERYTHING CAN BE AERO)** • A big part of product development can be aided with proper wind tunnel testing. And not just bikes. We'll now have the freedom to test everything we make—from a commuting helmet, to apparel, and everything in between—and deep-dive into every aspect of rider position from competitive racers to every-day commuters.



# LAST WORD ON AERO

It bears repeating—**AERO IS EVERYTHING**. Since it touches everything to do with our company, we are focused on aero just as much as we focus on a frame's stiffness, weight, or any other aspect of physics as we relate to our bikes and equipment.

The approach is not just the team. Nor is it just CFD. It's not holing up in a wind tunnel for weeks, or strapping out on cyclists and getting them to ride out in the real world and seeing what results we get. It's all these things, working together. A continuous loop of development across all product groups, equipment and bikes, and including rider position, paired with an infrastructure that ensures the best process and application of the study of these things.

At the end of the day, it's about the rider, and with continuous innovation in aerodynamics, that rider is only going to get faster.



#AEROISEVERYTHING