THE ALL-NEW TARMAC SL9

One Bike to Rule Them All

For nearly half a century, Specialized has pursued one goal: helping riders cross the finsh line first. Every generation of Tarmac has been shaped by this belief, refined through racing at the highest level and relentless engineering.

With Tarmac SL9, the definition of speed evolves. Rather than chasing individual performance metrics, speed is deliberately defined as an outcome. The only outcome that matters in racing is Time to Finish.

Time to Finish is the measurable result of the Equation of Speed—a physics-based framework that converts rider power into elapsed race time by integrating aerodynamics, mass, rolling resistance, mechanical efficiency, rider position, terrain, wind, and fatigue. This white paper explains how that framework shaped SL9, and how it delivers the lowest real-world Time to Finish Specialized has ever engineered.

INTRODUCTION

Every Tarmac is developed with the same obsession: winning races.

Not in theory or in perfect conditions, but in the moments that actually decide outcomes. The moments when riders commit, and when they need to trust that their equipment will help them to cross the finish line first.

Modern road racing has become more demanding. Races are longer, speeds are higher, and margins are smaller. Riders constantly move between the bunch, breakaways, climbs, and finales, adapting to changing terrain, wind, and race dynamics. Performance is no longer defined by a single dominant attribute, but by how efficiently speed can be sustained across the full duration of a race.

Tarmac SL9 was developed inside this reality. Built from racing, tested with riders, and shaped by the conditions that decide World Tour outcomes. Rather than optimizing for isolated numbers, SL9 was engineered around a single question: how do we reduce total race time where it matters most?

Answering that question required redefining speed itself.

Demi Vollering - Ronde van Vlaanderen 2026

Remco Evenepoel - Amstel Gold 2026

Speed is More Than Aero

Aerodynamics has become shorthand for speed. Wind tunnel drag numbers and CdA charts dominate bike comparisons because they are easy to measure and rank. Specialized helped lead this evolution through significant investment in aerodynamic development, like the Win Tunnel built more than a decade ago, and by demonstrating the meaningful impact of drag reduction.

But shorthand is not the truth. A race bike is not ridden in a tunnel, and speed does not belong to the bike alone. It belongs to both the rider and the bike. Racing unfolds through changing speeds, shifting wind, evolving posture, and repeated transitions between climbing, sprinting, and sustained efforts. In this context, a single aerodynamic value describes only a single condition, not real-world performance.

Weight has not stopped mattering. Its effects are simply harder to summarize in a single number. Weight influences acceleration, climbing, and repeated changes in pace, shaping how quickly a rider can respond and how much energy those responses cost. Over the course of a race, those costs accumulate in the rider.

The same is true of ride quality. Comfort, control, and surface management determine how long a rider can sustain power and how precisely speed can be held. Fatigue alters posture. Posture alters aerodynamics. Control influences confidence, and confidence shapes decisions. These are system effects, not standalone features.

Speed, therefore, is not aero, weight, or stiffness in isolation. Speed is the result of multiple interacting variables over time. Speed is an outcome of the rider and bike operating as one system.

Speed as a System Outcome

In modern road racing, speed cannot be reduced to a single number. Aerodynamics, weight, stiffness, and ride quality are all measurable independently, yet none determines results on its own.

Races are won across defining moments. Moments where riders accelerate, climb or descend, commit to breakaways, or sprint under fatigue. Wind direction changes. Rider posture evolves. Equipment configuration shifts with race context. In this reality, speed is not a static metric.

Speed is an outcome.

The outcome that matters is Time to Finish.

Time to Finish captures how efficiently the rider-bike system converts power into forward progress across terrain, wind, and fatigue. It accounts for how small design decisions and marginal gains compound over the full distance of a race. This definition fundamentally reframes development. The objective is no longer to win isolated metrics, but to build the complete system that finishes sooner.

THE EQUATION OF SPEED IN PRACTICE

To quantify time to finish, Specialized uses the Equation of Speed as the governing framework for performance development.

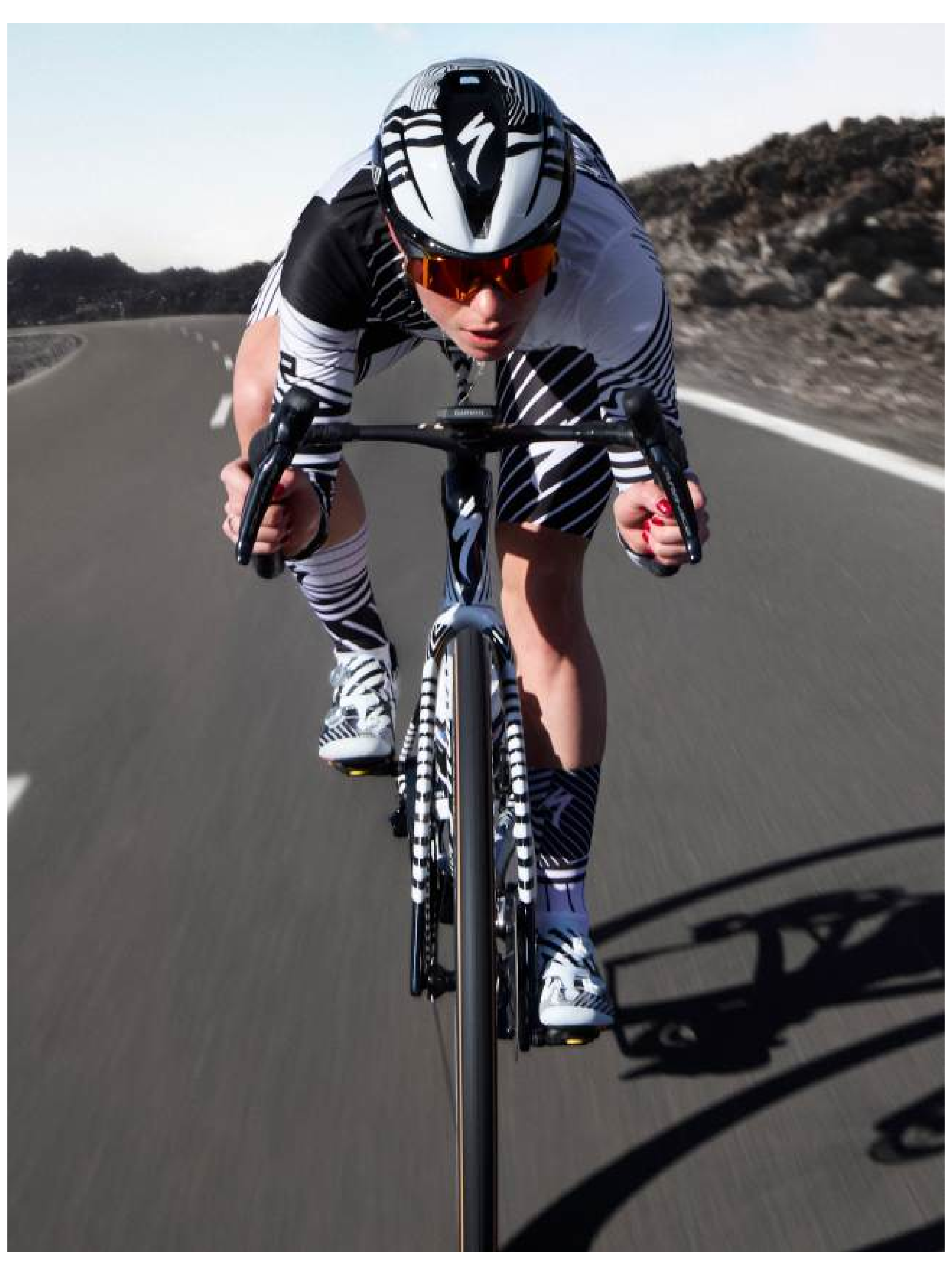
In its simplest form, it expresses one truth:

Rider + Bike + Route = Time to Finish

In practice, the equation integrates rider power and mass, bike mass, the aerodynamic drag of the rider and bike as one system, rolling resistance, drivetrain efficiency, terrain and slope distribution, and wind speed and direction. The output is singular and unambiguous: total elapsed time over a real course.

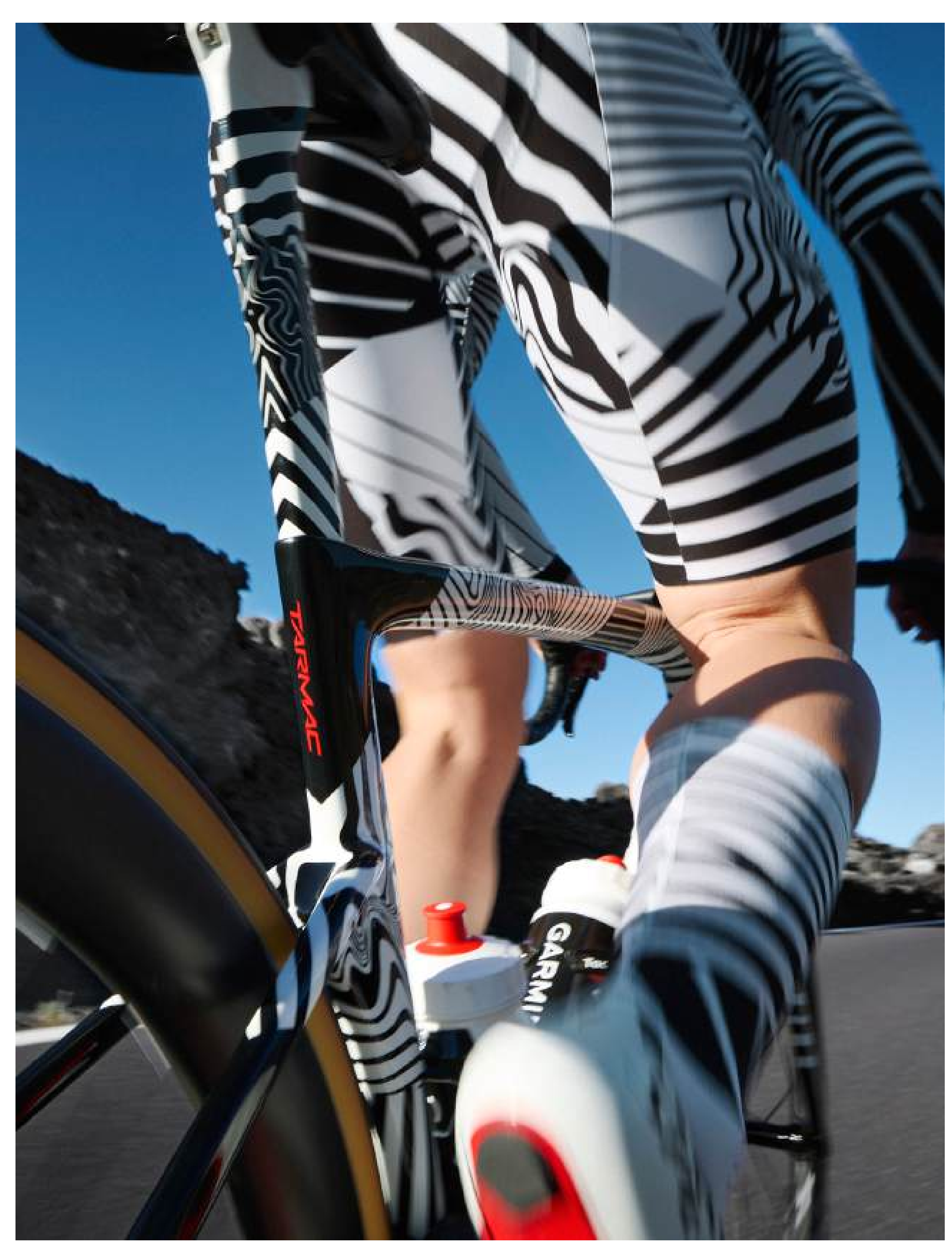
Within this framework, tunnel testing, CFD, and lab measurements remain essential, but their purpose changes. A gain only matters if it measurably reduces Time to Finish. If it does not, it is excluded.

This approach builds on previous Specialized platforms. Tarmac SL8 established a balanced integration of aerodynamics, weight, and ride quality. Aethos and Aethos 2 advanced workflow-driven optimization, treating structural efficiency and layup intent as true engineering levers. SL9 builds directly on this foundation while tightening the definition of speed to a single governing output.



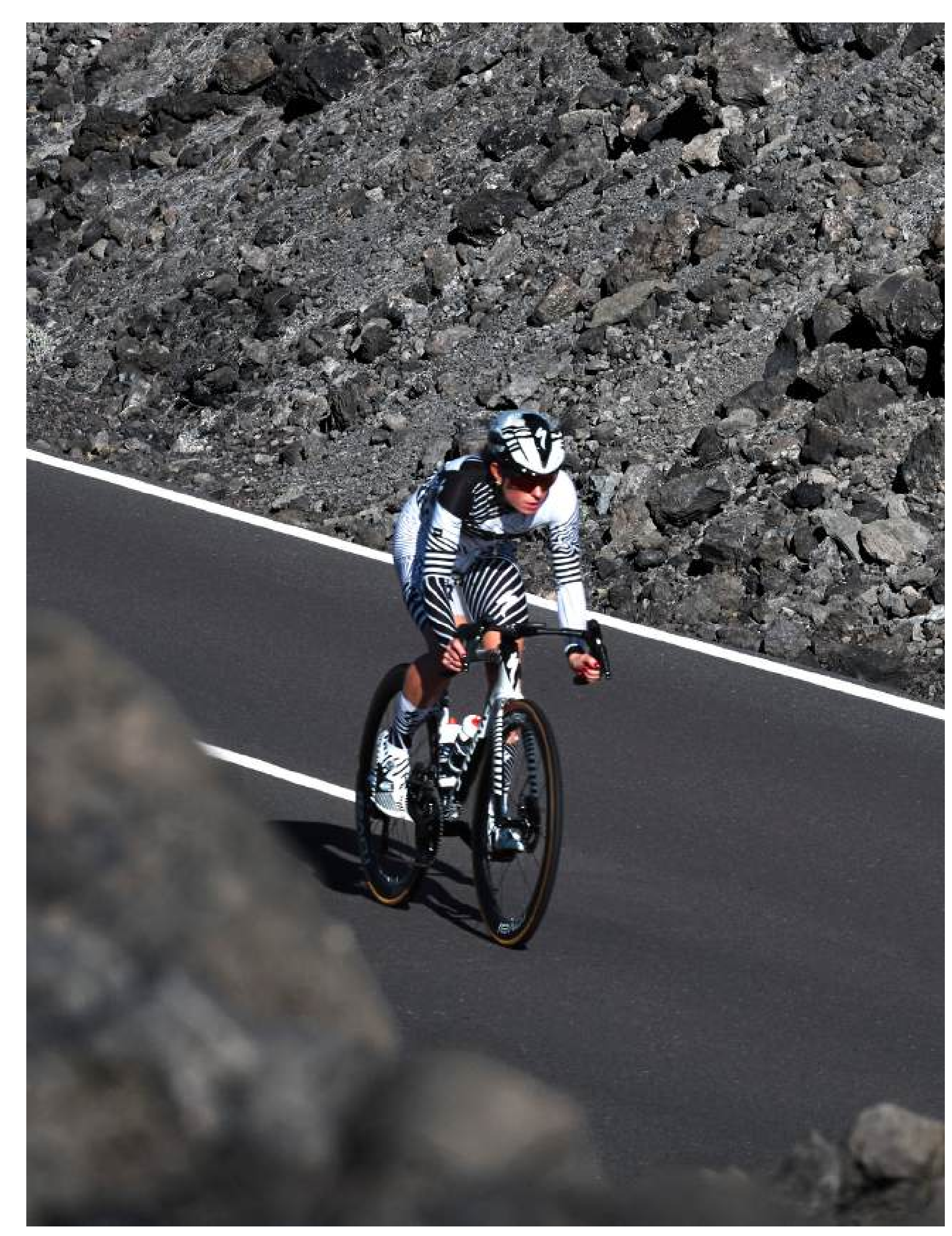
Rider

Power
Rider Mass
Rider CdA



Bike

Mechanical Efficiency
Rolling Resistance
System Mass
System CdA



Route

Gravity Acceleration
Ground Speed
Air Density
Wind Speed
Wind Angle
Surface Roughness

No race bike is ridden without a rider.

This single fact changes how aerodynamic performance must be understood. A frame, wheel, or cockpit that tests faster in isolation can produce a slower overall system once a rider is introduced, and vice versa.

As an example, the Roval Rapide CLX III wheels illustrate this clearly. The presence of a rider reshapes airflow across the entire system, reducing the relative importance of extreme rear wheel depth. As a result, a shallower rear profile can deliver a faster overall system when tested as part of a complete bike with a rider.

This is why aerodynamic gains are not additive. A faster bar, a faster wheel, and a faster frame do not automatically result in a faster bike once a rider is introduced.

MOVING LEG MANNEQUIN

If the rider and bike must be treated as a single system, rider motion must be included in the measurement. Static mannequins and bike-only protocols can be highly repeatable yet fundamentally wrong because they remove the most disruptive influence on airflow in real racing: pedaling.

To capture this, Specialized developed the Moving Leg Mannequin, integrating true pedaling motion into Win Tunnel testing and pairing it with pedaling CFD models to accelerate iteration. Introducing rider motion refined early predictions, revealing which gains remained meaningful under race-real conditions and which did not.

On the measurement side, repeatability must be balanced with relevance. Publications can achieve strong repeatability by simplifying the rider setup, yet those simplifications can amplify artificial differences between bikes. Other publications pursue realism with real riders, yet the error margin can exceed the differences they are trying to measure. Specialized addresses this by using a rider-inclusive mannequin in a tunnel environment designed for bike testing, paired with validation steps outside the tunnel.

The win tunnel itself exists for engineering development, not marketing output. Its dimensions keep blockage below five percent for most yaw angles, and turbulence intensity is set to 1.7 percent to reflect normal road-level wind conditions. Recent upgrades include improved positioning, improved repeatability across bike changes, and use of a strut system so the mannequin load is carried by the test structure rather than the bike. This reduces false drag differences caused by bike flexibility during testing.

What defines the most accurate bike-testing system ever made:

- Mannequin: Our mannequin is built from a scan of a real rider and can really pedal. It's as close as you can get to a real rider with robotic repeatability.
- Strut: The strut enables position to be fine-tuned and fully supports the mannequin without relying on the hands.
- If we support by hands every small change in bar width is a big change in drag.
- We want to measure bike drag, not rider drag from bar width.
- Laser Projector: A mm-accurate laser projector system is used to ensure that every time a bike is swapped, the mannequin is set up mm-accurate relative to each bike's bottom bracket.

"Our mannequin system's sixth generation was purpose-built using over a dozen years of experience Win Tunnel engineering to be the most precise, repeatable, and realistic way to test a bike, period. It is not just about having a realistic mannequin—it's about having an entire system built from the ground up to make sure every time we place a bike under the mannequin, the mannequin is in exactly the correct position and completely supported. If the mannequin's position is off by even half a centimeter, it can make a bigger drag difference than swapping the bike it's riding".

Lionello Bardina, R&D Engineer Aerodynamics

Wind Speed Conditions

Wind conditions used as design targets have a major influence on a bike's final shape. Among these, the wind distribution used to weight aerodynamic performance is particularly impactful. Designs that reduce frontal area and use slimmer tube sections deliver the greatest benefit at low wind angles, while deeper, heavier profiles can enhance sailing effects in strong crosswinds but offer limited advantage in near-frontal conditions.

Wind does not approach the rider from a single direction. Some wind angles occur far more frequently than others, which means aerodynamic performance must be evaluated not only by the wind angle itself but also by how often each condition is encountered in real riding.

This wind-angle distribution is primarily governed by two factors:

1. Rider speed: The target riding speed for which the bike is designed.

2. Average wind speed: Represents the typical wind intensity in the environments where races are held.

Higher riding speeds and lower wind intensity increase the likelihood of low wind-incidence angles, making an accurate definition of real-world wind conditions essential.

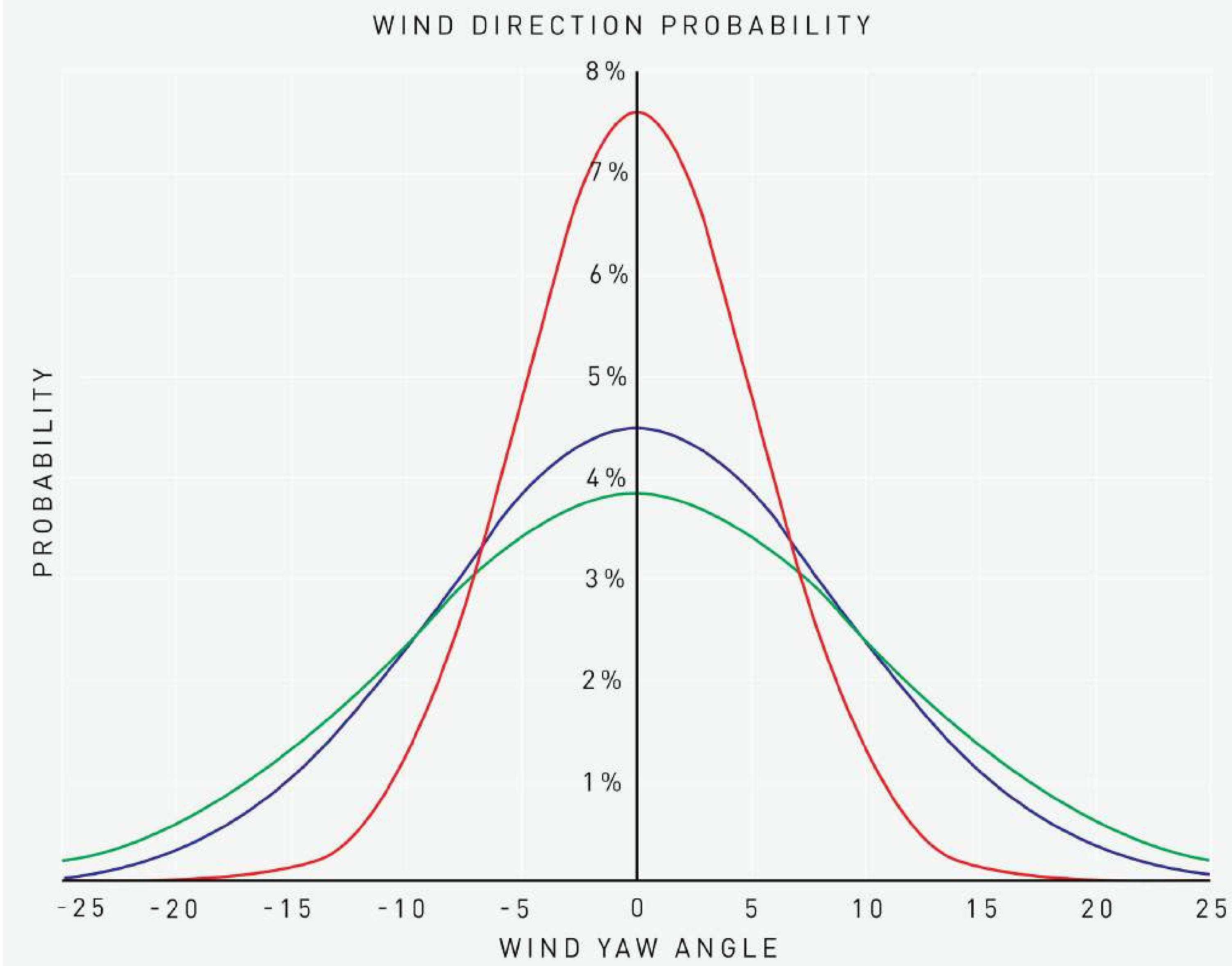
Since wind velocity decreases sharply near the ground, approaching zero at the surface, conditions must be characterized at approximately one meter above ground, where the rider and bike interact with the airflow. At Specialized, this is based on extensive real-world wind data, extrapolated to rider height to reflect actual race conditions.

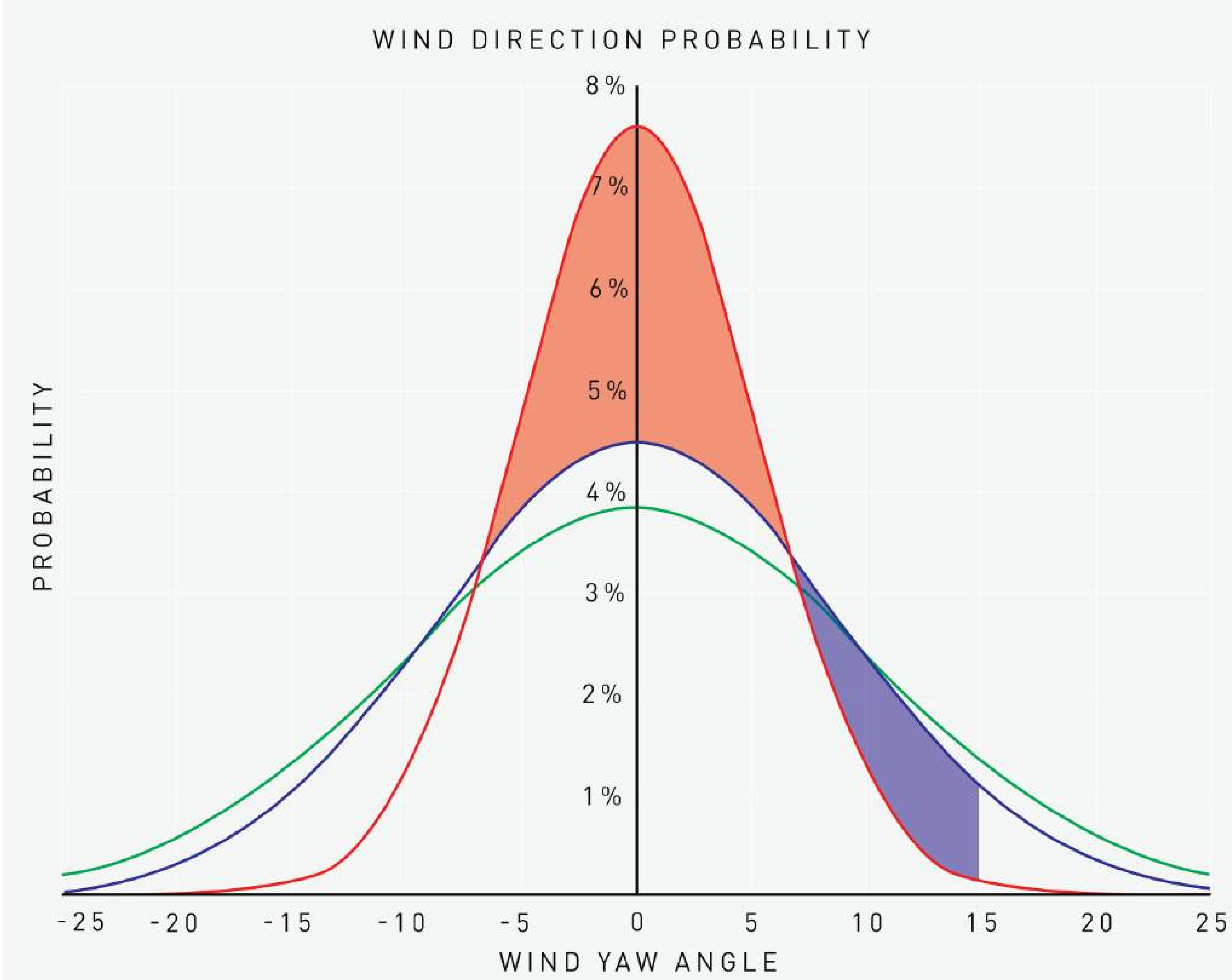
By contrast, some industry brands and media outlets use a three-meter reference height derived from SAE standards originally developed for truck testing, which does not accurately represent cycling conditions.

The results of this study are shown in the chart alongside the wind distributions commonly used in magazine reviews. As illustrated, different assumptions lead to fundamentally different weighting strategies, and the resulting bike rankings can change significantly depending on the chosen distribution.

Crucially, approximately 86% of real-world riding occurs within a limited range of yaw angles. Using a distribution based on real-world data, this range falls within roughly ±7°. In contrast, wider distributions often used in media testing extend this same range beyond ±15°.

This difference defines where performance is prioritized. Concentrating performance at lower yaw angles favors reduced frontal area and efficient rider-bike interaction, while broader distributions increase the apparent benefit of deeper, heavier profiles designed to maximize sailing effects.





- The red surface explains why Specialized focuses on improving the airflow at the intersection of the bike's legs. At low yaw angles, the amount of air that interacts between rider and bike is very high.

- The blue surface explains why others insist on using deep-section airfoils. The sailing effect of deep-section tubes trumps the benefits of a reduced frontal area and improved rider-bike interaction.

Aerodynamics and rider data alone are not enough to create the fastest bike for the fastest riders.

By studying riders in real races, we identified behaviors that fundamentally shift aerodynamic performance. One example is that riders in most breakaways carry only one bottle, not two. This significantly changes airflow around the seat tube and rear triangle compared to traditional setups that assume two bottles and two cages. We redesigned the entire rear of the bike around this real-race configuration. The result? Say hello to the Win Fin.

We also analyzed rider posture during high-speed breakaway situations, where aerodynamic efficiency has the greatest impact on winning outcomes. Our mannequin is now optimized to reflect these race-critical positions with greater accuracy, ensuring that every aerodynamic decision is shaped by how riders actually race, not how we assume they race.

This data feeds directly into our Time To Finish simulations.

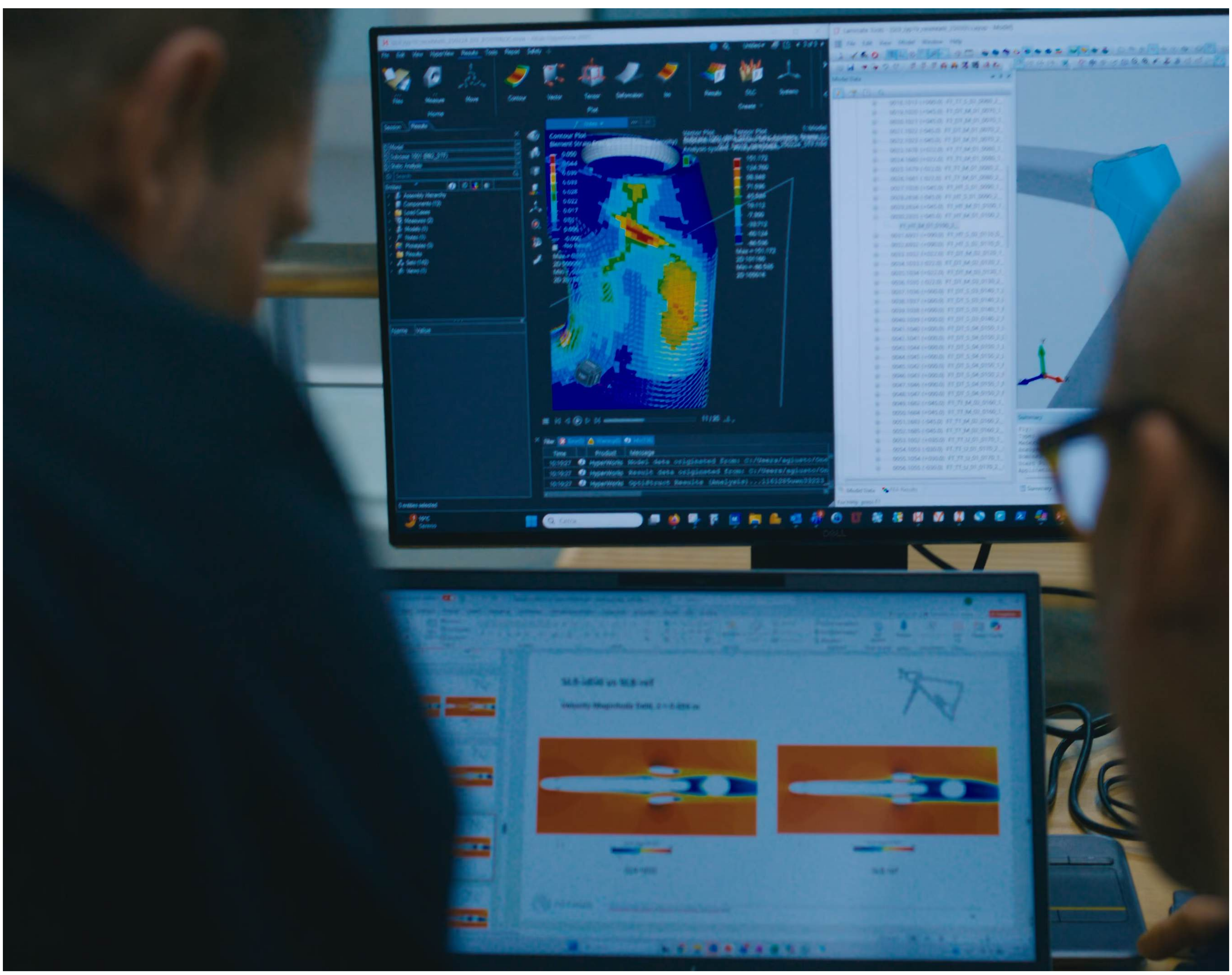
FLOW STATE DESIGN AND WEIGHT WITHOUT COMPROMISE

Aerodynamic gains only matter if they are not accompanied by an increase in mass.

The Tarmac SL9 achieves aerodynamic performance improvements without compromising system weight.

At 687 grams for the S-Works frame, SL9 sits at the top of the aero race category while enabling complete builds as low as 6.5 kilograms. This is made possible by Flow State Design, in which shape carries the load and carbon ply placement is guided by measured deformation patterns. Structural efficiency allows material to be removed without sacrificing stiffness or ride quality.

SL9 matches the compliance and stiffness targets of Tarmac SL8 while delivering measurable aerodynamic improvements.



Time to Finish moves validation from theoretical metrics to race-decisive outcomes.

Instead of asking how much drag a bike saves at one speed, the model asks how long it takes to complete an entire race under realistic conditions.

The Equation of Speed was used to benchmark the SL9 across representative World Tour race profiles. The Equation incorporates elements such as terrain distribution, wind variability, rider power, and full system parameters into a single output.

One example benchmarking approach uses a statistically representative 100 km course with a slope distribution derived from recent years of Grand Tours, paired with rider-input assumptions. In one internal comparison set, the assumptions included a rider mass of 65 kg, apparel mass of 1 kg, air density of 1.225 kg per cubic meter, rolling resistance coefficient of 0.005, drivetrain efficiency of 0.98, and rider power of 390 watts. Within that defined scenario, the time to finish is calculated for each complete bike system.

PROVING SPEED THROUGH TIME TO FINISH

These results illustrate why time to finish is the correct lens. The most aerodynamic platform in terms of weighted CdA is not necessarily the fastest overall. A small aero advantage on flat terrain can be offset by a large weight gap once slope increases and accelerations compound. In the same internal analysis, the S5 advantage exists only at very low slopes. Beyond approximately a 1.4 percent gradient, SL9 becomes the fastest of the group, and SL8 remains competitive in steeper regimes as well.

This kind of analysis does not stop at a single race or rider. We applied the same Equation of Speed methodology across a wide range of real-world race scenarios, using full course profiles from the world's most decisive events. Each simulation compares Tarmac SL9 against key competitors, tested in our own wind tunnel in the same specifications raced by professional athletes. The goal is not to chase isolated watt numbers, but to understand how small gains compound across breakaways, climbs, and hours spent in the bunch to deliver the lowest real-world Time To Finish where races are actually decided.

Think back to the final stage of the 2024 Tour de France Femmes, where Demi Vollering launched her decisive 80-kilometer breakaway across rolling terrain, flat transitions, and ultimately up Alpe d'Huez to the finish. She rode that legendary effort on the Tarmac SL8. But what would have happened if she had ridden the Tarmac SL9?

We ran the full stage through our Equation of Speed simulation using:

- 4 watts less aerodynamic drag
- A 687-gram frame
- 6.8 kg system weight
- Hyper-accurate Made In Racing real-world data
- Elite rider power profiles

The result? She would have been 14 seconds faster. A 14-second gain on a Tour decided by 5 seconds. The difference between losing the overall... or winning it by 9 seconds. The difference between heartbreak and history.

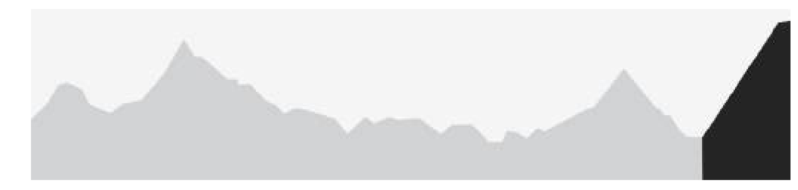
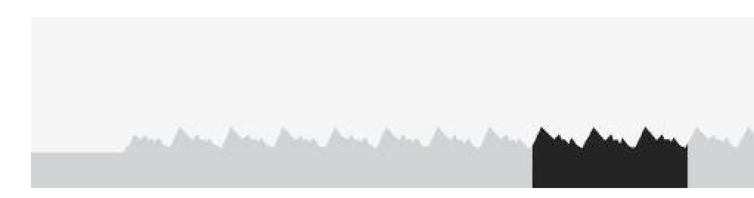
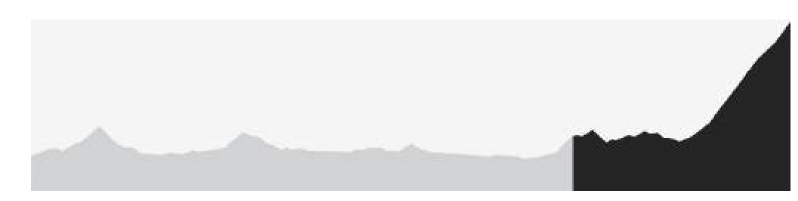
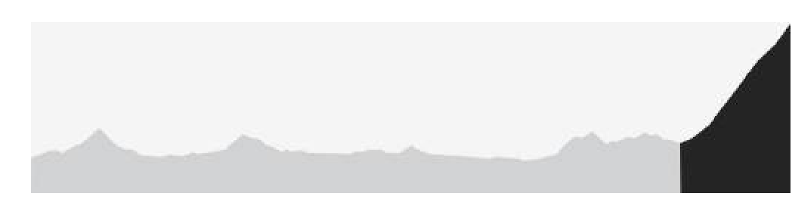
	Tarmac SL9	**Tarmac SL8**	**Colango Y1RS**	**Cervelo S5**	**Factor ONE**
Wheels	Roval Sprint CLX	Roval Sprint CLX	Enve 4.5 Pro	Reserve 57/64	Black Inc. 64
Groupset	Red E1	Red E1	Red E1	Red E1	Red E1
Cockpit size	110x380	110x380	105x377	100x380	110x380
Tires	Cotton TLR 30	Cotton TLR 30	Continental Archetype 30	Vittoria Corsa Pro 29	Goodyear Eagle F1 30

**All bikes in size 56cm, set-up with same saddle height with no spacers under cockpit*

Grand tour Stage 100 km*	2h 43' 44''	+28	+34	+18	+63
System weight (kg)	6.80	6.89	7.49	7.44	7.99
Weighted CdA (m²)	0.2227	0.2251	0.2227	0.2215	0.2231

** Benchmark example. Time to finish and system parameters for a 100 km Grand Tour profile. Grand Tours are defined by variety, not a single terrain type. By analyzing the Tour de France, Giro d'Italia, and Vuelta a España, we condensed their shared mix of fast flats, rolling terrain, steep climbs, and descents into a representative 100-kilometer course that reflects the dynamics of real races.*

PROVING SPEED THROUGH TIME TO FINISH

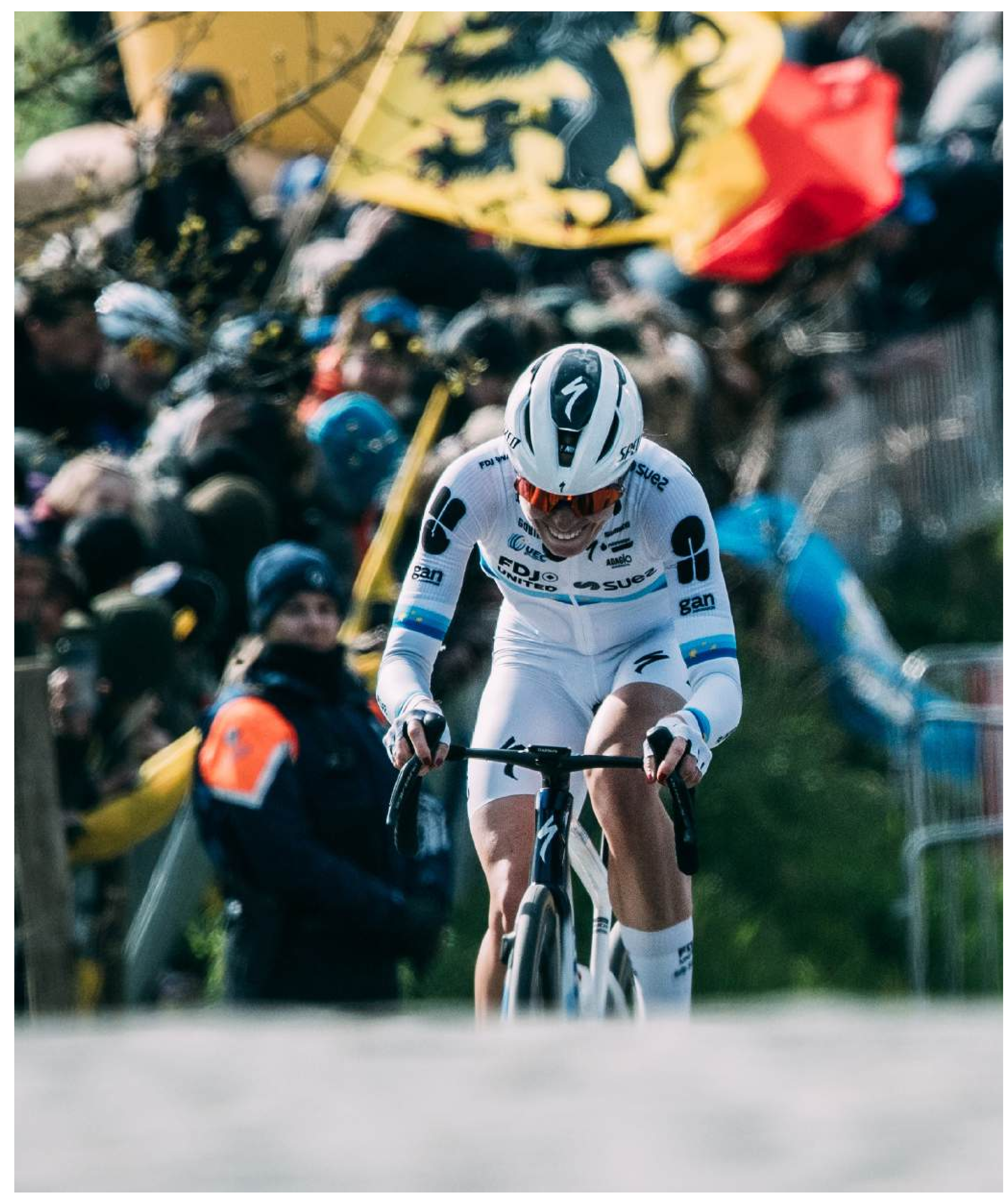
	SL9 Time to Finish	SL8	Cervelo S5	Colnago Y1RS	Factor ONE:	
TdF Stage 19 | Attack at Alpe d'Huez	'00:38:18.000'	+5.5	+16.4	+18.2	+30.9	
TdF Stage 20 | Attack at 'Mizoen	'00:54:27.400'	+8.6	+16.0	+18.9	+31.1	
Liège–Bastogne–Liège | Final 34km	'00:52:00.399'	+10.8	+2.4	+ 6.4	+7.7	
Worlds 2026 Montreal | Laps Only	'00:19:17.100'	+3.7	+0.5	+1.9	+2.1	
TdFF Stage 7 | Attack at last 44km	'01:53:57.799'	+20.0	+38.4	+45.2	+74.5	
TdFF Stage 7 | Attack at 'Ventoux'	'00:57:44.200'	+8.8	+28.0	+31.0	+52.8	

The Equation of Speed does not favor rider archetypes.

It favors outcomes. That is why Tarmac SL9 exists as a single platform for general classification riders, sprinters, and breakaway specialists. The frame does not change. The configuration can.

Whether optimized for stability and sprinting, low mass and climbing efficiency, or sustained speed in exposed conditions, every configuration is governed by the same principle: reduce Time to Finish on the course that matters.

When one platform can win across flat stages, mountain stages, and decisive final kilometers, it is not because it excels at a single metric. It is because it is engineered around the only metric that decides winners.



Conclusion

Tarmac SL9 is not defined by a list of features. It is defined by a measurable philosophy. Speed is defined as Time to Finish, and the Equation of Speed is the governing framework that converts rider power into elapsed race time by integrating the variables that determine races.

By treating rider and bike as one system, validating aerodynamics with rider motion, using statistical distributions for slope and wind, and optimizing shapes around a Time to Finish objective, SL9 advances the definition of speed beyond simplified metrics.

Not an aero bike. Not a climbing bike. The fastest race bike by the only metric that decides winners. Fastest Time to Finish wins.

SPECIALIZED SCIENCE CLUB

TARMAC SL9 WHITEPAPER