COLNAGO TT2

WHITE PAPER

The Colnago TT2 was born directly from the needs and requests of our WorldTour partners, UAE Team Emirates-XRG and UAE Team ADQ. In recent years, time trial racing has evolved significantly, with courses becoming increasingly varied and demanding, featuring hilly profiles, uphill finishes, and more technical sections requiring frequent accelerations, direction changes, and precise handling through corners.

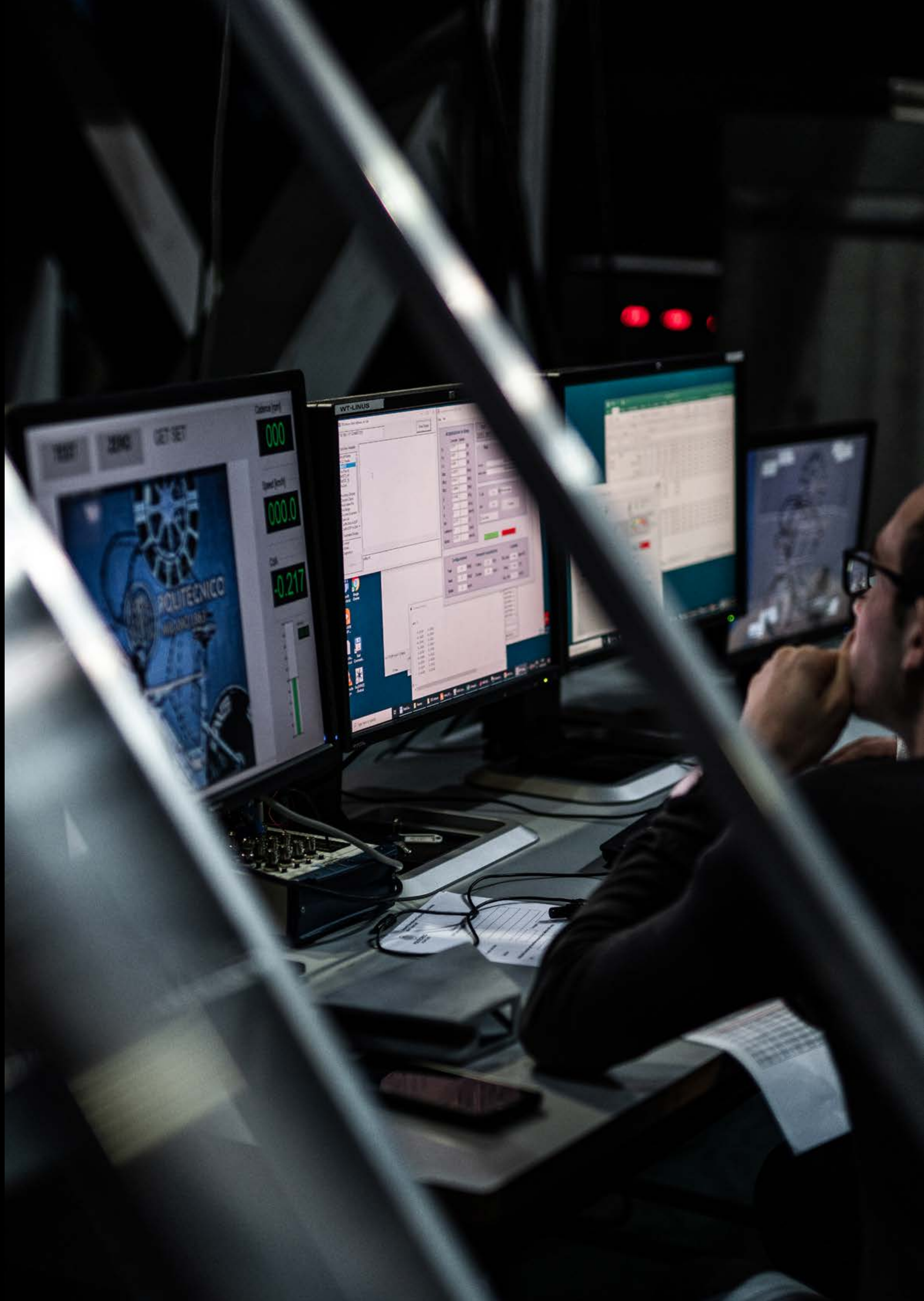
The development objective was therefore clear. Building on the experience, know-how, and engineering tools developed through the TT1 and the Y1Rs—both benchmark products in their respective categories for aerodynamic performance—we set out to improve every key performance area and optimize their balance to create the ultimate machine for modern time trial racing.

As with every Colnago performance project, the development of the TT2 focused on three primary pillars:

1. **Aerodynamics**
2. **Frame weight**
3. **Geometry for optimal rider fit and handling**

The result is **a comprehensive step forward in performance**. The **TT2** frame kit is approximately **550g lighter** than its predecessor, while delivering further aerodynamic gains, particularly in crosswind conditions.
In addition, the revised geometry enables **easier rider fitting**, greater positional customization, **improved handling**, and **more responsive acceleration**.

Together, these advancements make the TT2 a faster, more versatile, and more effective platform for the demands of contemporary time trial competition.



1. AERODYNAMICS DESIGNED FOR SPEED

In any time trial competition, the primary objective is to cover the course in the shortest possible time. At speeds exceeding 50 km/h, aerodynamic efficiency becomes the dominant performance factor, and even marginal reductions in drag can make the difference between winning and losing.

Over the past three years, the Colnago TT1 has established itself as a benchmark in aerodynamic performance. During the development of the new TT2, the challenge was to further reduce aerodynamic drag while simultaneously achieving a significant reduction in overall weight—an ambitious objective that required a holistic engineering approach.

Aerodynamic drag is determined by several factors, including the rider-bike frontal area and the drag coefficient of the system.

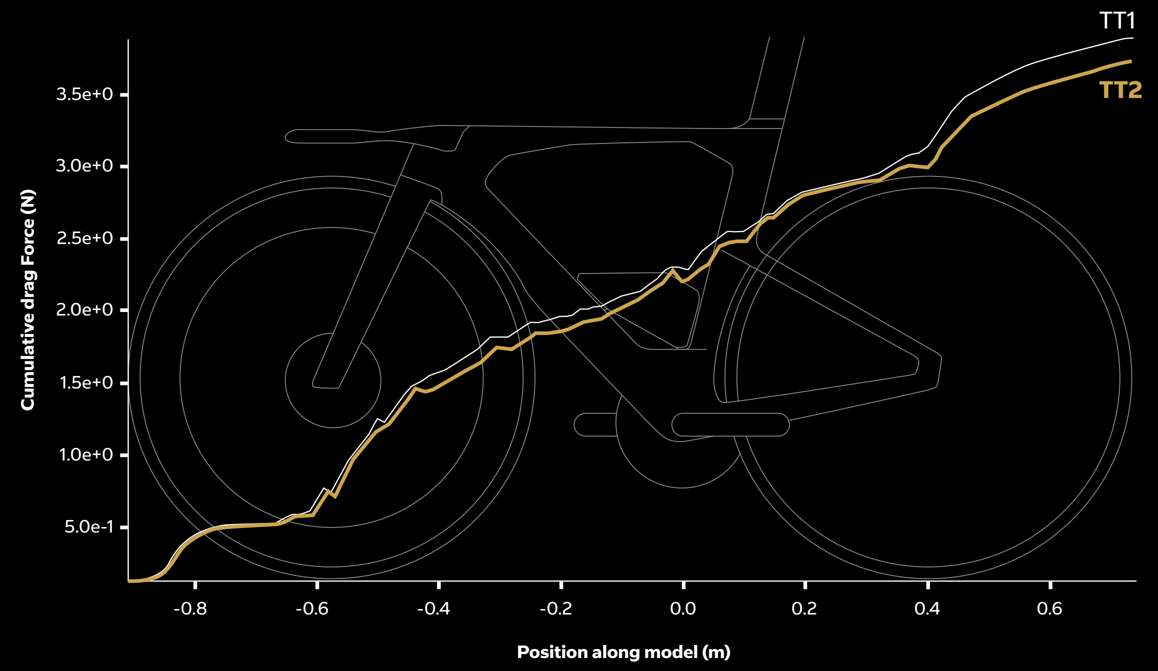
Aerodynamic Drag Force Equation

$$F_D = C_D \cdot A \cdot \frac{pV^2}{2}$$

Where:
- F_D = Drag force
- C_D = Drag coefficient
- A = Reference area (frontal area)
- p = Density of the fluid (air)
- V = Flow velocity relative to the object

The development process therefore focused on both minimizing the frontal/reference area (A) and reducing the drag coefficient (Cd). Particular attention was dedicated to the optimization of the front-end architecture—including the head tube, fork, and cockpit—as these components have a major influence on airflow management. At the same time, extensive work was carried out on tube profile design and component integration to maximize aerodynamic efficiency across the entire bicycle.

Through the extensive use of Computational Fluid Dynamics (CFD)* simulations and wind tunnel testing throughout every stage of product development, the Colnago TT2 achieves lower aerodynamic drag than its predecessor, the TT1. The improvements are particularly evident in real-world riding conditions, where varying wind angles and dynamic rider inputs play a critical role in overall performance.



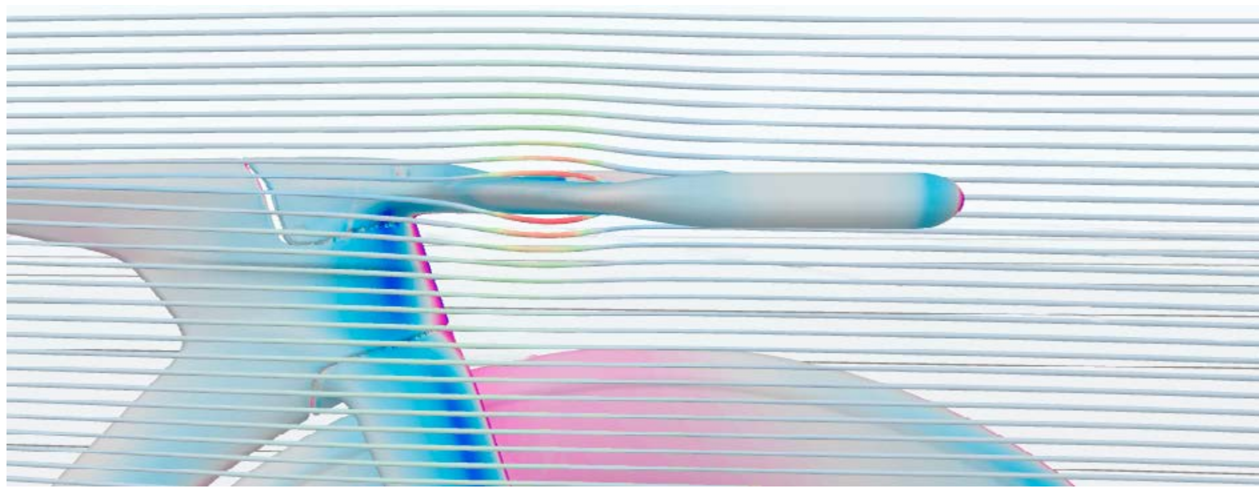
*The plot indicates the cumulative drag force along the bicycle with the contribution of each area to the overall drag force. TT1 line (white) vs **TT2 (gold)**.*

1. FRONTAL AREA REDUCTION

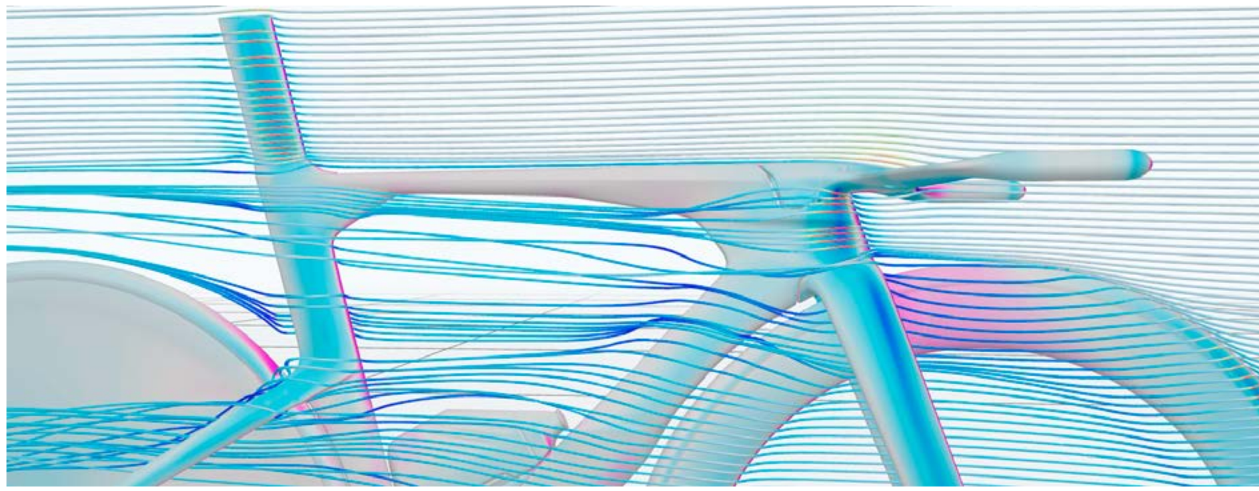
The reduction of the frontal area focused primarily on the bicycle's front end, as this is the first component to interact with relatively undisturbed airflow before it is influenced by the rider's body. Consequently, the front end has the most direct impact on the overall aerodynamic drag generated by the bicycle-rider system.

The key development areas were:

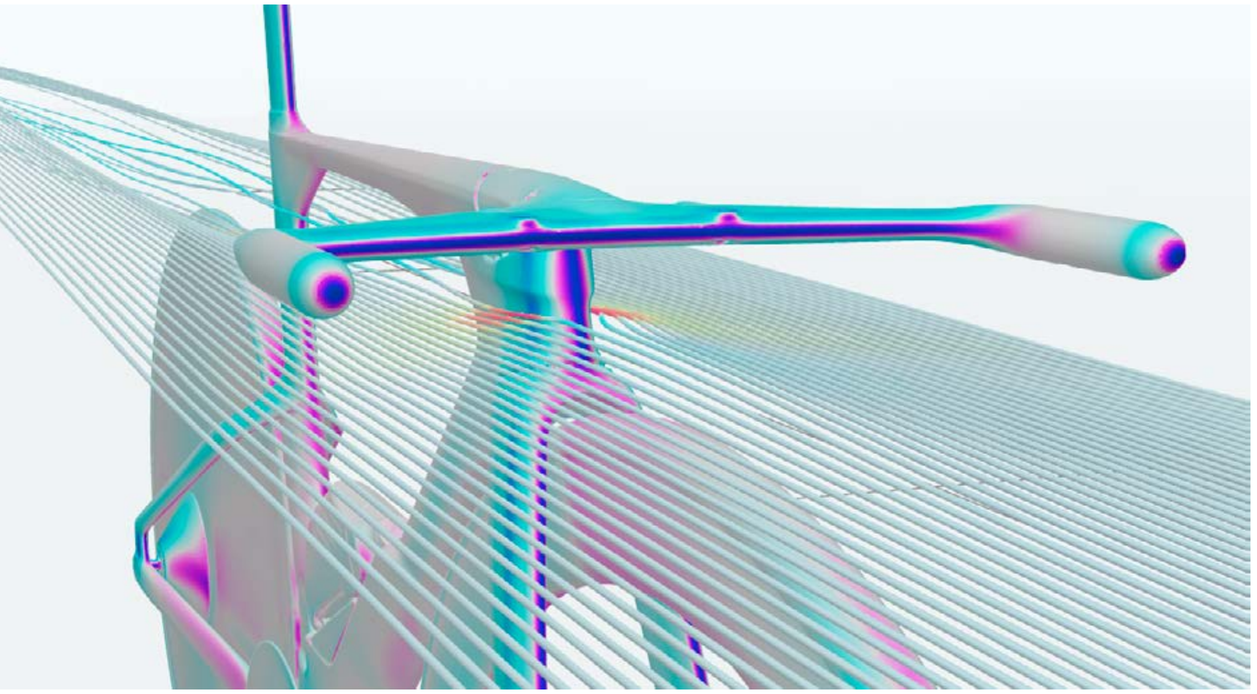
A fully integrated cockpit featuring a narrower width (360 mm center-to-center) and a slimmer overall profile.



A new fork designed around a conventional headset system, with blade profiles specifically optimized to minimize aerodynamic drag while maintaining excellent stability and predictable handling at high speeds.



An extremely narrow head tube, with a minimum width of just 32 mm, combined with low-drag aerodynamic profiles to further reduce airflow disturbance.



As a result of these optimizations, the TT2 achieves a frontal area comparable to that of the TT1, despite incorporating increased tyre clearance and a conventional fork and headset architecture.

This result highlights the effectiveness of the aerodynamic development process, which enabled the advantages of the new platform to be achieved without increasing the frontal exposure of the bicycle.

1. FRONT-END FRONTAL AREA COMPARISON

Frontal area calculated considering the complete front-end assembly, including head tube, fork, integrated cockpit, and cockpit cover. Measurements refer to size S frames configured with comparable stack heights.

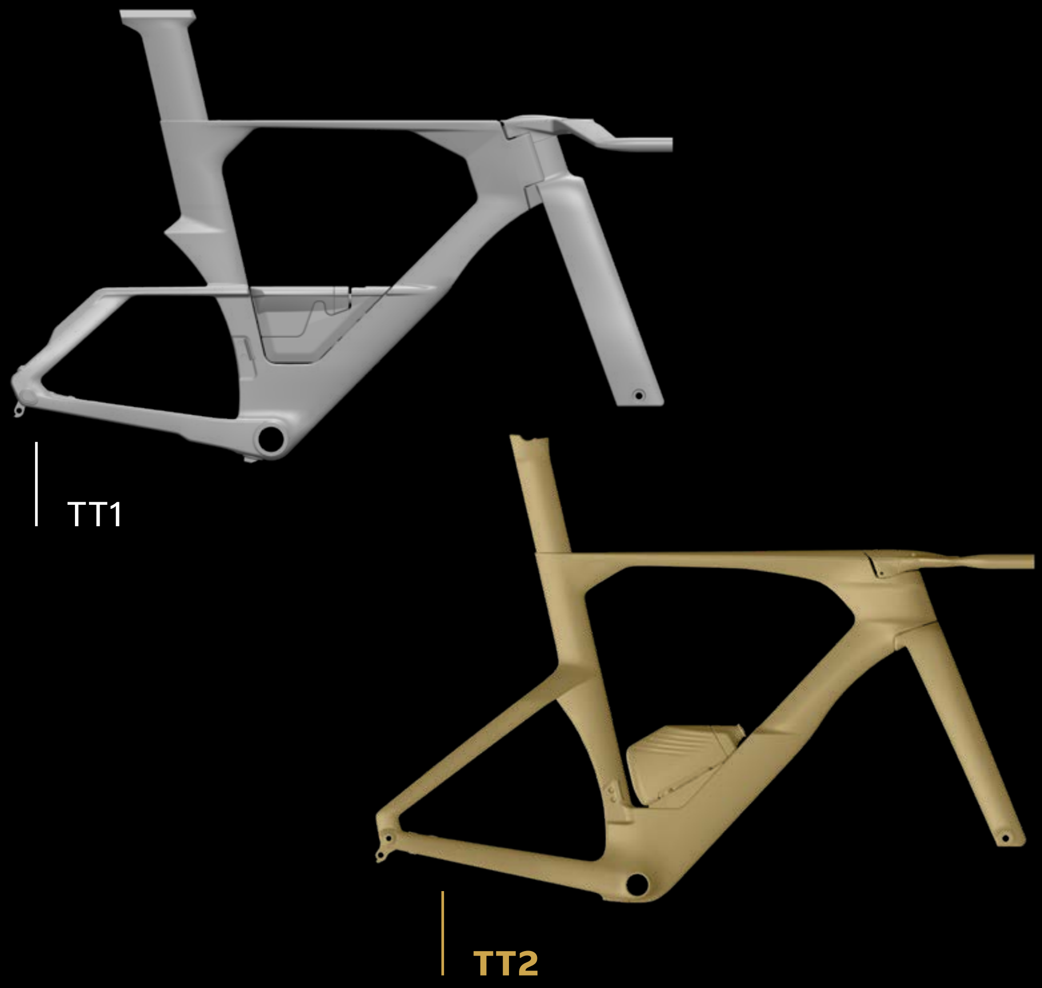
TT1
21,125 mm^2

TT2
21,008 mm^2

1. INTEGRATION

The TT1 features a highly integrated design, where every component and subsystem is engineered to work seamlessly together as a single performance platform capable of competing and winning at the highest level of WorldTour racing.

As a completely new project, Colnago TT2 requires a comprehensive redesign of the entire system. Major architectural changes, including the adoption of an all-new fork concept and front-end layout—made it necessary to re-engineer every component from the ground up.
This clean-sheet design approach allowed to optimize the integration of all components, ensuring that aerodynamic performance, weight reduction, rider fit, and handling characteristics were improved simultaneously within a cohesive and highly efficient platform.



New Colnago integrated Aero Bottle with Fidlock® System

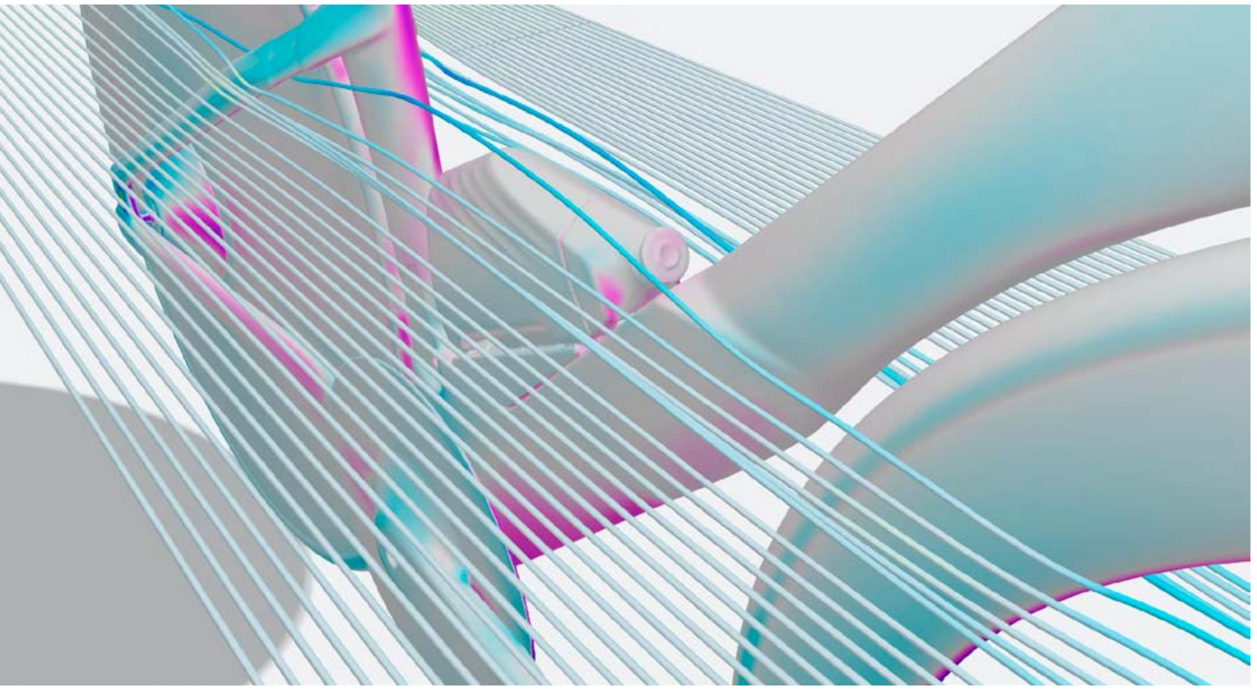
The hydration system plays a critical role in the aerodynamic performance of a modern time trial bicycle, as it can be used to create aerodynamic fairing effects within the frame envelope. For this reason, its design and dimensions are strictly regulated by the UCI.

The TT2 hydration system was developed alongside the frame from the earliest stages of the project, resulting in a fully integrated, UCI-compliant bottle and bottle cage assembly. Rather than being treated as an accessory, the bottle is conceived as an integral aerodynamic component of the bicycle, forming a continuous surface with the frame to promote smooth airflow and minimize flow separation.

The area between the rider's legs is characterized by highly disturbed and turbulent airflow. In this region, maintaining a slim, continuous profile is essential to reduce unwanted aerodynamic interactions between the various elements of the bicycle-rider system. For this reason, the bottle and bottle cage have been designed as a single integrated body featuring the thinnest and longest profile permitted by the regulations, minimizing vortex generation and reducing overall aerodynamic drag.

Particular attention was also dedicated to the bottle surface geometry, which was optimized to maintain attached airflow and delay flow separation near the trailing edge, further improving aerodynamic efficiency.

Beyond aerodynamic performance, rider usability was considered a key development objective. Accessing and storing a bottle while maintaining an aerodynamic position on the extensions can result in unnecessary time losses and rider distraction. To address this challenge, the TT2 hydration system incorporates the Fidlock® TWIST magnetic fastening technology, enabling quick and intuitive bottle removal while ensuring immediate, secure, and stable repositioning. This solution allows riders to hydrate efficiently without compromising control, stability, or aerodynamic position.



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1. STUDY OF THE AERODYNAMIC PROFILES

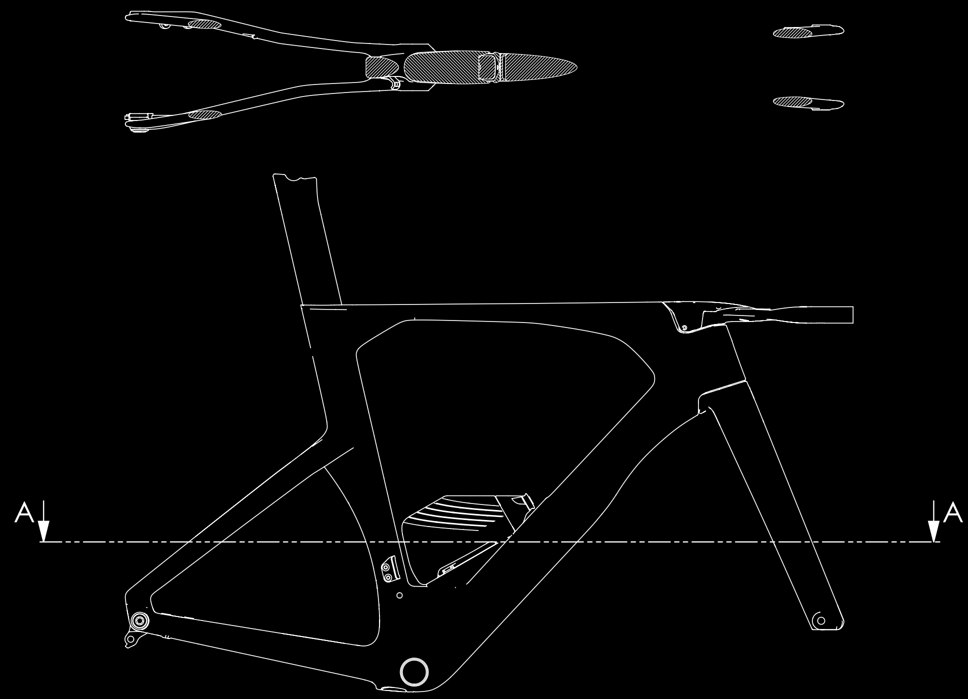
Weight reduction and aerodynamic performance are often conflicting design objectives. Lightweight structures typically favor shorter and more compact tube sections, which reduce material usage while inherently increasing torsional stiffness. Conversely, highly aerodynamic profiles tend to be longer and narrower, requiring additional material and structural reinforcement to achieve the necessary stiffness targets.

One of the primary objectives of the TT2 project was to achieve a significant reduction in frame weight while maintaining—and further improving—the aerodynamic efficiency that has characterized Colnago's time trial platforms. To achieve this balance, the depth of the frame tube profiles was reduced wherever possible, while each individual section was extensively optimized through advanced Computational Fluid Dynamics (CFD) simulations and wind tunnel testing.

The aerodynamic development methodology leveraged the tools and expertise originally developed for the Colnago Y1Rs project, including advanced surface pressure mapping techniques in the most aerodynamically critical regions of the bicycle. Particular attention was dedicated to the airflow behavior around the head tube, the down tube in the wake of the front wheel, the seat tube, and the integrated hydration system. This approach enabled to identify local flow separations and pressure gradients, allowing each profile to be refined for maximum aerodynamic efficiency with the minimum structural mass.

Beyond pure aerodynamic efficiency, riding stability was considered a critical performance parameter. In real-world racing conditions, crosswinds and sudden lateral gusts can significantly influence both aerodynamic drag and bicycle controllability. Excessive side forces require riders to devote attention and energy to maintaining their line and balance, reducing their ability to focus exclusively on power production.

For this reason, the TT2 features a new generation of aerodynamic profiles specifically optimized to deliver predictable airflow behavior across a wide range of yaw angles. The shorter, carefully refined tube sections promote controlled and progressive flow separation, minimizing abrupt changes in lateral aerodynamic forces. The result is improved stability in windy conditions, allowing riders to maintain confidence, aerodynamic position, and power output even when exposed to challenging crosswind environments.



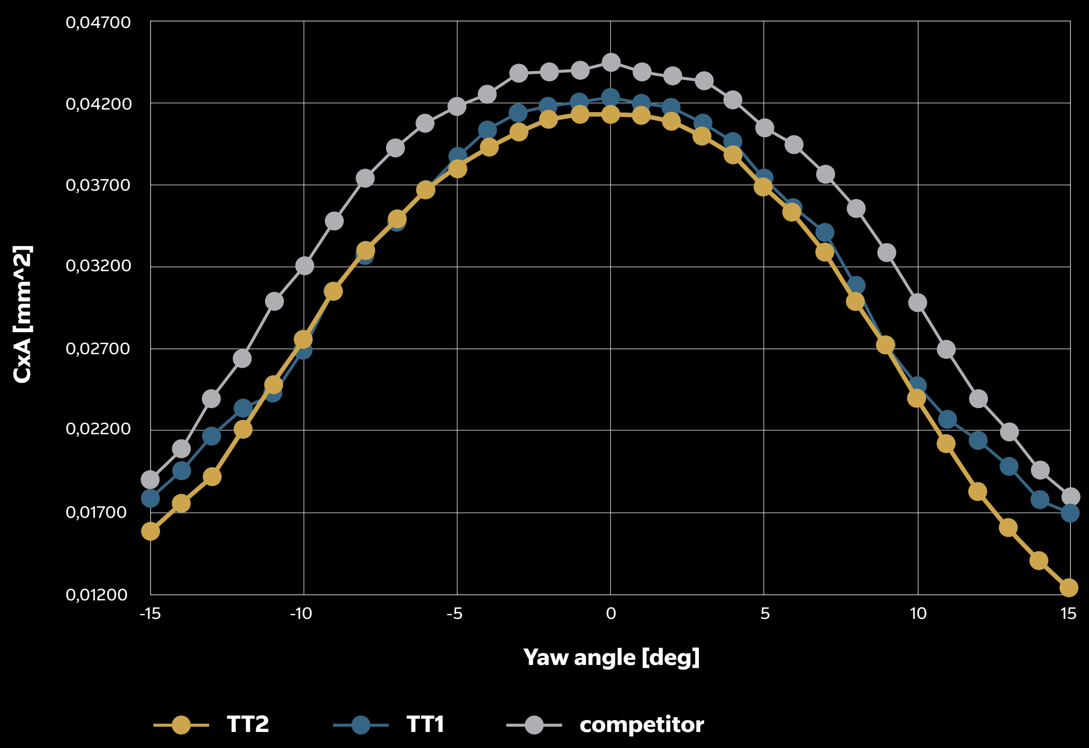
1. RESULTS

In the wind tunnel Colnago always tests in two different configurations.

Stand-alone bicycle

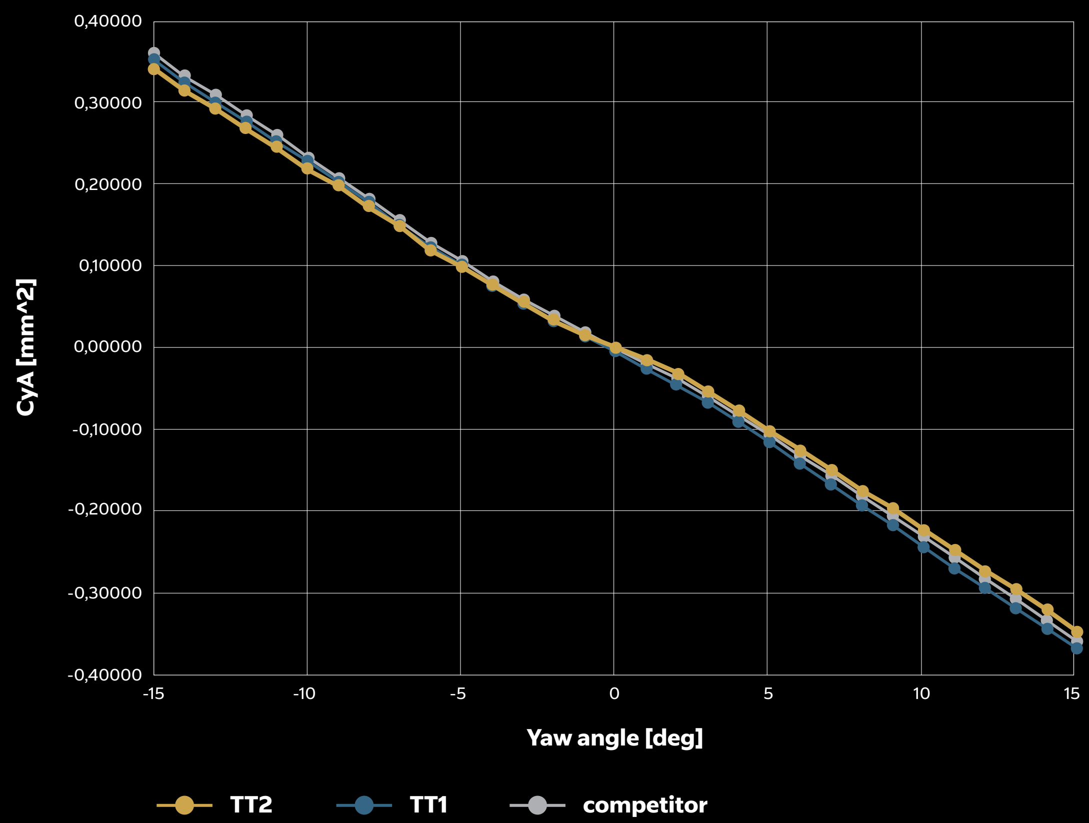
(Bicycle + integrated Colnago bottle system, @54km/h, yaws 0°÷15°)

CdA- Stand-alone bicycle



	TT2	TT1	Reference competitor
Power WAD [W]	66,7	68,5	74,9
Power@ 0° Yaw [W]	83,7	85,7	90,0

CyA - Stand-alone bicycle



The lateral force coefficient (CyA) describes the aerodynamic side force acting on the bicycle under crosswind conditions. This parameter is particularly important because it directly influences riding stability, steering corrections, and rider confidence when exposed to lateral wind gusts.

The TT2 exhibits lower lateral force values at higher yaw angles compared with the reference platform. The reduced magnitude of these side forces results in a more stable and predictable riding behavior, minimizing the rider's need for steering corrections and allowing greater focus on maintaining power output and aerodynamic position.

These improvements contribute to enhanced control and confidence in real-world racing conditions, where crosswinds frequently represent a significant performance challenge.

Complete racing setup

(Bicycle + Mannequin + Colnago bottle system, @55km/h, yaws 0°÷15°)

A stand-alone bicycle usually offers more accuracy, but it doesn't represent what happens in real world since the bike is always interacting with the rider, responsible of most of the drag. For Colnago it is crucial that results are coherent in both the setup.

The presented results are the average of 3 different data acquisitions for each setup, performed to reduce and compensate for the measurement variability.

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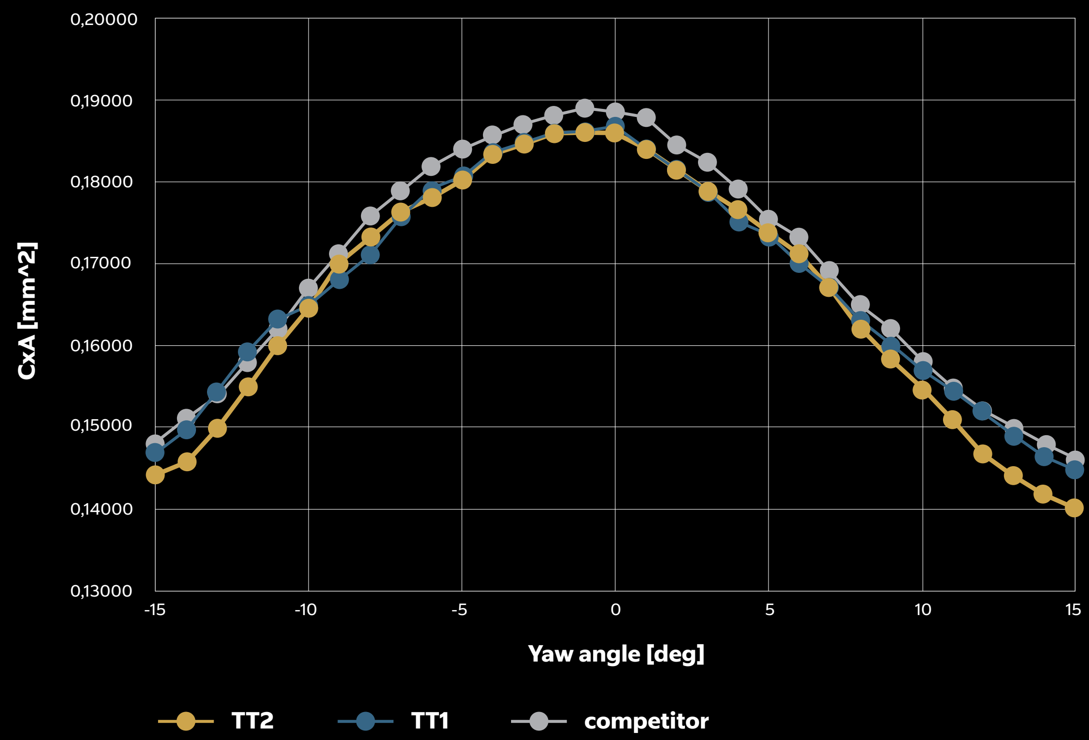
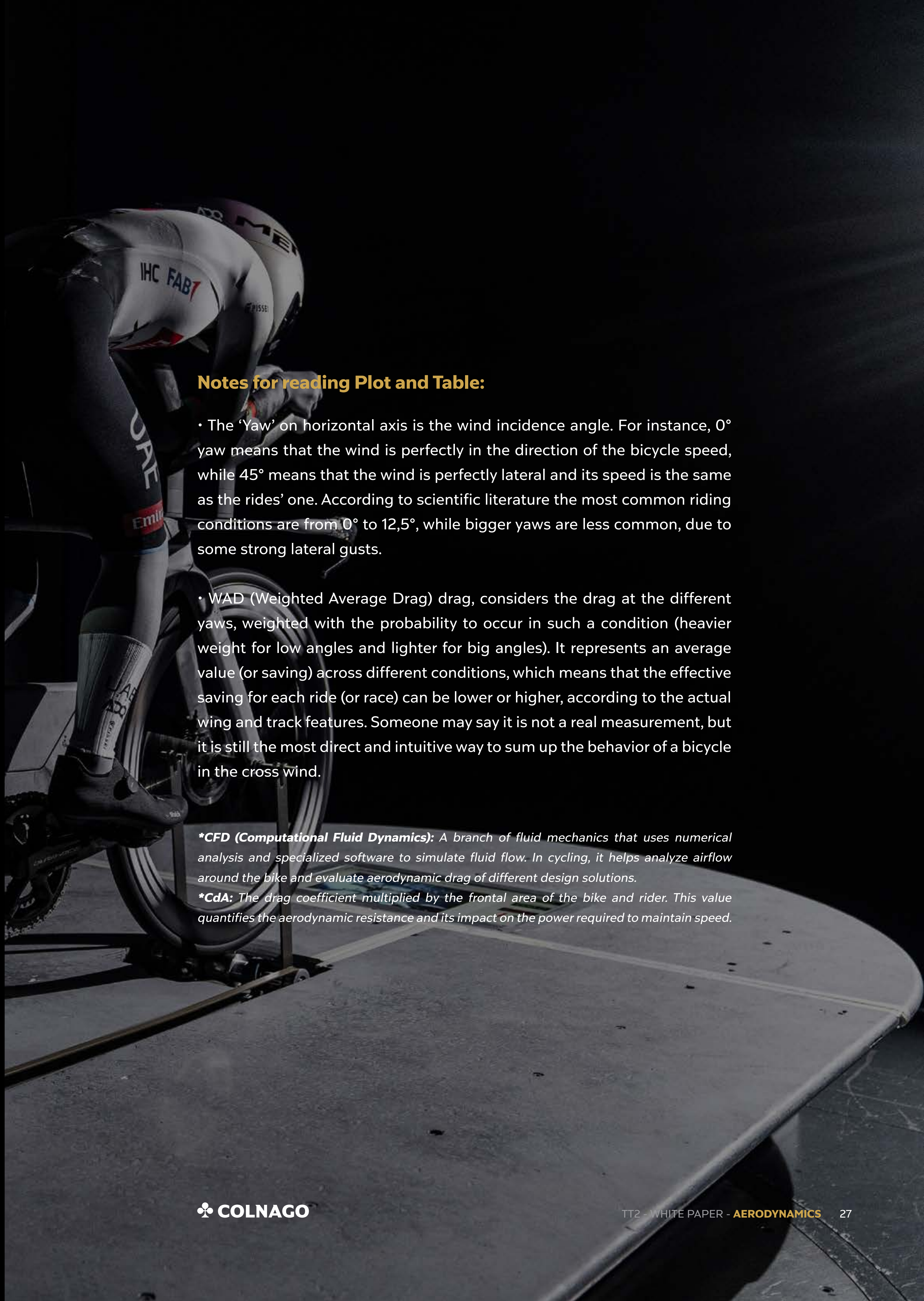


	TT2	TT1	Reference competitor
Power WAD [W]	344,4	346,0	350,3
Power@ 0° Yaw [W]	375,1	376,4	379,7



Notes for reading Plot and Table:

• The 'Yaw' on horizontal axis is the wind incidence angle. For instance, 0° yaw means that the wind is perfectly in the direction of the bicycle speed, while 45° means that the wind is perfectly lateral and its speed is the same as the rides' one. According to scientific literature the most common riding conditions are from 0° to 12,5°, while bigger yaws are less common, due to some strong lateral gusts.

• WAD (Weighted Average Drag) drag, considers the drag at the different yaws, weighted with the probability to occur in such a condition (heavier weight for low angles and lighter for big angles). It represents an average value (or saving) across different conditions, which means that the effective saving for each ride (or race) can be lower or higher, according to the actual wing and track features. Someone may say it is not a real measurement, but it is still the most direct and intuitive way to sum up the behavior of a bicycle in the cross wind.

***CFD (Computational Fluid Dynamics):** A branch of fluid mechanics that uses numerical analysis and specialized software to simulate fluid flow. In cycling, it helps analyze airflow around the bike and evaluate aerodynamic drag of different design solutions.*
***CdA:** The drag coefficient multiplied by the frontal area of the bike and rider. This value quantifies the aerodynamic resistance and its impact on the power required to maintain speed.*

2. FRAME WEIGHT

Although the key aerodynamic profiles have been preserved—and in some areas further refined—the overall frame architecture has been redesigned to simplify structural junctions and improve load paths. This approach reduces the amount of material required, improves manufacturing precision during the lay-up process, and increases structural efficiency.

Size S	TT1	**TT2**
Ready-to-paint frame [g]	1279	**985**
Ready-to-paint fork [g]	530	**393**
Seatpost (with clamp) [g]	295	**205**
Cockpit [g]	315	**305**
Total frame-kit weight* [g]	2785	**2240**

**The Total Frame Kit weight include carbon parts (frame, fork, seatpost, cockpit), all the metal parts and screw (headset and different interfaces) and the integrated bottle and bottlecage systems.*

Particular attention was dedicated to the following areas:

Rear Triangle and Seat Stay-to-Seat Tube Junction

The seat stays remain positioned at the lowest location permitted by UCI regulations to minimize their frontal area and aerodynamic impact. At the same time, they have been widened to improve airflow management around the rear wheel and are now integrated into the seat tube through smoother transitions, eliminating abrupt geometric discontinuities and reducing structural stress concentrations.

Bottom Bracket Area

The entire bottom bracket region has been redesigned with smoother surface transitions and more continuous load paths. By reducing localized stress concentrations typically generated by sharp corners and abrupt section changes, the structure requires less material while achieving improved torsional stiffness and pedaling efficiency.
The revised frame architecture also enabled the development of a completely new carbon-fiber lay-up strategy. This allowed a significantly broader use of high-modulus fibers throughout the frame structure, further reducing weight while maintaining the stiffness and strength required for elite-level competition.

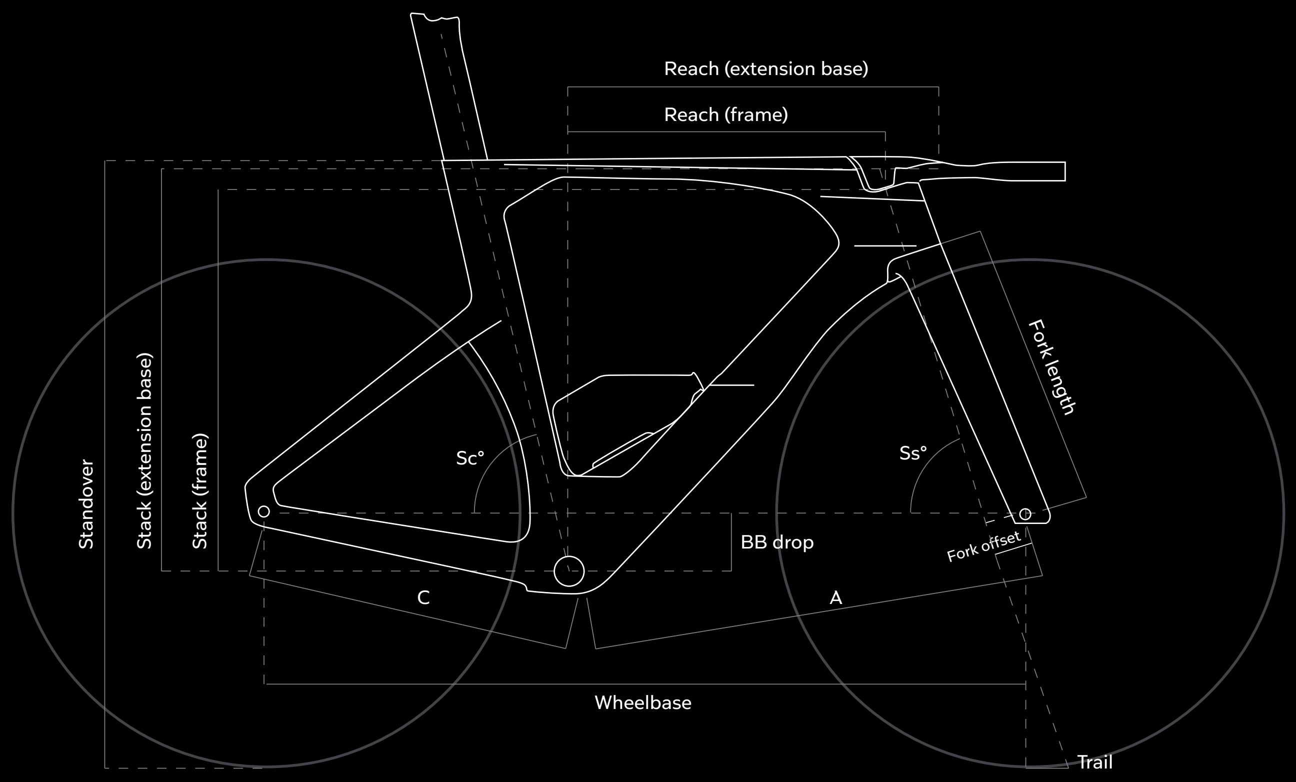
Fork

The fork represents one of the most significant departures from the TT1 platform. The previous bayonet design has been replaced by a completely new architecture, developed to reduce weight while maintaining an extremely low aerodynamic profile.
To achieve this objective, the TT2 features a 25 mm steering tube integrated within an exceptionally narrow head tube. In addition, the brake hoses are routed from the upper section of the steering tube through a dedicated structural expander and directly into the frame, minimizing the clearances required for cable routing and enabling a more compact front-end design.

Seatpost

The TT2 seatpost has been redesigned with reduced width and depth dimensions to further decrease weight and aerodynamic drag. To accommodate a wider range of rider positions, it is available in two offset configurations: a 0 mm setback version and a positive 22.5 mm setback version, allowing precise adaptation to different fit requirements and racing positions.
Despite its reduced dimensions, lateral stiffness and positional stability have been preserved through the adoption of an advanced internal rib structure, which increases structural efficiency while minimizing overall mass.

4. GEOMETRY



Size	XS	S	M	L
Stack (Frame)	468	473	501	523
Reach (Frame)	385	400	415	430
Stack (Center of extension base)	499	502	530	552
Reach (Center of extension base)	466	482	497	512
Ss°	71	72.5	72.5	72.5
Sc°	76.5	76.5	77	77
A	571	575	599	620
C	408	408	408	408
Wheelbase	967	972	995	1017
Fork offset	43	43	43	43
Fork Length	367	367	367	367
Trail (28-622)	70	62	62	62
BB drop	75	75	75	75
Standover	766	771	801	824

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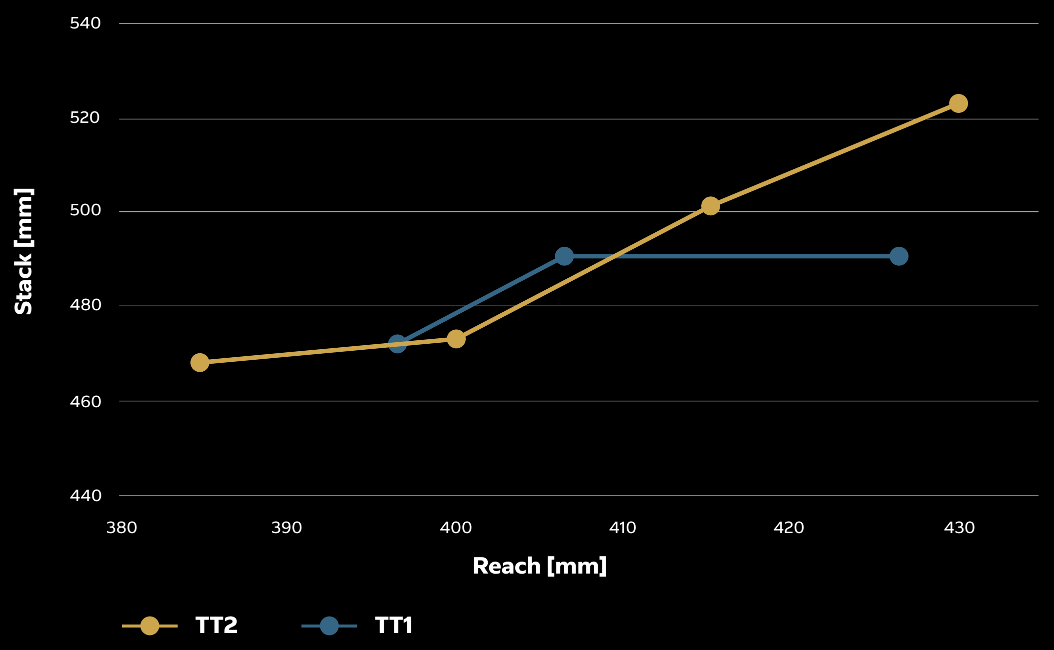

The geometry has been completely revised with the objective of improving rider fit, position flexibility, comfort, and overall control of the bicycle.

Key features include:

• **Expanded fit range.** The introduction of four frame sizes and revised stack-to-reach ratios allows a significantly wider range of position customization, particularly benefiting shorter and taller riders.

• **Enhanced rider comfort and positional flexibility.** The updated geometry, combined with the new integrated cockpit featuring a flatter and more compact design, enables higher handlebar and extension positions when required. This allows riders to achieve a more comfortable and sustainable posture without compromising aerodynamic efficiency, making the TT2 suitable for both short-duration time trials and longer endurance events, including triathlon competition.

• **Improved handling dynamics.** Head tube angles and fork rake have been carefully optimized to deliver more responsive steering, improved cornering precision, and quicker direction changes, particularly in technical race environments.

• **Optimized for modern aerodynamic positions.** The combination of a steep seat tube angle and a lowered bottom bracket facilitates aggressive forward rider positions, enabling highly compact and aerodynamic postures while maintaining efficient power transfer and rider stability.
Together, these updates provide a platform capable of accommodating a broader range of rider positions while delivering the balance of aerodynamics, comfort, handling, and efficiency required by modern time trial racing.

OTHER TECHNICAL INFO

- **Tyre clearance, up to 30-622**
- **HS bearing 39x30x6.5**
- **Bottom Bracket BSA 68 mm**
- **UDH Rear Hanger compatible**
- **Max chainring 70T**


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