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MASTERING A NEW ERA OF AERODYNAMICS WITH THE BUGATTI TOURBILLON

In June 2024, the Bugatti Tourbillon[1] made its first appearance on the global stage, with the highly acclaimed World Premiere at the marque's home in Molsheim. It is an automobile conceived in every way to push the boundaries of possibility — a philosophy most spectacularly manifested in its advanced aerodynamic design. In the latest episode of A New Era, Bugatti's world-class engineers and aerodynamicists uncover the art of creating a new hyper sports car that masters the forces of air.

The first step in crafting one of the world's most aerodynamically sophisticated road-cars started with a simple idea: to create a step-change from the masterpieces that have come before. "The Tourbillon's predecessor, the Chiron[2], was already a low-drag car. But with the

Tourbillon, we need to do better than that," emphasized Paul Burnham, Bugatti's Chief Vehicle Engineer for the Tourbillon.
Taking the concept of aerodynamic performance further than the top-speed world record-breaking Chiron, started at a conversely small point in the development process. With the foundation laid for Bugatti's next hyper sports car by the marque's design and engineering teams, months of CFD (Computational Fluid Dynamics) simulations gave them a first idea of the performance to come. For the next step, fifteen months prior to the Tourbillon's reveal to the world, a collective of some of Bugatti's finest engineers and aerodynamicists congregated at a state-of-the-art wind-tunnel facility in Italy — their focus a beautifully constructed half-scale model of the Tourbillon.

"This test represents the first validation of the scale-model. This is the first test in which we assess different design-volumes, and different changes to the car. By exchanging parts, we steer the car towards the pursuit of high-speed performance, shifting later on in the process to handling efficiency and dynamic ability."

DAVID ŠOŠTARIĆ

HEAD OF AERODYNAMICS AT BUGATTI RIMAC

The model at the center of the fastidious testing program is itself a work of art. Perfectly mirroring the shape of what would evolve to become the Tourbillon, the test-subject was meticulously crafted from 250 individual, 3D-printed components, fitted with over 100 pressure taps around the model's body-panels.

Such extensive measures, precisely placed across its exterior form, served a critical purpose in the Tourbillon's aerodynamic development. Correlating every single point relating to mass-flow measurements, static pressure points, and air velocities, the instruments were carefully analyzed by the Tourbillon's aerodynamic engineers to validate their expected performance profile for the car, scrupulously developed in the virtual world with cutting-edge simulation tools.

Lowering the intricate frontal area of the car; integrating a highly advanced rear diffuser; shrinking the glass house of the cockpit's exterior profile and its aerodynamic impact — throughout the Tourbillon, Bugatti's aerodynamicists and engineers fused data-led insight with their industry-leading expertise to enhance the vehicle's design, creating a powerful evolution from the Chiron.

The ultimate objective for the teams' masterful work was therefore clear throughout the Tourbillon's development: optimizing drag-coefficient and airflow over the entire car. The scores of hours, days and months in achieving this mission, thus come together to realize the dynamic ability set as the benchmark for performance. The dedication and skill poured in takes the concept of Bugatti hyper sports car capabilities to unprecedented heights — so much so that the Tourbillon can reach its top speed without its rear wing deployed, yet remaining highly stable.

As the intricate process of correlating the simulation models to real test results and part-development gained pace, the size of the Tourbillon itself grew over the next year from model, to full-sized prototype — an evolution that saw the scale of the wind tunnel facilities grow commensurately.

> "We've moved on from a scale-model wind tunnel to a full-sized facility, continuing our program of validating the Tourbillon's aerodynamic performance. Only now, we are using a full-scale prototype, which represents a natural step in enhancing calibration of our simulation tools, getting that next degree of accuracy in results."
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> PAUL BURNHAM
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> BUGATTI'S CHIEF VEHICLE ENGINEER FOR THE TOURBILLON

The culmination of an intensive project over years of passion-fueled craft, the first, experimental-prototype phase thus reaffirmed the aerodynamics teams' carefully curated simulation projections — setting the stage for creating yet more sophisticated prototypes and, ultimately, the final manifestation of Bugatti's new era.

> "The Tourbillon is a completely new program; we started really from scratch. We are merging over a century of expertise in combustion-engine power, with state-of-the-art electric performance. The new hybrid system is a significant change from Bugatti models of the past and makes the cooling system much more complex. But that's why we have taken the detail to the next level; looking intensively at the airflows through the radiator channels at the front, through to the intakes behind the door within the iconic Bugatti C-line, to ensure that our digital simulations align with the physical model and deliver enough cooling to manage the car's performance.
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> The Tourbillon has been created by teams dedicated to the pursuit of perfection. Everyone has been fully committed to making the Tourbillon a new benchmark for the automotive industry, and it is a true testament to the skill and passion that has fueled its development."
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> PAUL BURNHAM
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> BUGATTI'S CHIEF VEHICLE ENGINEER FOR THE TOURBILLON

Watch the full episode 'A New Era: Master of Air' on the official Bugatti YouTube channel.

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[2] Tourbillon: This model is currently not subject to directive 1999/94/EC, as type approval has not yet been granted.

[2] Chiron: WLTP fuel consumption, l/100 km: low phase 44.6 / medium phase 24.8 / high phase 21.3 / extra high phase 21.6 / combined 25.2; CO_2 emissions combined, g/km: 572; efficiency class: G