# The Long Road Leading to Streamlined Design

Nowadays making aerodynamic improvements on the computer and in the wind tunnel has become standard practice in the vehicle development process. But for many years the subject of air resistance was largely neglected by automotive engineers. In ATZ and its predecessors the subject was hardly touched on during the first few decades of publication.

**1955** A Porsche 356 outside an inn in Dinkelsbühl: At the time the car's drag coefficient of 0.31 was a notable exception (© Porsche)

Early cars with front-ends that looked like refrigerators indicate the lack of awareness at the time of the importance of flow dynamics. Only racing car designers and a few pioneers in the field of aerodynamics were interested in the fact that turbulence wastes energy. Many of these men were former aviation engineers who had been forced to take a new direction in the 1920s after the signing of the Treaty of Versailles. One of them was Edmund Rumpler, who presented his Tropfenwagen (teardrop car) in 1921. The aerodynamic shape of the body had a drag coefficient of 0.28, which is still an impressive figure today. This was confirmed in the 1970s by measurements made in the Volkswagen wind tunnel.

The subject that interested only a few engineers in the 1920s soon became a political issue. Kurt C. Volkhardt wrote in ATZ 2/1937: “More and more indications are gradually emerging that design trends in the automotive industry will have to take into consideration weight reduction and, in relation to this, the requirements of aerodynamics, which we will one day have to acknowledge as the legal consequences of the development of the motorway network.” In the early days of the Third Reich, Volkhardt was particularly concerned with making Germany “independent of foreign fuels and oils.” In a response printed in ATZ 10/1937, A. E. Thiemann raised the objection that the importance of air resistance had been common knowledge in the engineering world for at least 25 years: “If little attention has been paid to developing streamlined vehicle bodies, this is primarily because cars were intended to be comfortable means of transport and not sporting machines, as Ettore Bugatti, for example, believes.”

During the post-war period, when everything was in short supply, more and more engineers became aware of the significance of air resistance. For example, in ATZ 1/1948 R. Seyferth looked into the subject of “cars with the correct aerodynamic design,” while in ATZ 1/1949 Emil Everling described his idea of “truncating the ideal shape of half an airship at the point where it reaches the required transport length and not where the airflow breaks away.”

In the years that followed, individual models were developed with drag coefficients that still seem impressive to us today, but many of the other vehicles on the roads were less streamlined. It was not until the oil crisis of the 1970s that the situation began to change. However, the engineers did not have the right tools at their disposal. In ATZ 5/1978 Syed Rafeeq Ahmed and Wolf-H. Hucho noted that: “vehicle aerodynamics remains exclusively an experimental discipline.” Their article on simulating the flow of air around a vehicle using the panel method helped pave the way for today’s flow dynamic simulations. However, it would be years before computers were powerful enough to perform the necessary tasks. For example, in ATZ 11/1989 Rolf Buchheim, Heinz Röhe and Hans Wüstenberg reported on early attempts to run computerized flow simulations. The development of these simulation methods represented an important step toward improving the efficiency of the vehicle development process. The authors noted that around 1000 changes were made to the shape of the 1988 VW Passat using 1:1 model prototypes until the final aerodynamic form was created.

In ATZ 5/1982 Jürgen Nitz, Klaus-Rainer Deutenbach and Rolf Poltrock described an experimental car produced by the Volkswagen research group with a drag coefficient of 0.15, an engine power output of only 120 kW and a top speed of more than 360 km/h. However, things looked very different in the world of production vehicles. In ATZ 1/1983 Ferdinand Piëch and Jörn Klingel presented the new Audi 100, which had a drag coefficient of 0.30, making it the most aerodynamic production sedan in the world.

The future direction of aerodynamics was the subject of an article by Thomas Schütz and others for ATZ 12/2016. In addition to small-scale improvements, the authors focused primarily on active aerodynamic elements.

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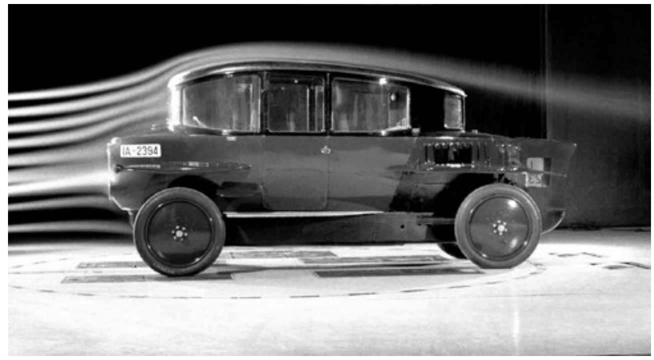
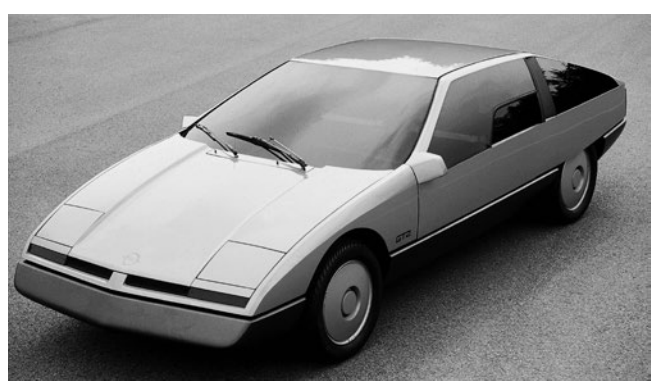



**1921** Edmund Rumpler’s Tropfenwagen: Measurements made in the VW wind tunnel in 1979 showed that it had a drag coefficient of 0.28 (© Volkswagen)


**1967** Works photo of the NSU Ro 80: The pioneering design resulted in a drag coefficient of 0.37 (© Audi)

**1974** In the case of the Citroën CX the drag coefficient is part of the model name, because $c_x$ is the French abbreviation used for the measurement (© Citroën)



**1975** Fuel consumption and aerodynamics were the development objectives behind the futuristic wedge shape of the Opel GT2 (© Opel)