Researchers solve the mystery of the ‘wing on wheels’

01 August 2014

Seventy-five years ago, flow researchers at the Aerodynamic Research Institute (Aerodynamischen Versuchsanstalt; AVA) in Göttingen unveiled a car that, for many years, was considered the quintessential execution of aerodynamic design in vehicle construction; its name was the Schlörwagen. A large number of myths have arisen about what became of the vehicle. Now the archives at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) – the successor to AVA – have helped shed light on some of the mysteries.

The Schlörwagen was an experimental vehicle that caused quite a stir in 1939. Its aerodynamic performance, expressed as its drag coefficient (Cd value), was a mere 0.186, and therefore a real sensation. Subsequent measurements that Volkswagen conducted on a model during the 1970s confirmed the Schlörwagen's Cd at just 0.15. Modern cars possess Cd values of between 0.24 and 0.3 and therefore do not come close to the Schlörwagen's perfectly tailored aerodynamic shape. Only modern experimental vehicles such as the Volkswagen ‘1-litre car’ or the ETH Zürich 'PAC-Car II' have lower Cd values. But unlike these models, the Schlörwagen could fit seven people – something of a family vehicle.

To mark the anniversary, the Göttingen-based DLR researchers returned a preserved, smaller original model to the wind tunnel. The images they acquired confirmed the analyses conducted during the 1930s – the airflow clung tightly to the model’s contours, causing neither stalls nor turbulence that might slow down the vehicle. The elongated rear, sloping down towards the ground, proved a perfect solution – it did not produce the backflow that causes drag in most cars.

Modern concept

The Schlörwagen is named after the German engineer Karl Schlör (1910–1997). The vehicle was not designed primarily to reach high speeds, but to ensure particularly low fuel consumption at normal driving speeds and to offer sufficient space for an entire family – a concept that appears extraordinarily topical in a time of climate change and energy crisis.

In selecting the basic shape of the vehicle, Schlör chose two aircraft wing profiles that offered particularly low drag. In a way, the vehicle resembles one half of a drop of water, which was probably the reason for its nickname, the 'Göttingen Egg'. "Basically, the Schlörwagen is a wing on wheels," explains Andreas Dillmann, Head of the DLR Institute of Aerodynamics and Flow Technology.

To ensure that this favourable aerodynamic form was disturbed as little as possible, the body was extended outward as far as possible to enable the front wheels to turn within the body of the vehicle. As a consequence, the vehicle had a width of 2.10 metres. The engineers accepted that this width would produce a slightly greater drag. The floor of the vehicle was smooth, while the windows were installed flush with the outer shell. Despite its aluminium body, the car weighed approximately 250 kilograms more than the production model on which it was based, a Mercedes 170 H.

A more economical vehicle

During 1939, the Schlörwagen was put through its paces in a series of tests conducted on the recently completed highway near Göttingen, the forerunner of today’s A7. The production car achieved a maximum speed of around 105 kilometres per hour, while the aerodynamic version recorded a remarkable 134 to 136 kilometres per hour. The Schlörwagen consumed eight litres

of fuel to drive 100 kilometres, while the production car used 10 to 12 litres – equivalent to a reduction of between roughly 20 and 35 percent.

Despite all the aerodynamic advantages that the Schlörwagen had to offer, it never went into production. There was a good reason for this: "The excellent aerodynamics came at the expense of driving safety," says Dillmann. The Schlörwagen was not just difficult to drive – strong crosswinds would simply have swept the vehicle from the road. Today, it is possible that electronic driving assistance functions would solve this problem.

After completion of the tests in Göttingen, the Schlörwagen was presented to a surprised audience at the 1939 International Motor Show (Internationalen Automobilausstellung; IAA) in Berlin, but the outbreak of the Second World War stopped any plans for the development of cars. In 1942, the Schlörwagen was equipped with a 130 horsepower aircraft power unit captured from the Russians. This unusual design created quite a stir during a test run in Göttingen.

The Schlörwagen disappeared from the public eye after the end of the war, although theories on its whereabouts remained in circulation. Some claimed it had been confiscated by the Allies and spirited away to England, while others speculated that it burned out in Riga or might even stand forgotten in a shed near Göttingen. But according to Jessika Wichner, Head of the DLR Central Archive, all of these theories are wrong: "We have evidence that the Schlörwagen was located at AVA Göttingen until at least the end of August 1948." Its inventor found out in a letter that 'the remains of the body of the vehicle are preserved in a damaged condition'. Parts such as seats and wheels had been removed during the war, and the car was ‘parked’ in a dilapidated building. "At that time, the vehicle was neither roadworthy, nor in any meaningful sense of the word a complete vehicle," says Wichner. Schlör's hopes to be given back at least the remains of his invention were finally dashed in 1948; a tow truck had to turn around and return from Göttingen without the vehicle when the British Military Administration refused to release it. After that, there are no further traces of the car. "Regrettably, it is extremely likely that the severely damaged body was quite simply scrapped," Wichner suggests.

A 1:5 scale model of the Schlörwagen, built according to the original drawings from the DLR archive has recently been showcased in the newly opened exhibition centre PS.Speicher in Einbeck .

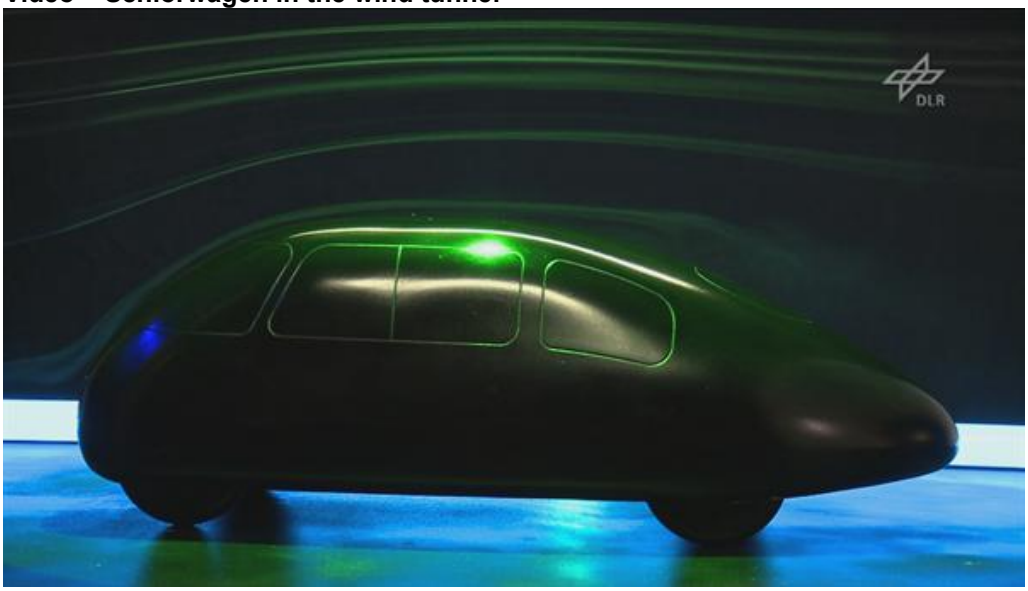
Contacts

Jens Wucherpfennig
German Aerospace Center (DLR)
Tel.: +49 551 709-2108
Fax: +49 551 709-12108
Jens.Wucherpfennig@dlr.de

Prof. Dr. rer. nat. Dr.-Ing. habil Andreas Dillmann
German Aerospace Center (DLR)
Tel.: +49 551 709-2177
Fax: +49 551 709-2889
Andreas.Dillmann@dlr.de

Dr. Jessika Wichner
German Aerospace Center (DLR)
Tel.: +49 551 709-2153
Fax: +49 551 709-2948
Jessika.Wichner@dlr.de

Video – Schlörwagen in the wind tunnel



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Credit: Video: DLR (CC-BY 3.0)/Music: Franz Josef Grümmer.

The Schlörwagen

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Credit: DLR (CC-BY 3.0).

Schlörwagen from the front

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Credit: DLR (CC-BY 3.0).

Test drive on the highway

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Model in the wind tunnel

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Credit: DLR (CC-BY 3.0).

Karl Schlör

The Schlörwagen is named after the German engineer Karl Schlör (1910–1997). From 1936, Schlör worked at the Aerodynamic Research Institute (Aerodynamischen Versuchsanstalt; AVA) in Göttingen, one of the predecessors of today's DLR. From 1941–1944, he headed the AVA branch in occupied Riga. After the war he worked at the Ministry of Transport in Munich.

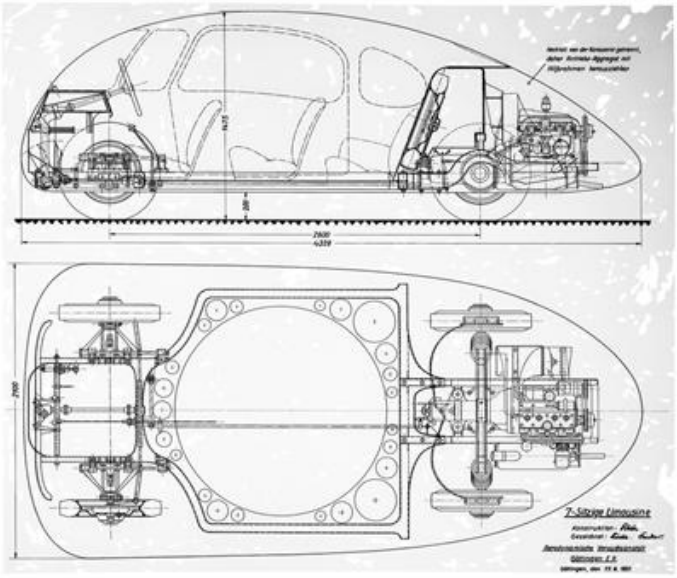
Credit: DLR (CC-BY 3.0).

Interior view

The steering wheel of the Schlörwagen was in the centre of the vehicle. Overall, there was room for seven people.

Credit: DLR (CC-BY 3.0).

Construction drawings



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Credit: DLR (CC-BY 3.0).

Test drive with a Russian aircraft power unit

The outbreak of the Second World War stopped any plans for the development of cars. In 1942, the Schlörwagen was equipped with a 130 horsepower aircraft power unit captured from the Russians. This unusual design created quite a stir during a test run in Göttingen.

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