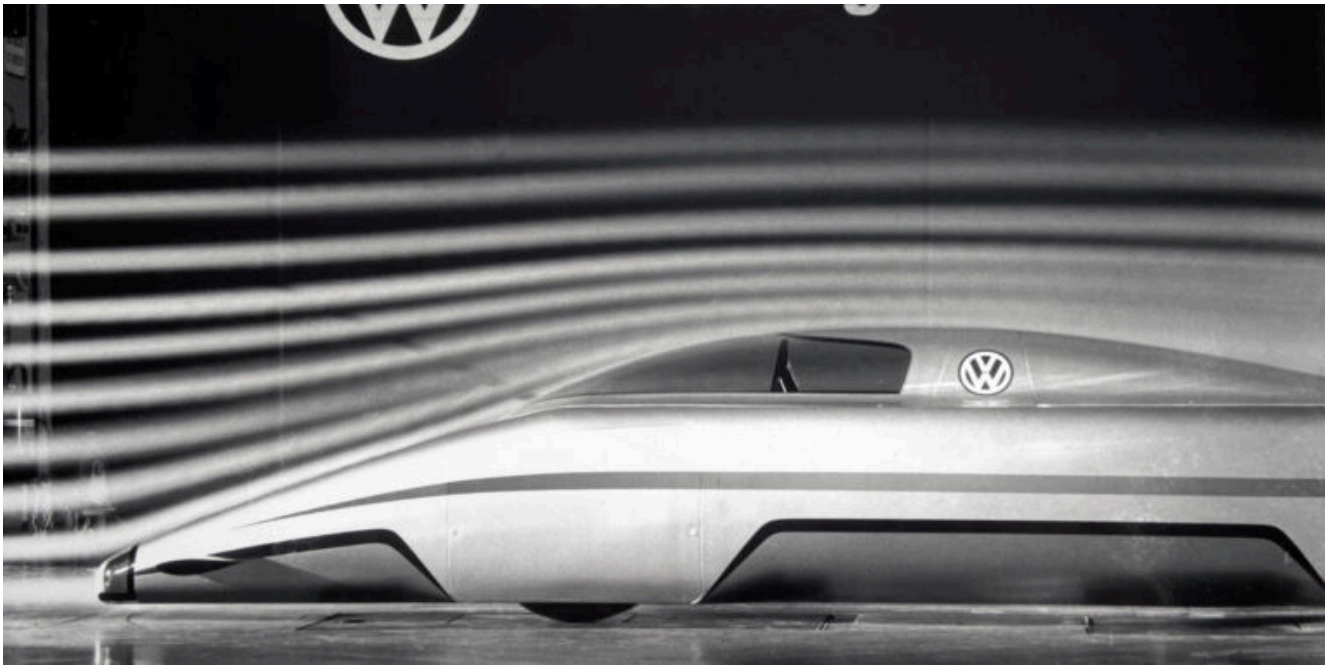
These streamliners are the world’s most aerodynamic cars



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- In 1980, Volkswagen built the ARVW concept car, the most aerodynamic vehicle it has ever created. It achieved a drag coefficient (Cd) of just 0.15. By contrast, most road cars have a Cd of between 0.3-0.4.
  Volkswagen
- The ARVW was able to reach 225mph (362km/h) at the Nardo high speed bowl.
  Volkswagen
- The Model 3 (and now Model Y) has a Cd of 0.23, but only when fitted with the aero wheel covers.
  Sean Gallup/Getty Images
- When a wheel rotates, it disturbs the air a lot, and that causes aerodynamic drag. That’s why electric cars

often have wheel faces that are as close to being a solid disc as possible, while still allowing the brakes to cool.
Christian Marquardt/Getty Images

- The Porsche Taycan 4S (pictured) and Taycan Turbo have a Cd of 0.22 when fitted with these wheels.
- In 2013, Mercedes-Benz tweaked the shape of its CLA 180 BlueEfficiency diesel to generate a Cd of 0.22.
  Mercedes-Benz
- Four years later, BMW managed the same Cd of 0.22 with its 520d EfficientDynamics diesel.
- In 1996, GM's EV1 electric car had a Cd of 0.19. Sadly, almost all of these cars ended up in the crusher.
  General Motors
- In 2013, VW built the XL1, which can get more than 200 US mpg.
  Volkswagen
- Covering the wheels cuts drag even more than clever wheel design.
- The Lightyear One is a solar EV being developed in the Netherlands, and if it makes it into production, it should beat the XL1 and EV1 in terms of drag.
- For even lower-drag vehicles, we need to forget about road legality. This is the JCB Dieselmax, the fastest diesel-powered vehicle on earth. In 2006, it went 350mph, and it cuts through the air with a Cd of 0.147.
  Rui Vieira – PA Images/PA Images via Getty Images
- The slipperiest concept car I can find is this, the 1986 Ford Probe V. Its Cd is 0.137.
  Boris Nizon/RDB/ullstein bild via Getty Images
- As far as circuit racing cars, I don't think anyone has created one with less drag than the 1964 Panhard CD LM64. Its shape—with a Cd of 0.12—was designed with Le Mans' three-mile Mulsanne Straight in mind.
  GP Library/Universal Images Group via Getty Images
- Another land speed car is even sleeker than the JCB Dieselmax—it's the Goldenrod, and it held the record for

the fastest wheel-driven car on earth from 1965 until 1991.

- But even the Goldenrod has to bow down to this torpedo on wheels. It’s called the Eco-Runner 8, and its shape has a Cd of only 0.048!
  Eco-Runner Team Delft

With no car launches to work on thanks to COVID-19, some automakers’ press offices are filling the gap by digging into the archives to share interesting stuff with the rest of us. On Thursday, Volkswagen North America reached out to tell us about the company’s most aerodynamic car ever. It was called the Aerodynamic Research Volkswagen, and it was built in 1980 as a demonstration of how to make a vehicle as slippery as possible, with a drag coefficient (Cd) of just 0.15. Powered by a 177hp (132kW) 2.4L inline-six cylinder engine, the ARVW reached a speed of 225mph (362km/h) at the Nardo test track in southern Italy. But the ARVW isn’t the lowest-drag vehicle ever built, just the lowest-drag VW. So what is the most aerodynamic car of all time?

Production cars

When Tesla revealed its Model 3 sedan a few years ago, it was justifiably proud of the car’s Cd of 0.23, which bettered the Models S and X by 0.01. Tesla didn’t optimize the Model 3’s aerodynamics just for bragging rights. The lower a car’s drag, the farther it can go per unit of energy because it doesn’t have to work as hard to push its way through the air. However, a Model 3 is only this slippery through the air when the car’s 18-inch wheels are fitted with the aero wheel covers, something Car and Driver put to the test late last year. (If you’re a Model 3 owner and into hypermiling, you can cut your car’s drag—and thereby boost its range—even further by fitting aftermarket front- and rear spoilers.)

But the Model 3 isn’t the lowest-drag car to have gone into

production. Porsche's Taycan battery EV bested Tesla's best when it went on sale last year. Both the Taycan Turbo and Taycan 4S manage a Cd of 0.22, although again, only with the most aerodynamic wheels fitted. The Taycan Turbo S uses a different design, and in the wind tunnel, that adds 0.03 to the Cd.

That number is pretty low, and it's one reason Autoblog, Car and Driver, The Drive, Inside EVs, MotorTrend, Road and Track, Roadshow, and others have all found its EPA range is woefully pessimistic. But Porsche wasn't the first automaker to sell a car with a Cd of just 0.22. Both BMW and Mercedes-Benz got there first, each with a diesel sedan. In 2013, Mercedes optimized the already slippery 2013 CLA—Cd 0.23—a little further for the CLA 180 BlueEfficiency, fitting different mirrors, wheel covers, serrated spoilers, and a few other tweaks here and there to reach a Cd of 0.22. Four years later, BMW got the same number for its 520d EfficientDynamics diesel sedan.

But we're not done yet. Way back in 1996, General Motors' late lamented EV1 BEV cut through the air with a Cd of just 0.19. That was equalled in 2013 when VW—building on the lessons it learned with the ARVW—brought out the XL1. This two-seater was built at the behest of Ferdinand Piech, who told VW's engineers he wanted a "1 liter car" able to travel 100km on just 1L, which works out to 235.1mpg if you speak American. In fact, the XL1, a plug-in hybrid that combined a 47hp (45kW) two-cylinder diesel engine and 27hp (20kW) electric motor was able to better Piech's target, achieving 0.89L/100km (265mpg) on the European test cycle.

The XL1 might not hold the crown for the lowest-drag production car for too much longer. Over in the Netherlands, a startup called Lightyear is developing a solar EV called the Lightyear One. If it manages to make it into production, it should equal or better the EV1 and XL1—for now, Lightyear is just claiming a Cd of "below 0.2."

Concepts and racers

A Cd of 0.19 is indeed slippery, but as the ARVW shows, if you don’t need to meet any road car homologation rules, it’s possible to cut drag even further. Like the JCB Dieselmax: in 2006, this diesel-powered land speed record car was designed by Ron Ayers, also responsible for the Thrust 2, Thrust SSC, and Bloodhound SSC (now Bloodhound LSR) land speed cars. (Also, the Enfield 8000, which was turned into Jonny Smith’s Flux Capacitor.) The JCB Dieselmax wasn’t as fast as the jet-powered land speed cars driven by RAF Wing Commander Andy Green, but it did set a world record for diesel-powered vehicles, reaching 350mph (563km/h). Its Cd? 0.147.

In the realm of pure concept cars, Ford’s Probe V of 1986 might be the most aerodynamic ever created. As the name suggests, it was the fifth in a series of Probe concepts dating back to the late 1970s. The engine was mounted at the rear, which allowed for a very low hood, and all four wheels were covered with fairings, which meant when tested in the wind tunnel, the Probe V recorded a Cd of only 0.137.

There are even more slippery cars out there, though. Although these days race cars are optimized to create downforce, before aerodynamicists worked out that the air could be harnessed for added grip, their efforts were mainly focused on drag reduction. This was particularly true at Le Mans, where the track included the three-mile (4.8km) Mulsanne straight. No Le Mans car appears to have taken this more seriously than the Panhard CD LM64. Its bodywork was the result of aerodynamicists Charles Deutsch and Lucien Romani, and it used covered wheels and a smooth underfloor to race down the Mulsanne straight with a Cd of 0.12

Even the Panhard is bettered, however, by another land speed car called Goldenrod. Built by brothers Bob and Bill Summers, in 1965 it set a world record for the fastest wheel-driven car

on earth, at 409mph (659km/h). That record stood until 1991 and was down to a combination of four Chrysler Hemi engines and a Caltech-honed shape with a Cd of 0.1165.

But the record for the lowest-drag wheeled vehicle of all time goes to a much stranger looking machine than any of the others featured in the gallery above. It’s called the Eco-Runner 8, and it’s one of a series of cars built by Team Delft for the Shell Eco-marathon. With a recumbent driving position and just three wheels, Eco-Runner 8’s torpedo-like body is probably the most aerodynamically efficient road vehicle ever, with a scarcely believable Cd of 0.045.

Listing image by Volkswagen

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