

# EYESON DESIGN

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## EyesOn Aerodynamics

### From Art Deco Streamlining to the Modern Art of Aerodynamic Design

By Gary Witzenburg

The shapes of cars have run in cycles as trends and fashions have come and gone. Early automotive style was an afterthought to engineering, then it passed through a period of ornamental embellishment before body shapes began to evolve as metal forming techniques enabled them. The turbulent '30s brought the beginnings of Art Deco car design and some early "streamlining," which resulted in some truly stunning shapes, and some less so.

American cars became flamboyantly finned in the 1950s, more rounded in the '60s and slab-sided in the '70s before aerodynamic efforts began to evolve in the '80s as part of the march toward improved fuel economy. Then downsizing brought boxy shapes as cars tried hard to appear larger than they were, and aerodynamic design was de-emphasized for a time. Today, with fuel prices high and unpredictable, aero-efficient design seems back to stay.

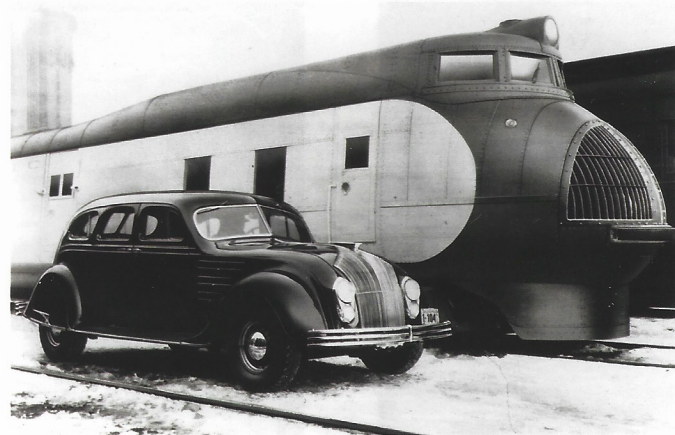
Aerodynamic shaping of vehicle bodies is accomplished through exhaustive work in both studios and wind tunnels to enable them to part the air with a minimum of resistance and drag-producing turbulence. While the ideal aero shape is a falling teardrop - round in front, tapered to a point in back - this is impractical for an automobile. Designers have attempted teardrop shapes with mixed success, and arguably the best has been General Motors' EV1 electric car. Boasting an amazing coefficient of drag (Cd) of 0.19 (vs. a previous production-vehicle low of 0.26), EV1 was ultra-slick to achieve semi-usable range with the energy equivalent of a half-gallon of gas on board. Then GM trumped even that with its 2000 Precept PNGV 80-mpg concept car's astounding 0.16 Cd.

With this year's EyesOn Design theme of "Aerodynamics and Streamlining - by Design," we asked a cross-section of designers for their thoughts, beginning with definitions.

"Aerodynamics in cars has been around since the 1930s but became known to the American public in the early '80s to combat the energy crisis," opines Tom Matano, the former Mazda executive designer who is now Chairman, Transportation Design at the San Francisco Academy of Art University. "Today, it is not just drag co-efficiency but entire airflow management, including downforce, wind noise reduction, and stability control. Streamlining, in my mind, applies to cars of 1930s, when many experimental designs were tried, and some became production models. The main purpose was smoother

airflow to reduce drag for better fuel economy, or to supplement engine power at higher speeds."

"To the automobile designer, there are two definitions of aerodynamics: one subjective, the other objective numbers from the wind tunnel," GM designer Brian Baker points out. "Streamlining is usually associated with a period of design dominated by styling giants such as Loewy and Bel Geddes, who applied linear wrapping graphics and ornamentation to everything from trains to pencil sharpeners to make them look as if they were breaking the sound barrier while sitting still."



1934 Chrysler Airflow

"Streamlining" is usually used in reference to a 'look' we see in certain vehicles," adds former GM Design Vice President Wayne Cherry. "It was very visible in Art Deco design."

#### *How important is aerodynamic design today?*

"Aerodynamic shape is the most significant way in which a designer can influence the fuel economy of an automobile," says Cherry's successor, GM Global Design Vice President Ed Welburn. "Aerodynamic studies also can make the driving experience more pleasant through reduction in wind noise and improved handling. And a vehicle with the appearance of aerodynamic efficiency may have an advantage in a market in which consumers are looking for very fuel efficient automobiles."

"Aerodynamics is critical to today's cars and will continue to be for several reasons," says Charles Allen, senior VP, president/general manager, Honda R&D Americas. "First is fuel efficiency...the less drag a form produces, the less fuel it needs. Second is efficient air routing and flow control for mechanical purposes such as radiator cooling, engine air intake,



1950's Firebird concept vehicles

brake cooling and rain water management. Third is wind noise...driver and passenger comfort is greatly enhanced by how quietly a vehicle flows through the air. Finally, it's always a pleasure to hand wash an aerodynamic shape!"

"Following basic aerodynamic rules leads to smooth, dynamic design, which is still a vital ingredient in 'good' car design," says Roland Sternmann, executive design director of VW/Audi's California Design Center. "Aerodynamics also is very important for vehicle stability at higher speeds. Achieving appropriate downforce in combination with low drag has always been a challenge. And cooling efficiency for the engine, transmission and brakes is largely influenced by aerodynamics. Still, there has never been a car designed by a wind tunnel. All so far have been designed by designers."

"As fuel economy has grown in importance, so has aerodynamics," says Imre Molnar, chairman, transportation design of Detroit's College for Creative Studies. "As the application of aerodynamic principles to cars has become very advanced and sophisticated, we have learned that to achieve low drag, cars no longer need to look aero or teardrop. Careful attention to underbody and surface detail can lead to very slippery vehicles that don't look especially aero."

"Aerodynamics plays a pivotal role in improving gas mileage for medium and high speed driving," adds Victor Nacif, Vice President, Design Business Aspects, Nissan, "and in reducing wind noise, especially around the 'A' pillars, side mirrors and door gaps. It dictates the proper handling of a car at high speed driving and safety in cross winds, and aerodynamic aids are used to convey design innovation and performance."

*Which vehicles most clearly illustrate streamlining?*

Cherry -- "One of my favorites is the Phantom Corsair."

Matano -- "Mid-'30s BMW 328 and other German cars of that era with experimental streamlined bodies; 1936-37 Auto Union 16 cylinder Type C racer; 1939 Mercedes Record Car T 80."

Baker -- "The Golden Rod and the Campbell family's land speed record vehicles represent the high-water mark in streamlined vehicles. This is exemplified in production vehicles such as the Chrysler Aero Sedans of the '40s and Pontiacs of the same period, with their brushed metal streamlined wrapping over the hood and down the center of the fastback sedanettes."

*Which vehicles exemplify the best in aerodynamics?*

Cherry -- "One excellent example is the Audi LMP race car."

Matano -- "1967 NSU RO 80; Toyota Prius; Ferrari's underbody airflow management; current race cars."

Baker -- "The Dr. Paul Jarrey Aero studies in 1930s' Germany; Tatra type 77 with its dorsal fin and air cooled rear engine; Porsche 550 Spyder; Ferrari Testa Rossa of 1984, which benefited from Pininfarina's aero research in the early '80s and paid as much attention to airflow under the car as how air got in and out of the engine compartment; today, the Corvette C6 Z06, with its conscientious effort to reduce frontal area."

*Why is this an important theme for EyesOn Design 2007?*

Cherry -- "It offers a real-time environment for design education and a marvelous opportunity to show any number of beautifully designed vehicles, some illustrating the wonderful shapes that people associate with streamlining, others showing how applied science has evolved the management of air."

Matano -- "I thought it was time to revisit this important area with new criteria to encourage further development and increase public awareness of this new way of thinking for attaining performance with less energy."

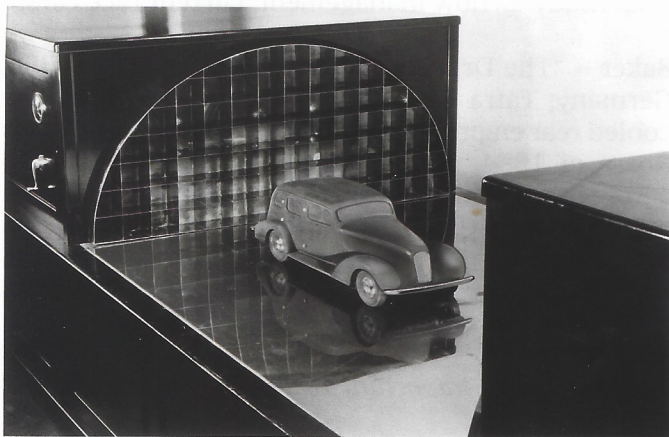
Baker -- "Design has become a global language: Post Modern, Retro, Streamlined, Function over Form, Bling, Deconstruction...every imaginable form of vocabulary is being explored. Ultimately they all must face the same environment on our planet's roadways: air. Darwin didn't know everything, but he got the survival of the fittest part right."

# EyesOn Aerodynamics

## Aerodynamics and Streamlining by Design

By: Glen Durmisevich

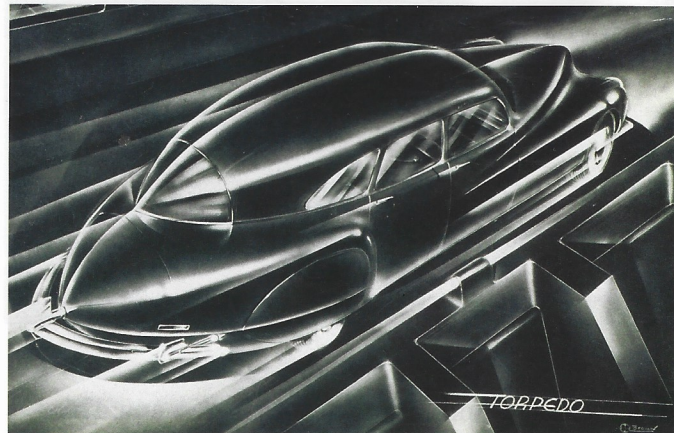
Aerodynamics is the study of the motion of air and the forces acting on objects as they move through the air. Streamlining is to design the contour of an object, such as an automobile or airplane, to minimize wind resistance as it moves through the air. Throughout the history of automobile design, aerodynamics and streamlining have in some way influenced both the appearance and function of the automobile. Sometimes the influence is real; sometimes it is just for looks. The 2007 *EyesOn Design* automotive design exhibition is a look at how aerodynamics and streamlining have influenced and evolved the shape of the automobile; past, present and future.



*An early wind tunnel.*

There were early attempts in the 1930's at true functional aerodynamics for the automobile. Wind tunnel studies were conducted on scale models. But, as a whole, these early aerodynamically styled vehicles, such as the Chrysler Airflow, were not widely accepted by the general public, who preferred more conventionally styled automobiles.

Streamlining, as a styling element however, intended to impart the appearance of speed and motion in cars and trains. The Art Deco era brought graphic elements like speed whiskers; those long tapering horizontal chrome features that gave the appearance of speed. Tapering forms and sweeping fender lines



*An early streamline sketch.*

eventually evolved into teardrop shapes, fastback body styles and fully enveloped bodies without protruding fenders. Early examples of fastbacks from the late '30s through the '40s will be on display at the *EyesOn Design* along with the return of the fastback in the 1960s as a mainstay body style.

At times, the designer's inspiration was drawn from the aerodynamic shapes on airplanes, jets and rocket ships. General Motors is displaying the Firebird Concept vehicles from the 1950s showing not only aerodynamics from airplanes, but gas turbine engines as well. The tail fin, beginning with the 1948 Cadillac, was patterned after the tail fins on the P38 aircraft shown to Harley Earl during WWII. This literally and figuratively grew to inspire



*1936 V-16 Cadillac Aero-Dynamic Coupe*