The AirFlow Truck Company Concepts and Test Trucks

Peter Lobner, 2 April 2020

Introduction

In 1983, Bob Sliwa founded the AirFlow Truck Company (http://www.airflowtruck.com) with a vision to substantially lower the cost-per-mile operating cost for fleet operators and owners of big rigs. This led him to develop advanced aerodynamic design concepts for Class 8 tractor-trailers and fully-operational test trucks that demonstrated the performance gains in real-world, revenue-generating service. These four AirFlow trucks are described below.

- SuperTruck design concept, circa 2011
- FutureTruck design concept, circa 2011
- BulletTruck test truck, circa 2012
- Starship Initiative test truck, circa 2018

The AirFlow SuperTruck

The SuperTruck, developed in 2011 by the industrial design consultant firm Jeremy Singley for AirFlow Truck Company, started life as a Kenworth T2000 tractor-trailer and morphed into a much more aerodynamic form. Many design compromises had to be made, but it enabled AirFlow to demonstrate that a large aerodynamic drag reduction and improved fuel efficiency could be achieved by significantly modifying an existing Class 8 tractor-trailer.

The AirFlow SuperTruck design was estimated to reduce aerodynamic drag by 55% and increase fuel efficiency by 25% in comparison to the T2000 baseline truck.
The AirFlow 2011 SuperTruck.  
*Source, both graphic: Jeremy Singly Industrial Design*

For more information of the AirFlow SuperTruck:

The AirFlow FutureTruck

One particularly elegant concept vehicle, the AirFlow FutureTruck, developed in 2011 by Jeremy Singley Industrial Design for AirFlow Truck Company, is shown below.

*FutureTruck aero-optimized heavy freight vehicle. Source: Jeremy Singley Industrial Design*

This vehicle is representative of a “clean sheet” advanced aerodynamic tractor-trailer design that has the potential to significantly reduce aerodynamic drag and boost fuel efficiency. Working with the AirFlow Truck Company, Jeremy Singley Industrial Design used SolidWorks design and SolidWorks Flow Simulation CFD (computational fluid dynamics) analysis software to create and optimize the innovative conceptual design of the FutureTruck tractor-trailer. This was a more radical solution than the SuperTruck, and the FutureTruck offered greater aerodynamic drag reduction (63%) and increased fuel efficiency (30%).

Jeremy Singley developed CFD models for a baseline conventional tractor-trailer, the SuperTruck and the FutureTruck. As shown in the following graphic, the conventional truck generate much more aerodynamic drag (595 pounds) than either the SuperTruck (330 pounds) or the FutureTruck (220 pounds). As noted above, the FutureTruck drag reduction was 63% from the conventional truck baseline.
Comparison of CFD aerodynamics.
Source: Jeremy Singley Industrial Design

For more information on the AirFlow FutureTruck, see the following video:

- “The AirFlow Truck Prototype Project” (3:25 minutes):
  https://www.youtube.com/watch?time_continue=100&v=gqv3kDUH-DE&feature=emb_title
The AirFlow BulletTruck test truck

AirFlow Truck Company unveiled its diesel-powered BulletTruck in 2012. The BulletTruck is a highly modified and streamlined Kenworth T2000 tractor-trailer, powered by a 450 hp Cummins ISX diesel engine, intended for use as a test truck while operating on revenue-producing freight runs. It is the physical manifestation of Jeremy Singley’s SuperTruck concept.

Aerodynamic features include:

- Extended, faired-in nose cone reduces drag at the front of the tractor.
- Trailer gap sealer is installed between the cab and the trailer to minimize turbulent flow.
- Side skirts (fairings) along the lower sides of the tractor and trailer reduce drag by smoothing airflow in the region and limiting turbulent airflow under the trailer.
- At the back of the trailer, a tapered boat-tail fairing smooths the airflow and reduces the size of the low-pressure area behind the trailer.

The HVAC and power steering pumps are electrically driven, thereby reducing parasitic accessory drag on the engine. A 6000 watt Dynasys APU (auxiliary power unit) supplies the HVAC and other electrical loads. Electric door steps automatically deploy and retract with driver's door operation.

Regarding the three-year development program for the BulletTruck, Bob Sliwa commented: “If I was starting today, and not in Feb. 2009, both the grill inlet and the ground effects would have been dynamically variable. If I was starting tomorrow, we would do it from scratch and not retrofitting an older Class 8 rig.”
In June 2012, the BulletTruck made a 3,043 mile coast-to-coast, revenue-producing, real-world, freight hauling run from Connecticut to Tracy, CA. and delivered an average 13.4 mpg at 65,000 pound (29,484 kg) GVW. This is a very large improvement over the FHWA 5.84 mpg national average fuel efficiency for Class 8 trucks in 2012.

For more information on the BulletTruck:


BulletTruck circa 2012. Source, both photos: Airflow Truck Company
The Shell - AirFlow Starship Initiative test truck

The Starship Initiative is a collaboration between Shell Lubricants and AirFlow Truck Company to develop and operate an advanced, aerodynamic tractor-trailer that can be used to explore the future of what’s possible in truck design, fuel economy savings, and CO₂ reduction. The mission of the Starship Initiative is to minimize the amount of energy it takes to move cargo between two points, with the goal of doubling fuel efficiency. The Starship Initiative tractor-trailer made its debut in April 2018.

The Starship is propelled by a Cummins X15 six-cylinder diesel engine with 400 horsepower and 1,850 pound-feet of torque and an 18-speed transmission. A 5,000-watt solar array on the roof the trailer charges a 48 volt battery bank that powers on-board electrical components, including the HVAC, digital dash and full LED lighting.

The Starship tractor-trailer. Source: AirFlow Truck Company
The Starship tractor-trailer.
Source, both graphics: AirFlow Truck Company
Starship key design features include:

- Lightweight truck construction:
  - The semi-tractor’s cab, hood, bumper, and aerodynamic side fairings are carbon fiber.
- Improved aerodynamics:
  - Claimed drag coefficient ($C_D$): 0.25.
  - The grille has active shutters to optimize aerodynamics.
  - The back of the 80 foot (24.4 meter) long trailer has a fold-out aerodynamic boat tail to streamline air flow.
  - There are automatic extenders between the cab and the front of the trailer to streamline airflow, plus full carbon-fiber fairings over the double-axle drive wheels on the semi-tractor.
  - Full belly pan and side fairings along the sides of the trailer minimize drag-inducing airflow.
  - Small side cameras have less drag than traditional side mirrors.
- Hybrid power train:
  - A hybrid electric axle system with an electric motor and axle replaced the original rear tractor non-driven axle.
The electric motor is powered from batteries to supplement diesel main propulsion during transient load conditions (i.e., acceleration, climbing grades).

*The Starship tractor-trailer. Source: Shell International*

In May 2018, the Starship completed a six-day, 2,300 mile (3,701 km) journey from San Diego, CA to Jacksonville, FL with almost 40,000 pounds (18,144 kg) of cargo at a gross vehicle weight of 73,000 pounds (32,659 kg).

*Starship cross-country route, 18 – 24 May 2018
Source: Screenshot from Shell Lubricants video*
Shell reported that cross-country, the Starship truck attained a freight efficiency of 178.4 ton-miles per gallon, an almost 248% improvement over the North America average freight efficiency of 72 ton-miles per gallon. Average fuel economy for the journey was 8.94 mpg vs. the 2017 FHWA average for Class 8 trucks of about 5.98 mpg. On this journey, the Starship operated at a GVW that was about 16,000 pounds (7,257 kg) higher than the nation average for Class 8 trucks.

You’ll find more information on the Starship Initiative here:


The following short videos provide a comprehensive review of the Starship Initiative:

- “Shell Rotella’s StarShip Concept Tractor-trailer Debuts Ahead of Cross-country Run” (2:54), an introduction by AirFlow Truck Company President Bob Sliwa, 4 April 2018: [https://www.youtube.com/watch?v=Bs7t--6wQz0](https://www.youtube.com/watch?v=Bs7t--6wQz0)

- “Shell Starship - Hyper-Fuel Efficient Truck” (7:38 minutes), Shell Lubricants, 6 June 2018: [https://www.youtube.com/watch?v=G87meJV66Gg](https://www.youtube.com/watch?v=G87meJV66Gg)

- “The StarShip / AirFlow Truck Company” (8:15 minutes), this is a ride along in the Starship on a short trip narrated by Bob Sliwa, 5 May 2019: [https://www.youtube.com/watch?v=aAbf9mOTLAc](https://www.youtube.com/watch?v=aAbf9mOTLAc)