CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

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Project Number

J0111

Project Title

Improving Aerodynamic Drag by Altering the Shape of a Pickup Truck Tailgate

Abstract

Objectives/Goals

This experiment was conducted to identify the most aerodynamic pickup truck tailgate configuration, to lower drag, increase efficiency, and reduce the amount of hydrocarbon fuel consumed. The hypothesis of this experiment was that a more rounded, smooth tailgate would reduce the aerodynamic drag.

Methods/Materials

In order to conduct aerodynamic testing of various tailgate configurations, a small wind tunnel was constructed using instructions from NASA#s Glenn Research Center. Nine different tailgate configurations were evaluated on five different truck-like vehicles. A supplementary experiment was conducted, using a small digital scale, hairdryer, pulley, and a 50 gram weight to collect objective air drag data, to compare and contrast with the wind tunnel data.

Results

Test results showed that each type of pickup truck performed differently with the various types of tailgates. Overall, the tailgate shaped as an #M# and the trapezoid shaped tailgate worked better in general, reducing the aerodynamic drag (lower Number) of most of the pickup truck models. The #M# shaped tailgate#s Reynolds Numbers were 3.5-1983 Chevy Silverado, 5.5-1987 Toyota, 8.5-1997 Ford F-150, 3.0-2009 Ford F-150, 5.5-Jeep Scrambler; while for the trapezoidal tailgates, the Reynolds Numbers were 4.5-Chevy Silverado, 5.0-Toyota, 3.5-1997 Ford F-150, 2.5-2009 Ford F-150, 10-Jeep Scrambler). The supplemental experiment test data showed that the aerodynamic drag on the trucks varied from a low of 4 grams of force, to a high of 9 grams of force. In general, this data supported the earlier experiment.

Conclusions/Discussion

The Ford F-150s were proven to be the most aerodynamic in their original state (5.0 and 6.0 Reynolds Number, respectively), perhaps due to the smoothness of the front end and transition to the cab. The remainder of the pickup trucks were observed to be very inefficient. The addition of the various tailgate designs improved the aerodynamics of all models; the #M# shaped and trapezoidal tailgates proved to be the best designs overall, with the lowest visual turbulence and measured aerodynamic drag forces. This experiment proved that the aerodynamics of these pickup trucks could be improved significantly by using different types of tailgates.

Summary Statement

My project focus was to identify ways to improve the aerodynamic drag of a pickup truck tailgate by altering its shape.

Help Received

Wind Tunnel design modified from Tom Benson, NASA Glenn Research Center; Father cut Plexiglas and truck tailgates.