CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

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Project Number

J0110

Project Title

Shape and Flow: What Makes My Derby Car Go?

Abstract

Objectives/Goals

This experiment was conducted in a full-scale, low speed wind tunnel in order to test the aerodynamic properties of a soapbox derby car and to create a racing strategy based on science. Derby cars have only gravity as their engine, so reduction in drag is critical to maximize speed. The hypotheses for this experiment is that there are four variables that have the greatest effect on the shape of the car and how air flows around it in a race; airfoils, a painted car shell, a foam lined cockpit and a driver seated as far forward as possible - and that this will be the combination that yields the lowest grams force drag on the car.

Methods/Materials

Two super stock soap box derby cars were tested in the San Diego Low Speed Wind Tunnel to allow for accurate calculations and data capture. A plate was made to place on top of the load cells to secure the car in the wind tunnel. The cars were loaded inside the wind tunnel and the tests were conducted at 10-35 miles per hour in 5mph increments. There were three categories of tests - car only, car and a "human analog," and car with human.

Results

The results of the experiment showed that airfoils attached to the axles lowered grams force drag and had the greatest impact of any variable. Lining the cockpit with foam reduced grams force drag as hypothesized. The tests regarding driver position revealed that a rear seated driver actually had a better reduction in grams force drag than a forward seated driver. The data showed that there is a benefit for a smaller driver to sit in the rear of the cockpit opening for a reduction in drag.

Conclusions/Discussion

The data proved the experimental hypotheses to be correct with respect to the airfoils and a foam lined cockpit yielding a lower grams force drag. The data showed that the rear position for driving had less grams force drag contrary to my hypothesis. The experiment revealed that the painted shell and unpainted shell had similar grams force drag but it also highlighted the importance of measuring the actual frontal area of a cars shell because the smaller the shell the lower the drag. The data will be used to create a scientifically sound racing strategy and to refine slow speed computer models for the US Olympic Bobsled Team.

Summary Statement

This project was conducted to test the aerodynamic properties of a superstock soap box derby car in a low speed wind tunnel and to use the data to create successful racing strategies based on scientific evidence.

Help Received

San Diego Low Speed Wind Tunnel - ran wind tunnel. Ollie Brower - US Olympic Bobsled Team aerodynamicist helped review data and critiqued test procedure.