CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

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Project Number

31375

Project Title

Winglets in Wind Tunnels: How Do Winglets Affect Lift and Drag of Aircraft Wings?

Abstract

Objectives/Goals

My science project was to build a wind tunnel in order to create an experiment that tested the efficiency of different winglet designs. Winglets are the physical extension on the end of airplane wings that protrude and stand vertically. I intended to test three different winglet configurations (no winglet, 90 degree winglet, and angled winglet), and measure lift and drag attributes of the different designs.

Methods/Materials

I built a subsonic, open-circuit, closed test chamber wind tunnel from plywood, polycarbonate lexan, an attic fan, and other materials. The wind tunnel was approximately 8 feet from end-to-end, and consisted of a contraction chamber, a test chamber, and a diffusion chamber. I carved test wings and winglets out of balsa. The test rig consisted of brass rods attached on one end to a wing in the test chamber, and on the other end to two multi-force sensors measuring lift and drag. The sensors were linked to a computer running data collection software. For each of three winglet configurations I ran multiple tests and averaged the results. Each test collected data for 10 seconds. I compared and graphed the data results.

Results

The data convincingly showed that winglets increase lift, but angled winglets as opposed to vertical winglets contributed the most lift and actually reduced drag compared to a wing without winglets. The average ratio of lift to drag in the no winglet configuration I measured at 0.85, compared to 1.20 for a 90 degree winglet, and 1.74 for the angled winglet (with the higher value reflecting greater wing efficiency).

Conclusions/Discussion

The evidence from my science project showed that aircraft wings can be made more efficient with the use of winglets, and that angled winglets produced the most beneficial increase in lift with reduced drag. This suggests that through wing designs incorporating angled winglets, aircraft could be more fuel efficient, both lowering costs and reducing environmental impact.

Summary Statement

I built a wind tunnel to test the efficiency of different winglet designs.

Help Received

My father assisted me with some of the wind tunnel construction.