BLA Wing: Boundary Layer Adhesion Prototype to Minimize Aircraft Stalling via Wind Tunnel Testing Apparatus

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Aircraft stalling accidents, caused by boundary layer separation over wings, are nearly 50% more likely to be fatal than non-stall related accidents posing as a momentous safety hazard on commercial flights. To mitigate the risks imposed on passengers, the BLA (Boundary Layer Adhesion) Wing was developed featuring a cavity for pressurized air input, holes for airflow redirection, and lightweight structure. The prototyping was completed via SolidWorks and included five variations of the anti-stall design as well as the industry standard profile produced using vat photopolymerization. To accurately quantify the improvement between the standardized and revised BLA prototypes, a wind tunnel apparatus was constructed to provide air pattern visualization. The components include: 6:1 Venturi Tube ratio, flow straightener, glycerine fog generator, fog reservoir, smoke manifold, pressurization fan (displaces fog), masonite lining (reduce friction), wing-mounting brackets, acrylic sheets (transparency), 1,130 RPM fan (power), and anemometer. The five prototypes/standard wing were tested at 0-30-60° angles. The most effective BLA prototype has a calculated Reynolds Number (Re), of 606.187 compared to the industry standard of 803.299, giving a 24.54% increase in laminar flow. Computational Fluid Dynamics (CFD) diagnostics were run on BLA Wing as a supplemental result to the Re, demonstrating improved flow and pressure distribution. CFD Case Solver produced 246 contacting fluid (air) cells for standard wing and 736 for BLA Wing within the cavity (60 degrees). These results represent an increase of laminar flow, as opposed to turbulent, minimizing boundary layer separation making commercial flight safer.

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