Analyzing the Effectiveness of Various Rocket Nose Cone Shapes in Reducing the Effect of Aerodynamic Drag Experienced During Flight

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One of the main problems with spaceflight is the high costs associated with it. For example, the Space Shuttle cost $65,000 per kilogram of payload delivered to Low Earth Orbit. Drag is a factor that contributes to the high cost of spaceflight, which is reduced through the use of nose cones. To help improve rocket efficiency and reduce the costs of spaceflight, the researcher set out to identify the nose cone shape that was most effective in reducing the impacts of drag experienced by rockets during flight. The researcher initially tested five rocket nose cone shapes (conic, biconic, elliptical, parabolic, and tangent ogive). After testing these shapes, the researcher modified the tangent ogive shape to have a finesse ratio of 4.5:1 and a blunted tip. Nose cones were tested in a home-built wind tunnel that utilized a load cell and microcontroller, which recorded 100 data points per second for 10 seconds, to measure drag. Also, model rocket flights were equipped with an altimeter to record measurements such as apogee and top speed. The long tangent ogive-shaped nose cone had the lowest drag force in the wind tunnel test at 1.027 g of force (s=0.042g), 0.083g more efficient than the next most efficient shape. This shape also had the highest apogee at 105.8m (s=6.85m), the highest average speed of 44.2m/s (s=1.33m/s), and the highest max acceleration of 8.3 Gs (s=1.05Gs). Overall, the longer tangent ogive nose cone outperformed the other shapes, and was overall superior, likely aided by its increased finesse ratio. The success of this modified nose cone shape adds to the importance of further research on rocket nose cone design improvements to achieve the highest efficiency possible for reducing flight costs.

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