



## AIRFOILS

How do airplanes fly? The answer is explained by the science called aerodynamics. This is the study of air in motion and the forces that act on solid surfaces moving through the air. Aerodynamics is the reaction of the air on the specifically shaped wings, or airfoils, which lifts an airplane off the ground and supports it aloft. Lift is one of four forces that act on an airplane. The others are weight, drag, and thrust. Lift is an upward force that offsets the aircraft's weight. Airfoils are typically designed to withstand varying degrees of dynamic force. The airfoil must be designed for minimal drag and maximum lift to achieve greater performance.

### Your Challenge

Design and construct an airfoil that will perform with the *greatest* amount of **lift** and the *least* amount of **drag** at the prescribed wind speed and angle of attack. Base your design and construction on solid research & design principles and calculations.

#### Limitations/Specifications:

1. Airfoil must be exactly 3 inches in sectional length.
2. Airfoil must not exceed 4 inches in width (leading edge to trailing edge).
3. Airfoil must not exceed 1 ½ inches in thickness.
4. Airfoil must be designed to attach a mounting flange on the bottom center (mount area is 3/4" wide and must be 1/4" thick internally).
5. Airfoil must be able to withstand 80 mph wind speeds.
6. Airfoil will be tested at 55 mph.
7. Airfoil will be tested at +10° angle of attack.

#### Design and Construction:

1. Design airfoil using appropriate technical design methods and procedure (preferably CAD)
2. Construct airfoil using Computer Numerical Control (CNC) technology

#### Wind Tunnel Testing:

1. Attach mounting flange to the bottom of the airfoil.
2. Attach airfoil to mounting support of test bed of wind tunnel.
3. Fasten test bed firmly in place in the wind tunnel.
4. Check for alignment in wind tunnel.
5. Activate computer and wind tunnel. Initiate wind tunnel test program.
6. Establish wind speed for initial test (e.g., 55 mph).
7. Test at specifically designated angles of attack (e.g., +10 degrees).
8. Print graph and data for each test.

#### Scoring:

Scoring will be based on:

- Your rationale for your solution (grounded on strong research)
- Technical design of your solution (technical drawing & parts list)
- Craftsmanship and construction of airfoil
- Functional test of your airfoil
- Post test analysis of your solution

You will be expected to give a short oral presentation describing the rationale for your design and structure. See [R&E Experiment Evaluation Form](#) for details and point values.

