

# Aerodynamics Part 2 - Wings and Lift

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*Daniel Sullivan September 25, 2019*

## *Wings when they're nice.*

1. What are the general wing shapes for sub-sonic aircraft (There are variations on the themes but most references and study guides refer to five or six different types).
2. What is the most efficient wing shape (compared to other shapes with the same aspect ratio) and why is it rarely seen?
3. And – just what the heck is ‘aspect ratio’ and how does it relate to lift (or maybe think of this as stall speed) and drag (in general - some wings’ “mileage” does vary)?
4. Defining the physical shape of a wing
  - a. What four geometric parameters define the physical shape of a wing? Yes, there are a lot of other things, some which are subparts and specific points along some of the basic parameters but we’re just going for the basics here. Feel free to be more specific.
  - b. How can you change these parameters in flight – and what parameters change when you do each of these things?
5. Angle of attack:
  - a. What is the geometric angle of attack?
  - b. What is the absolute angle of attack?
  - c. Under what condition is the geometric and absolute angle of attack the same?
6. The lift formula
  - a. What is it?
  - b. How does the coefficient of lift ( $C_L$ ) correlate to angle of attack (in the pre-stall region)?
  - c. What happens to  $C_L$  in the stall region? So based on the lift formula what does this say about lift in the stall region?
7. How an airfoil creates lift is complicated. We try to boil it down to some basic principles and to things that are easy for us to visualize. What do you think regarding these “lift analogies”?
  - a. Air is like bullets – when it hits the bottom of the wing it pushes the aircraft up.
  - b. A wing (looking from the side) is curved on the top, flat on the bottom. That means the air that goes over the top has to go faster in order to keep up with the air on the bottom because the air molecules on the top have to rejoin the air on the bottom, pairing up again just like they were at the point they separated.
8. Aerobatic aircraft fly upside down, sometimes for fairly long distances. What type of wing is required for an aircraft to fly upside down?
9. Ground effect – another thing that used to be taught (incorrectly) some years ago was a “cushion of air” formed by the wings compressing air beneath them. But, it is not that. So (because lift itself is complex) give a just a general description of what ground effect really is and give the four things that change (and how they change) when an aircraft leaves ground effect on takeoff.