FOUNDATIONS OF FLIGHT
RAM-AIR PARACHUTE ANATOMY—WING PROPERTIES

AXIS Flight School®

Brought to you by Niklas Daniel and Brianne Thompson of AXIS Flight School at Skydive Arizona in Eloy. Images by Bruce Fournier.

In the previous article, we discussed the internal structure that makes up a parachute's cells and contributes to its airfoil shape. In this article, we shift our vantage point to view the parachute from above.

Planform—Vertical Axis View

One can see the wing's planform—the two-dimensional shape and size of the wing—when viewing it from above. Shape and size play an important role in aerodynamics, as the design of a wing deflects airflow in ways that yield specific flight characteristics. There are a variety of shapes based on a wing's mission, but most are referred to as either rectangular or tapered (sometimes elliptical for highly tapered planforms). Surface area also plays a vital role in how much weight a wing can carry safely and is why tandem canopies are much larger than solo jumpers' wings. A future article will address the concepts of wing loading and taper in more detail.

Nerd Zone!

There are two ways of defining the surface area of a wing. There is the actual area (flat area) of the wing when it is spread out on the ground. The other is the projected area, which is in concept like a shadow the wing casts on the ground when it is fully inflated. Due to the canopy's curvature when inflated, the projected area is always smaller than its flat area.

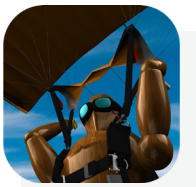
Aspect Ratio (AR)

Aspect ratio is a measurement of how slender a wing is, defined by the relationship between the wingspan (span) and the chord. The span (S) is an imaginary reference line that connects the wingtips, while the chord (C) is the greatest distance between the leading and trailing edges (in some cases, the mean chord is used for tapered wings). In stable coordinated flight, the span is perpendicular to the oncoming airflow while the chord is parallel with it. AR=S/C

Most skydivers correlate the concept of AR with the number of cells a canopy has (seven vs. nine), but theoretically one can subdivide a rectangle into an unlimited number of segments while maintaining the same AR. Therefore, adding cells to a specific size and shape does not automatically equal a greater aspect ratio.

Influence on Performance

A wing's AR is a great predictor of performance and maneuverability (aerodynamic efficiency). In scientific terms, a high-aspect-ratio wing can produce greater lift at lower angles of attack with less induced drag when compared to a low-aspect-ratio wing of the same size. Over-simplified, a skinnier wing can glide farther than a stubby one of the same square footage. An extreme example in the ram-air-canopy world are paragliders, which can glide great distances. The average AR for paragliders is around six or greater, while a skydiving parachute's is two to three. Though a design that yields a long glide is great at face value, there are limitations to how skinny designers can make parachutes before this property starts to negatively affect the opening characteristics and stability. Higher-aspect-ratio wings are more prone to suffer from off-heading openings and closed end cells during deployments, and their pilots need more skill to recover smoothly from stalls.



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Your reserve, which is designed to have predictable openings and docile flight characteristics, will likely not glide as far as your main and its flare response during landing may be quite different. (Side note: You can demo reserves.)

It is important to choose a wing that is right for your experience level, skill, currency and discipline. Know that each wing on the market is designed with a specific purpose in mind and that it is up to you to do your due diligence ensuring the best fit for your needs and preferences. In the next installment, we will take a closer look at the fabrics used to build parachutes.

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