

# Stability Curves for Kayaks

Adapted from “Kayak Stability and Leaning” by Nick Schade of Guillemot Kayak by SKSA-Ltd.

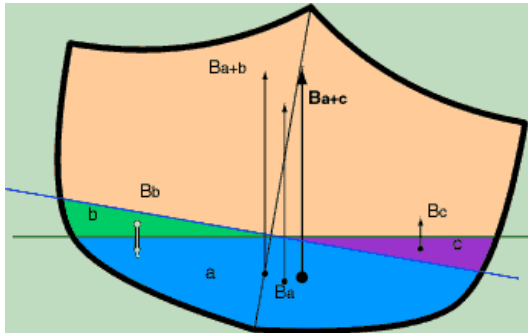


Figure 1: Forces affecting a tipped boat.

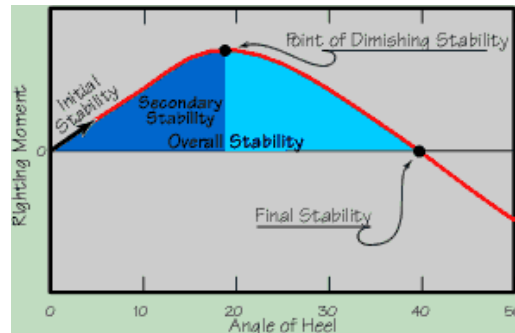


Figure 2: Sample Stability Curve

Most kayaks have some “stability” meaning that they tend to stay upright unless tipped past a certain point. This stability changes depending on the size and weight of the paddler, and will also be affected by the volume and weight of gear stowed in compartments. Forces acting to restore a tipped kayak to an even heel are shown in Figure 1. In a level boat the center of gravity (center of mass) is directly over the center of buoyancy. As the boat tips, the center of mass moves in the direction of tip. In a stable boat, the shape of the boat moves the center of buoyancy in the same direction as the center of gravity, which acts to restore the boat to a stable position.

Published stability curves are generalities containing many compromises. A typical curve may be given for a 200-lb load centered 10 inches above the bottom of the boat. Obviously different paddlers will simulate this situation to a greater or lesser degree. A short, light woman will experience stability differently than a large, tall man. Even so, the stability curve is a useful way to compare different boats.

**Initial Stability:** The initial stability (IS) is determined by the shape at the very bottom of the hull. A flat hull will have a good initial stability. Boats with a very high IS (steep slope) will show a steep initial slope in figure 2 and will have very flat, wide bottoms and low seats (but may not track well). This makes the paddler feel quite secure when sitting upright in the boat.

**Secondary Stability:** Secondary stability (SS) comes into play as the boat tips. SS is more important to experienced paddler that will often lean their boat to aid in turning or maintaining course in wind. The SS is determined by the width of the boat just above the waterline. A hull that brings more volume into the water as the boat tips will show significant SS. In figure 2 this is the area under the stability curve. The chine is the shape of the hull between the base of the hull and the side of the boat. A boat with a sharp chine may seem more stable in calm water but rounded chine will react less to waves and chop - improving perceived stability.

**Ultimate Stability:** As the tipping angle increases past the point of diminishing stability the boat will begin to seem less stable. Actually, the restoring force still acts to restore equilibrium, it is just getting increasing weaker. As the righting moment decreases to zero, capsize becomes inevitable. This is the point of ultimate stability.

**Overall Stability:** Overall stability is the entire stability curve from zero lean to the angle of ultimate stability. At this point, the boat and paddler are going in the water unless some other force acts to prevent it, like a good brace and recovery stroke. Stability is very subjective. A boat that seems dangerously “tippy” to a novice may be slow and boring to an experienced paddler.