CHOOSING YOUR CANOE

By John Winters

Choosing the best canoe for your purposes from among the many different models available would be difficult under the best of circumstances, but given the claims, counter claims and advertising exaggerations, the job is nearly impossible. Even the best paddlers have different opinions on the best canoe for any given purpose. Short of undertaking a full scale study of hydro-dynamics, the buyer is on his own. Fortunately, a knowledge of design funda-mentals can help you separate the most promising canoes for your needs from those that are unsuitable.

The following explanation of how canoe performance is affected by shape, is written by designer John Winters. It should allow you to evaluate, in an objective manner, the merits of different canoes. If you have an interest in the more technical aspects of design, we recommend you to read John's articles at Green Valley Boat Works:
http://www.greenval.com/jwinters.html

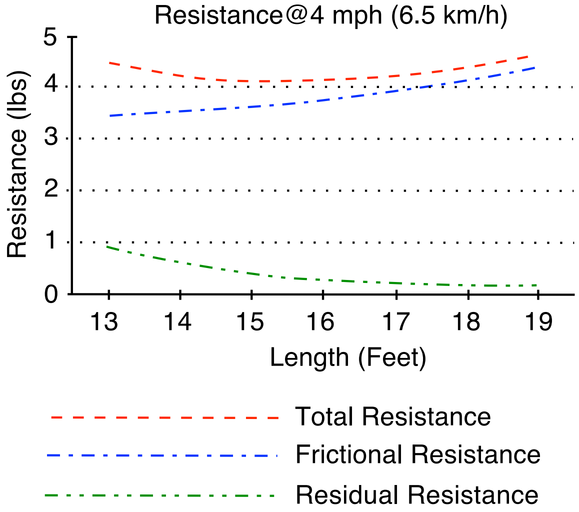
FACTORS AFFECTING PERFORMANCE

Every canoe is a compromise between conflicting needs. For example, many of the characteristics that make a canoe stable also make it hard to paddle, and many of the features that make a canoe track will also make it hard to turn. Obviously we can't have everything we want in the same boat and must find the best compromise to suit our requirements. The designer faces the task guessing what compromises will appeal to the costumer. How well he does this will determine how many canoes of his design are sold. You might think that after thousands of years of development, canoes would be pretty standardized, but they aren't. In fact, the variety has increased as boats are designed for ever smaller niches in the market. Further complicating is the fact that only recently, rudimentary scientific principles have been applied to canoes and their design has lagged well behind that of yachts and other watercraft. Nevertheless, canoeing is catching up and more and more designers are applying scientific principles to their designs in an effort to optimize performance. Newer designs can be a significant improvement over traditional types. Their shapes are based on sound rational thinking rather than opinion and subjective guesswork. The downside of this is that the technical aspects are often confusing for the paddler who just wants a good canoe and not an education…

To help you wade through – or avoid – the technical swamps, the following is a general guide for the effects of various hull characteristics. Keep in mind that this is neither all inclusive nor can it be applied to canoes carelessly. *Canoe are complicated subjects and the more we know, the more it seems we have to learn.*

Length — Length is measured at two points, at the waterline and overall. Of the two, the waterline is most important as this is a primary influence on how easily a boat will paddle and, to some extent, how much load it will safely carry. It is commonly believed that longer canoes are faster or easier to paddle than short canoes. This is, however, not the case, for with greater length comes increased wetted surface, and at typical cruising speeds wetted surface accounts for over 80% of all resistance. If you paddle consistently at 40 or more strokes per minute or regularly carry in excess of 500 lb (230 kg) load (all gear plus people!) then you will need a tandem canoe of 18 feet (5.5 m) or longer. On the other hand, if you paddle at about 30 strokes per minute and carry between 400 and 560 lb (180–250 kg) load (people & gear) most of the time, then a 16 to 17 foot (4.8–5.2 m) canoe will be best — and so on down the scale. Too large a canoe will simply mean extra work paddling at your cruising speed.
The designer must take these factors into account when he shapes the hull and determines the dimensions.

The figure below shows a typical graph of resistance used to determine the ideal length at a particular speed. This can be done for any speed, but here it is done at a typical cruising speed for recreational canoeing.

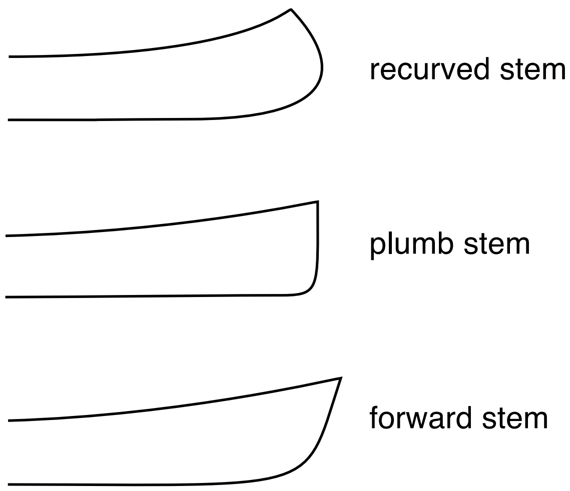


Wavemaking and frictional resistance (bottom and middle curves) are plotted for a single shape but for varying lengths. The two are added together and a curve of total resistance is drawn. You can see that the ideal length for this speed is where the curve is at its lowest point on the red line — in this case 15 feet (457 cm). Designers can choose somewhat greater length though for increased speed potential for stronger paddlers or emergency situations.

Every canoe has a speed at which it is most efficient. This speed is a function of both hull shape and dimensions. The problem for the designer is to match that speed with the power output of the paddler. As you can appreciate, every paddler has a different stroke rate and strength. To determine the proper cruising speed then, a large number of paddlers of varying abilities were observed to arrive at a typical power output. If you are an ‘average paddler’ and do about 30 strokes per minute, your cruising speed should range between 5.3 km/h when paddling a 15 feet (4.5 m) and 6 km/h for an 18 feet (5.5 m) long canoe.

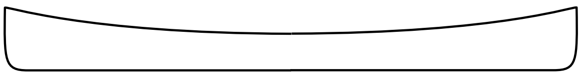
The important thing to be aware of is that even though the longer canoe has a higher cruising speed, you do not get something for nothing and will have to work harder to maintain that speed in the longer canoe. Canoes only go faster if you are strong enough to push them that hard.

The amount of reserve buoyancy a hull will have is a function of overall length and topside shape. Canoes with bows that re-curve in the traditional fashion or have tumblehome have relatively less buoyancy than those with vertical bows which, in turn, have less than those with ends that extend beyond the waterline.

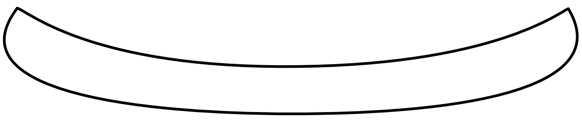


Beam — Waterline beam, properly measured at the actual waterline when loaded, is a good indicator of many canoe characteristics. The familiar 4 inch (10 cm) waterline beam is of little use, as it is simply a measurement of convenience. From a positive standpoint, wide beams provide stability, but the negative aspect is increased resistance. A waterline beam in excess of 18% of the waterline will usually produce a slow stable canoe, while one of less than 14% will make a fast but tippy canoe. The ideal beam for you will depend upon your goals and experience.

Underwater profile — This profile has a major impact on maneuverability and tracking. The greater the amount of rocker, the more easily a canoe will turn but the more poorly it will track. The reverse is, of course that straight keel lines improve tracking to the detriment of maneuverability and also increase wetted surface. A more recent development in the evolution of profiles is that of a straight keel aft to promote good tracking and rocker forward for good maneuverability. Such canoes are not only easier to handle but have more predictable handling in large waves.

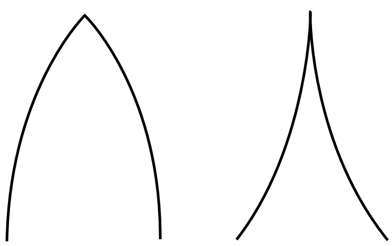


straight keel



rocker

Waterline Shape — The designer's art has its most varied expression in waterline shapes. Over 100 years of scientific testing and research in universities and the leading hydrodynamic labs has taught us what shapes are most efficient, and to vary significantly from them usually results in substandard performance. The most efficient shape for speeds associated with canoe touring is one with straight or slightly concave waterlines forward with a gradual increase in waterline beam to a point 1–5% aft of the middle.

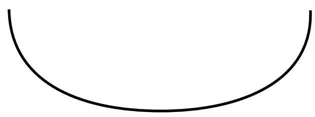


convex concave

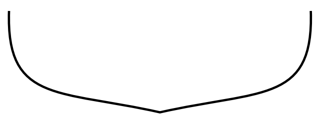
Past that point the waterline can remain full and taper to concave waterlines at the stern. If the waterlines are too concave forward the result is an abrupt increase in volume about one quarter of the way along the hull which will slow the canoe almost as badly as convex waterlines seen on so many thermoformed and aluminum hulls. These same fine ends also bury deeply into waves making maneuvering difficult just when you may need it most. Conversely, full convex entries will pound in waves and allow the hull to be pushed off course by wind and waves. Somewhere between those two lies the best shape. The waterlines aft are largely responsible for how the boat tracks and concave waterlines produce the best tracking while convex waterlines produce greater maneuverability.

Section Shape — There are three basic types of hull section: flat bottom, arched bottom and V-bottom, and some canoe hulls will combine all three in the same hull. How these are combined or used will determine stability, speed and maneuverability. Arched bottoms generally have less initial stability, a more predictable motion in waves and less wetted surface than the other types.

flat bottom



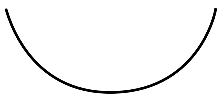
arched bottom



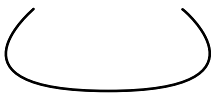
V-bottom

Test data indicates that the best combination is that of 'U' shaped sections at the bow, rounded sections midships, and 'V'd sections aft. The "U'd" forward sections allowing the bow paddler to make effective control strokes while the "V'd" aft sections provide directional control.

Shape above the water — Hulls can have flare, tumblehome or any combination or degree of these. Tumblehome, when it is located at the paddling position, improves efficiency by keeping the paddle closer to the paddler. What you sacrifice for this efficiency is reduced seaworthiness and a wetter ride through rough water. For wilderness or open water paddling flared sides provide an essential safety margin and, if well thought out, do not hamper paddling significantly.



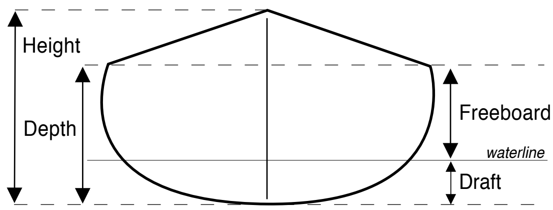
flare



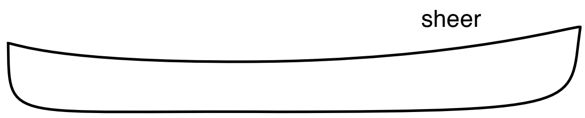
tumblehome

Stability — The most important aspect of stability is neither the ultimate stability nor the initial stability but how the two work together to give the canoe its 'feel'. Ideally there should be a gradual impression of greater resistance to capsize as heel increases. Canoes with rounded bottoms and flared hull sides will most often have these characteristics. Flat bottomed, 'V' bottomed and canoes with tumblehome can feel good initially but become more tippy as they are leaned. It is far easier to adapt to a little initial tenderness than it is to anticipate and react to an abrupt change under difficult conditions. A simple test is to heel the boat until water begins to pour over the gunwales. At that point it should still right itself. If it keeps going or requires a quick response from the paddler, the boat may very well let you down at the worst possible moment.

Freeboard — While the more common term is 'depth', which is the distance from the sheer to the keel, what you really want to know is how much canoe will be above the water when it is loaded. This is called freeboard. Too much freeboard and the canoe will be blown about by the wind too much. Too little freeboard and waves slop in easily. Tandem touring canoes should have at least 7–8 inches (17–20 cm) of freeboard amidships to assure reasonable dryness, while solo canoes can get by with about 6–7 inches (15–18 cm).



The height of the ends should normally be 1/10 of the overall length, although it is permissible to be a few inches lower in the stern. What is not shown by these dimensions is what shape the sheer profile should be. Since waves come aboard about 2–3 feet (60–90 cm) aft of the bow, the sheer should not have a sharp curvature towards the ends but rise gradually in a smooth uniform sweep.



Summary — There is much, much more to design than the above, but if you search for a boat that fits within the parameters given here you will probably get a good boat. In every case, you should test paddle the boat loaded as you would normally load it and paddle it as you would normally paddle it. The advice of experts is valuable and useful, but you are the one who will have to paddle the boat so it should suit you first and foremost.