

# **THE J CLASS RATING RULE**

Adapted From *Yankee III*, by Earl Boebert

## Why Did The J's Look So Much Alike?

### *Rating Rules*

Well, it was a rule, that's why. Not a rule that they had to look alike, but that their designs were constrained by a so-called "Rating Rule." Rating rules began as ways of handicapping races between boats of varying sizes. A "rating" was an estimate of a boat's relative speed based on certain critical dimensions. Later on, rating rules were used to determine whether or not a boat belonged to a particular class; all members of the class then competed on equal footing.

Once this happened there arose a constant battle between the rule makers and the rule beaters. The rule makers attempt to devise a rule which encourages innovation but outlaws "freaks" -- boats that are unsafe or just plain ugly. The rule beaters search for loopholes and exploitable factors to improve performance, even if a "freak" is produced. The rule makers then modify the rule, the rule beaters go back to work.

By the early part of the 20th Century it was well known that two dimensions govern the speed of a yacht: sail area, which determines how much power it generates, and "sailing length," the result of a combination of heeling and wave formation. Sailing length puts an upper limit on speed which can only be exceeded if the boat is capable of planing.

At first, rule makers thought that sailing length could be closely approximated by the waterline length of the boat at rest. Designers quickly "beat" these rules by designing boats with long overhangs at bow and stern, which increased the sailing length as the boat heeled and formed a wave pattern by its motion through the water. Two approaches to compensating for, or limiting, overhangs were devised. One, called the "International Rule," governs the so-called "Meter Classes," such as the 12 Meter boats that vied for the America's cup from 1958 to 1987, and that rule's basic principles govern America's Cup boats to this day. The second approach was devised by Nathanael Herreshoff, and became the basis for what was called the "Universal Rule," and it is this rule, now discarded, which governed the design of the J's.

### *The Universal Rule*

The final Universal Rule was the product of several committees, and it would be foolish to expect the result to exhibit either artistry or science. The various committees simply tinkered with the rule until it produced yachts of a form they liked, and then they had the sense to quit.

The rule is most commonly, and misleadingly, presented as the following formula:

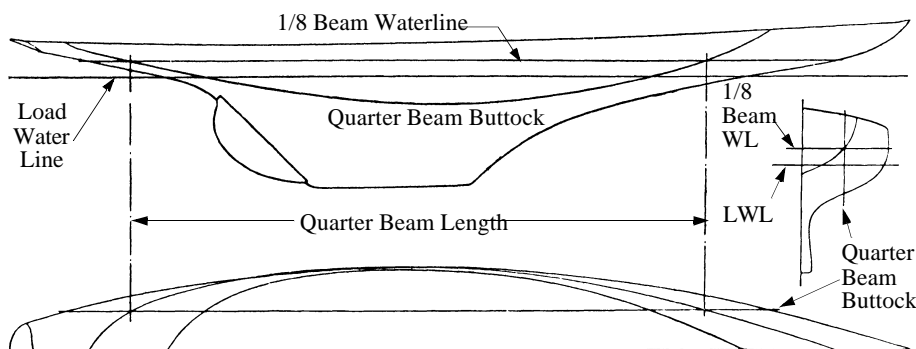
$$\text{Rating} = 0.18 \times \frac{QBL \times \sqrt{SA}}{\sqrt[3]{D}}$$

*During the 2003 America's Cup, the rule-beaters at Team New Zealand used the clause permitting "appendages" to "beat" the clause forbidding hollows or reverse curves in a hull. And so it goes, into the 21st Century.*

Where:

- Rating = The value used to determine the class of the boat, in feet. To qualify for the J Class, this number must be between 65 and 76 feet. The smallest boats under the Universal Rule were the R Class and rating limits were established for the range between that and the J class, although only the Q and M classes in between ever achieved any degree of popularity.
- 0.18 = A “fudge factor” included to make the boats rated under old rules maintain the same approximate rating under the new rule.
- QBL = “Quarter Beam Length,” an estimate of the “sailing length,” as described below.
- SA = Sail Area, in square feet.
- D = Displacement, in cubic feet.

Herreshoff's definition of “Length” addressed the “rule beater” technique of long hulls whose load waterline (on which earlier rules were based) was much shorter than the “sailing length” presented to the water when the boat was heeled. Herreshoff asserted that the true “sailing length” of a heeled boat was to be found at a buttock halfway between the centerline and maximum waterline beam of the boat. This dimension eventually became the so-called “Quarter Beam Length” as shown in the diagram, and its relation to any real or imagined “sailing length” was quickly forgotten.



*A diagram showing the measurement of Quarter Beam Length. Herreshoff understood the effect of heeled waterline well; his Gloriana was the first yacht to beat a “pure” waterline rule in this fashion.*

The steps in calculating the Quarter Beam Length (QBL) were as follows:

- The maximum beam at the load waterline was measured. This is called the “Beam.”
- A second waterline is drawn 1/8 this distance above the load waterline. This is called the “1/8 Beam Waterline.” Originally this was at 1/10 beam, and remained so for the smaller classes. It was changed to 1/8 beam for the J Class in 1930.
- A buttock, called the “Quarter Beam Buttock,” is drawn one quarter of the beam distance from the centerline of the hull.
- This buttock crosses the 1/8 beam waterline at two points. The distance between these points is the “Quarter Beam Length.”

This measurement puts a constraint on both overhangs and beam. If the designer stretches the overhangs, the QBL naturally increases. If the designer widens the beam in order to produce a “skimming dish,” the 1/8 Beam Waterline rises, thereby increasing the QBL as well. After a little tinkering with actual values, the designers were tightly constrained into producing boats of the “classic” J form; even so, subtle differences in shape produced wide differences in performance.

A second innovation in the rule was the notion of “penalties.” Rather than introduce fixed limits on dimensions, the rule allowed designers to exceed the limits at a cost in sail area.

After sixteen years of experience and “tuning” of the rule, the result was described by Charles Poor in his *Men Against the Rule* (1937):

*... the Measurement Rule became a single-factor (sail area) rule with limits and penalties for departures from what was deemed a wholesome, seaworthy type of yacht. The rating, or measurement for racing purposes, became a direct percentage of the square root of the sail-area; such percentage being determined by a sliding scale depending upon water-line length. To control undesirable features of design three limits were imposed upon the design of the hull, with severe penalties for infringement beyond these limits. These hull controls are:*

*1. Limitation on Draft:*

*The draft of all yachts is limited by a sliding scale depending upon water-line length; heavy penalties are imposed for excess draft.*

*2. Limitation on Quarter-Beam:*

*The quarter-beam length is limited to a percentage of the water-line length determined by a sliding scale varying with water-line; heavy penalties are imposed for excessive quarter-beam length.*

*3. Limitation on Displacement:*

*The normal displacement of a yacht is determined by a sliding scale depending upon water-line length: heavy penalties are imposed for “lack” of sufficient displacement: no premium is given for excess displacement.*

*Except for these three limitations the designer is perfectly free. The type of yacht produced by the new rule is seaworthy, wholesome, with relatively small rig, good living quarters, and easily handled.*

Poor’s “relatively small rig” assertion was true for the smaller boats in the class but the J’s were notorious for carrying more sail than the mast and rigging technology of the day could handle.

*The rule resulted in such reduced sail area in the smaller classes that scale models of R boats of three or four foot length sail perfectly well with exact scale sail dimensions.*

### *Other Dimensions*

#### Hull Measurements

The other dimensions for the hull of a J Class yacht at the top of the rating range were:

- Maximum LWL: 87 feet.
- Maximum Quarter Beam Length: 82.9 feet.
- Minimum Displacement: 367, 061 lbs.
- Maximum Draft: 15 feet.
- Minimum Freeboard at Center of LWL: 5.56 feet
- Maximum Tumble Home: 2% of the extreme beam.
- Minimum Deck Camber: 1/4 inch per foot of beam.

#### Other Hull Constraints

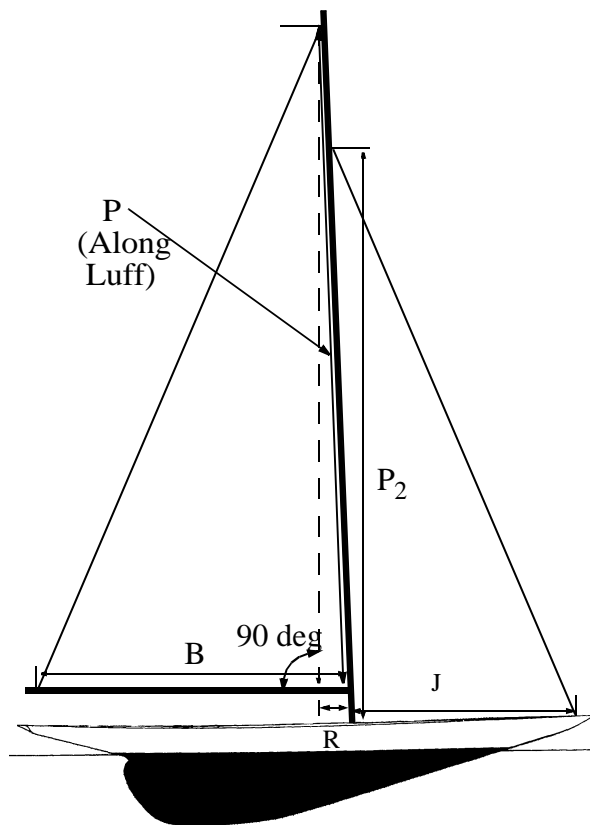
- Centerboard: Must be pivoted at forward end. Centerboard and trunk must have minimum of 6 feet 6 inches clearance below main deck beams at the center line. Centerboard trunk must not be above the cabin floor. Maximum weight of centerboard in pounds is area of one side only in square feet times 0.5.
- The sheer shall be a fair, continuous, concave curve.
- Hollows in a plane of measurement will be bridged, for measurement purposes, by a straight line equal to 1/3 the greatest load waterline beam, except for hollows at the stem, which will be bridged by a line 13 feet long, placed with its center at the load waterline.
- All winches on deck except those used to tension fore and head stays.
- [From the 1936 Rule:] ... *the yacht must at all times in cruising or racing trim, be arranged, fitted, furnished and stocked to accommodate with reasonable comfort for sleeping and living on board, the owner, guests, and crew. Such accommodations shall be sub-divided into saloon, staterooms, and toilets, by permanent and substantial partitions, fitted with doors all of a permanent character, arranged with lockers, furniture, furnishings, and fittings suitable to the size of the yacht. Galley, pantry, ice-box and water-tank facilities commensurate with the size and complement of the yacht are required. All quarters must be ventilated and lighted by skylights of a substantial character...* Note that a typical complement of owner, guests, and crew could be as many as thirty-five people.

- Construction to be to the standards for insurable ocean-going yachts, called “Lloyd’s *Rules for Construction of Yachts.*”

It should be clear by now that these were not intended to be the narrow, wet, flat-out racing machines that compete in today’s America’s Cup.

### *Sail Area*

The maximum sail area for an 87 foot waterline boat was 7550 square feet. This was the “rated area,” or the sail area to be used in the rating formula. Especially on a run with the spinnaker set, the actual sail area of a J Class yacht could be up to three times as much as the rated area. The formula and limits used to calculate the rated area are given below.



Dimensions in the diagram:

- B: Boom length, measured horizontally
- P: Measurement along luff of main sail. Maximum value is 153 feet.
- R: Horizontal distance between a perpendicular from head of mainsail to boom, and the back of mast (caused by mast rake).

- P<sub>2</sub>: Perpendicular measure of fore triangle. Maximum value is 126 feet.
- J: Horizontal measure of fore triangle.

Rated sail area is then given by the following formula:

$$SA = \frac{B \times \sqrt{P^2 - R^2}}{2} + 0.85 \times \frac{P_2 \times J}{2}$$

Other restrictions on rig and sails:

- No more than 82% of the rated area may be aft of the mast.
- Maximum width of boom is 6% of B.
- Maximum depth of boom is 4% of B.
- Permanently curved masts and rotating masts are prohibited.
- Maximum of five battens in any single sail. Upper and lower battens can be no longer than 10% of the length of the foot of the sail plus one foot; intermediate battens may be no longer than 12% of the length of the foot of the sail plus one foot.
- Spinnaker boom can be no longer than the measurement J in the diagram.