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THE EFFECT OF MEASUREMENT RULES ON DEVELOPMENT AND SOME NOTES ON THE OLYMPIC CLASSES AT THE 1956 OLYMPIC GAMES.

by

D. S. CARMENT, B.Sc. (MEMBER).

This paper deals only with yachts propelled by the force of the wind.

We may define a yacht as a vessel used for pleasure as distinguished from war, commerce, or fishing.

History records many vessels used by royalty or nobility for pleasure--the equivalent of the modern "Royal Yacht." However, the beginnings of yachting as we know it began in Holland in the second half of the Seventeenth Century, where many craft were used for pleasure sailing.

Such yachts were known to Charles II during his exile in Holland.

At the Restoration we find Charles II taking most enthusiastically to yacht building and racing.

In the Diary of Samuel Pepys, Secretary to the Admiralty, we find July 15, 1660, "Found the King gone this morning by 5 of the clock to see a Dutch pleasure boat below bridge, where he dines and my Lord with him."

October 1, 1661, "Between Charles II and his brother the Duke of York for 100 guineas from Greenwich to Gravesend and back. The King won."

Sept. 17, 1665. "Lord's Day. To church to Gravesend in the "Bezan" yacht and then to anchor for all night--and with much pleasure at last to sleep--having very good lodging upon cushions in the cabbin."

October 1, 1665. "Lord's Day. Embarked on board "Bezan"......After supper on "Bezan", then to cards for a while and so to sleep; but Lord! the mirth it caused me to waked in the night by the snoring around me." The "Bezan" was a Dutch yacht.

The King during his reign had 28 yachts constructed in ten years.

One of the great influences on yachting was the success of the "America" in 1851. The slide shows her lines. The very hollow waterlines are a feature of the design, much copied later by British designers.

It is logical to assume that the design of yachts would depend on the laws governing the movement of a partially immersed body propelled by the wind. This is not the case. The prime factors are nature and position of ballast and measurement rules.

The early yachts, pilot cutters, fishermen, were ballasted with stone, all of course inside.

Shifting ballast introduced in England in the 1820's was prohibited in 1856. The desire to place weight as low as possible in a concentrated form led to the introduction of lead ballast.

However, designers were more loath to put it overside on the keel.

At first only small amounts were so placed. "Cymba" designed by Fife in 1852, had 3 tons outside and 20 inside.

Designers feared the effect on the hull structure of such a concentrated load. Nevertheless, by 1871, yachts were built with all the lead ballast outside.

In passing, we may note that a number of the early designers were drawn from the ranks of Architects. J. Beaver Webb (who stated that no yacht would be a successful racer unless she could lead fast), Alexander Richardson, and the great Dixon Kemp.

G. L. Watson was the son of a Glasgow Doctor. Will Fife Jr. was the third generation, and it is a matter of regret that we now have no Fife to design those beautiful yachts which always carried the mark of their craftmanship.

Nathaniel Herreshoff was an engineer and a famous designer of light fast steaming boilers and light fast running steam machinery.

When Charles raced his yachts it was boat against boat, but very soon a demand arose for some system of handicap. In 1892, Lord Dunraven who twice raced for the America's Coup with his Valkyrie's I and II worte, "With shame I confess that the problems and calculations, the combinations of straight and crooked lines, with large and small numerals and Lating and Greek letters, the mathematical contortions and algebraic hieroglyphics ...... are meaningless to my uncultured eyes. They are fascinating; I admire their beauty, and can well understand that inventing rules for rating must be a most charming pursuit for intellectual yachtsmen." The yachts were therefore measured for "Tunnage."

A "tun" was a large cask containing 252 gallons, of about 40 cubic feet capacity. The rule for tonnage was $\frac{L \times B \times D}{100}$ = Tons. This was the tonnage of warships of this era.

In 1694, an act was passed defining Tons as $\frac{L \times B \times D}{94}$. L = Length of keel, B = Breadth inside ceiling, D = Depth of hold from underside of upper deck to plank below keelson. In 1720 this was amended to $\frac{L \times B \times \frac{1}{2}B}{94}$ = Tons. The reason for this change was that depth of vessels at this time was approximately half the beam.

In 1773, the length for tonnage was taken along the rabbit of the keel from a perpendicular dropped from the foreside of the stem under the bowsprit to the after part of the main sternpost, the beam being taken outside planking but excluding heavy wales or doubling. To allow for the forward rake of the stem, a deduction of $\frac{3}{5}$ the breadth was taken from the length. The formula was $\frac{(L - \frac{3}{5}B) \times B \times \frac{1}{2}B}{94}$ = Tons

Builders Measurement, known for long as Builders' old Measurement (B.O.M.) The rule in the United States at this time was similar.

The Yacht "America" was measured under the following rule:-

$$\frac{(L - \frac{3}{5}B) \times B \times D}{95} = \text{Tons.}$$

D = depth underside of deck to ceiling.

In 1854, The Royal Thames Yacht Club formulated the Rule:-

$$\frac{(L-B) \times B \times \frac{1}{2}B}{94} = \text{Tons Thames Measurement.}$$

L. measured from fore point of stem to after part of sternpost measured in a straight line along the deck.

The effect of the heavy penalty on beam is shown in the dimensions of "Buttercup" launched in 1880 and a most successful racer.

L.W.L.	42 ft. 3 in.
Extreme Beam	7 " 4 "
Draught	8 " 0 "
Least Freeboard	2 " 9 "
Displacement	22 tons.
Lead	14 tons.
Sail Area	2580 sq. ft.

These yachts were known as planks on edge and lead mines.

The Thames Rule still exists. Yachts are still given in Lloyd's Register of Yachts as Tons T.M., and it is an established method of quoting for new construction in Britain, -- so much per Ton. T.M.

The most extreme design was the famous "Evolution" of 1880. The lines are shown in the diagram.

These racing yachts now became bad boats in every way. Poor sea boats, lacking in stability, and with no useful accommodation.

In the 1880's and early 1890's before the Bank crash, large fleets of yachts to this rule raced in Sydney. The 5-Tonners were very popular and there wer a few $2\frac{1}{2}$-Tonners. The largest class was of 40 Tons.

I do not have personal experience of these yachts, my informat-tion is from an early book, "The Yachtsman's Guide to Sydney Harbour."

In 1882, the Y.R.A. produced the rule $\frac{(L + B)^2 \times B}{1730}$ = Tons. However, this produced no change in design.

In fact, the most unhealthy type of plank on edge.

These craft were very deep, with large weight of lead in the keels, to make up for the lack of form stability. They were also too narrow to allow for proper staying of the mast.

These points are well brought out in the lines of "Clara", a 20 ton yacht under this rule.

The Yacht Racing Association (Y.R.A.) was founded on November 17th, 1875. Lord Exeter was the first President and Dixon Kemp the Secretary.

This body was responsible for the rating rules from its inception. In 1886, the Rule was changed to the famous $\frac{L \times S.A.}{6000}$ = Rating. L. Being length of load water line.

For instance, a yacht of 60 ft. L.W.L. and 4000 sq. ft. Sail Area had a rating of 40.

Some of the most famous yachts were built under this rule, For instance, "Britannia", whose lines are shown.

This rule also produced an enormous number of small yachts. The 5 Raters, the 2½ Raters, 1 Rater, and ½ Rater. These small classes had a great vogue on Sydney Harbour. The illustration shows "Bronzewing", a 2½ Rater, designed, I believe, by J. L. Watson and also "Bronzewing IV" ½ Rater, both raced by the late Sam Hordern.

A Sydney yachting writer of this time writes, "Then there is the class of small raters. They are, perhaps, the handiest craft ever built; you have only to see them threading their way in a regatta crowd to acknowledge the fact. They are stiff and seaworthy, but very wet."

To give some idea of the Dimensions of these yachts:-

"DACIA", a very famous 5 Rater designed by Nicholson,

L.W.L. 33.83', O.H.Fwd 5.14', Aft 9.17',

L.O.A. 48.14', Beam 8.3', Sail Area 889 sq. ft.

Draught 8.6', Displacement approx. 8.7 tons.

Ballast 5.5. tons.

"TRIXY", a 2½ Rater designed by Sibbick, a famous designer of these small craft,

L.W.L. 20', O.H.Fwd 3.95, Aft 6.05', L.O.A. 30',

Beam 8', Draught 5.2', Displacement 4 tons,

Ballast 2½ Tons.

"CARIAD", a 1 Rater designed by Sibbick,

L.W.L. 21', L.O.A. 26.6', Beam 6.6'

"WEE WIN", a ½ Rater, a sketch of whose lines is shown, designed by Herreshoff.

L.W.L. 15.65', O.H.Fwd 3.78', Aft 4.53', L.O.A. 23.92',

Beam 4.8', Draught 2.9', Displacement 8 cwts,

Ballast 3 cwts.

In 1883, The Seawanhaka Corinthian Yacht Club brought in its famous rule, $\frac{L + \sqrt{S.A.}}{2}$. L. Length on water line. The result racing length. It will be seen that this rule preceded the British Rule by 3 years. The lines of "Minerva", a fine yacht under this rule, is shown. This rule produced some of our best racing in the past.

The 30 foot Class. The original boats were all built in New Zealand, to the designs of Logan of Auckland. At least one of the later boats was designed by Fife and one, I believe, an imported yacht by Payne. One by Mr. A. E. Cutler, manager of Cockatoo Dockyard. However, the lack of restrictions in the Rate made their presence felt.

The yachts became longer and longer overall, with light displacement, hard bilges and in the extreme boats, steel fins with a lead bulb.

Accommodation was almost non-existent, and with their long, flat ends they were bad sea boats even in a moderate chop. They were very fast off a wind. To show the extremes that the class produced, I once saw a yacht, in the U.S.A., 25' L.W.L., 50' L.O.A. The sketch shows the type developed in the later period of the Seawanhaka Rule. To overcome these faults the Y.R.A. introduced the first linear rating rule

$$\frac{L + B + \frac{3}{4}G + \frac{1}{2}\sqrt{S.A.}}{2} = \text{Lineal Rating}$$

G is skin girth at a station approximately amidship. The idea being to place a penalty on flat sectioned boats.

In 1901, the second linear rating rule came into force:-

$$\frac{L + B + \frac{1}{2}G + 3d + \frac{1}{3}\sqrt{S.A.} - F}{2} = \text{Lineal Rating.}$$

Note the addition of "d" the difference between skin girth and chain girth and the deduction for mean freeboard.

In 1906, a Conference was held in London at which delegates from eleven countries were present. This conference adopted a rule called "The International Rule of 1906." The rule is:-

$$\frac{L + \frac{1}{4}G + 2d + \sqrt{S.A.} - F}{2.3} = \text{Rating in meters.}$$

It was decided that to ensure the yachts being of sound construction, they should be classed either with "Lloyds Register," the "Germanisher Lloyd," or "Bureau Veritas."

The original intention was that the class rating would be approximately the waterline length. However, this did not happen as an Eight Metre yacht under the rule probably had an L.W.L. of 30 ft.

This Rule was to be in force for 10 years, however, it was not until 1919 that it was revised.

The idea of a formula which should completely govern a Class was seen to be impossible and a combination of Formula and Restrictions came into force. The Restrictions are probably of more forced than the Formula.

The Formula adopted was:-

$$\frac{L + \frac{1}{4}G + 2d + \sqrt{S} - F}{2.5} = \text{Rating.}$$

This rule came into force January 1st, 1920, and was used for all classes up to 14½ Metres. The rule in this case was:-

$$\frac{L + \sqrt{S.A.} - F}{2.3}$$

The Rule to-day is:-

$$\frac{L + 2d + \sqrt{S} - F}{2.37} = \text{Rating.}$$

The rule is by no means as simple as the formula would suggest. For instance, "L" is the length measured at a height 1.5 per cent of the Class Rating above L.W.L. plus one and one half times the difference between the Girth at the bow section, measured to points 5 per cent of the Rating above "L" and twice the vertical height from L. to those points plus one third the difference between the girth, covering board to covering board at the stem ending of this length, and twice the vertical height at the side of the yacht at this station. The minimum difference of girth at the bow station as above defined to be 30 per cent of twice the said vertical height.

This seems complicated but the slides show it quite clearly.

The Restrictions are:-

No hollows in the surface of the hull between L.W.L. and sheer line, except in the profile of the stem forward of the point of measurement L.

Draught.

Maximum draught, 16 per cent of L.W.L. plus .5 Metre.

Freeboard.

Maximum 0.08 of Rating plus 0.25 Metres.

Sheer.

Fair continuous line.

Tumble Home.

Not to exceed 2 per cent of extreme beam

Displacement.

Displacement in cubic metres $(0.2 \text{ L.W.L. in metres} + 0.15)^3$

Displacement in cubic feet $(0.2 \text{ L.W.L. in feet} + 0.5)^3$

This is not determined by the Measurer, but is given in a Designer's Declaration.

Beam.

Class Metres.	Minimum.
6	6
8	8
10	9.9
12	11.8

Maximum Height of Sail Plan.

Class Rating multiplied by 2 plus 1 Metre. Size and Number of sail battens are fixed.

Maximum height of fore triangle and Balloon Jibs.

Size of spinnakers.

Number of crew.

Cabin fittings.

Masts. Dimensions and minimum weight all fixed.

Booms are fixed in size and height above deck.

Scantlings as laid down by one of the five Classification Societies.

Weighing. 6 Metre yachts are weighed.

The Rating Certificate of "Saskia", designed and built by Fife in 1931, and probably the fastest 8 metre yacht ever built, is shown.

This is the rule under which our Premier Interstate yachts race for the Sayonara Cup. Many yachtsmen believe this is for 8 Metre yachts, but the deed of Gift states it is for yachts of up to 50 ft. Load Water Line. The Rating Rule used is to give a basis for handicap.

According to R.Y.A. scale the Theoretical Speed Seconds per Nautical Mile is, for an 8 Metre Yacht, 452.1. For a 9 Metre 428.3. Therefore, for a 20 nautical mile race, the length of the Sayonara Cup course, a 9 Metre yacht would give an 8 Metre yacht

$$(452.1 - 428.3) \times 20 = 4 \text{ min. } 36 \text{ secs.}$$

In the last race sailed, "Francis" allowed "Erica J." and "Saskia" 2.4 secs. per mile as she rated 8.14 Metres to the others' 8 Metres.

<u>The American Universal Rule</u>:

Up to 1883 the Americans used the Seawanhaka Rule,

$$\frac{L + \sqrt{S.A.}}{2} = \text{Racing length.}$$

This being the equilavent of the British $\frac{L + S.A.}{6000}$ Rule.

The defects of the rule were the same as the British rule, and it was considered imperative that some new and more restrictive rule be used.

In 1902, N.G. Herreshoff, the famous designer of American Cup Defenders, was asked by the New York Yacht Club to formulate a new rule. The proposed rule was: $\frac{L + \sqrt{S.A.}}{5\sqrt[3]{D}} = \text{Rating.}$

The bulb fin type was eliminated by use of the desplacement divisor, and to obtain somewhere near the heeled waterline, Herreshoff introduced "quarter beam length" the mean of two measurements, one on deck and one on the waterline, when each is cut by a vertical plane distant one quarter of the beam from the centre.

In 1904, the constant for D was increased to 5.5, and the rule became $\dfrac{L + \sqrt{S.A.}}{5.5\sqrt[3]{D}}$

In 1909, the constant 0.18 was substituted as multiplier for the entire formula in place of 5.5 for D. The rule then became:-

$$0.18 \; \frac{L + \sqrt{S.A.}}{\sqrt[3]{D}}$$

In 1931, various restrictions were added for the 56 foot, 65 foot and 76 foot classes.

$$L = L.W.L. + \tfrac{1}{2}(q.b.l. - (\frac{100 - \sqrt{L.W.L.}}{100} \times L.W.L.)$$

Displacement in cubic feet shall never exceed 20 per cent of L.W.L. plus 0.50.

Draught limit 0.16 Times L.W.L. + 1.75.

Freeboard not less than 5.7 per cent L.W.L. plus 0.6

Camber of deck not less than ¼ inch per foot of beam.

Sheer - fair continuous concave curve.

Tumble home - not to exceed 2 per cent of extreme beam.

Masts - not less than 0.0125 cube of rating.

Schooners rate 90% of rated sail area.

Yawls 93%.

Scantling to rules of classification societies.

Burgess has stated that it did not pay to have any excess of quarter beam length and L to all intents and purposes became L.W.L.

Both the International and Universal Rules aim to produce seaworthy yachts with fair accommodation in classes 8 Metres and over.

Both are restrictive rules in which the restrictions are more important than the formula.

The Universal rule is the more logical and easier to apply as principal factors can be determined afloat.

Both rules produce similar types of yachts, and both rules are essentially length and sail area rules.

The Square Metre Rule:-

There is a demand in the smaller classes for a fast racing yacht with smaller sail area and displacement than either the Universal R class or International 6 Metres. The R class is slightly larger than the 6 Metres. L.W.L. approx 26 feet to 23 feet in a 6 Metre but yachts are similar.

The Swedish Scharen-Kreuzer square metre rule gives this.

This is a light displacement type where sail area is the principal restriction although there are numerous other restrictions in the rule.

As a comparison of the type compared to a 6 Metre:-

"Sea Swallow", designed by Uffa Fox, has the following dimensions:-

Length overall	41'-7"
Beam	6'-11½"
Displacement	2.75 tons.
L.W.L.	27'-0"
Draught	5'-3"
Sail Area	323 sq. ft. (30 sq. Ms.)

"Circe", a 6 Metre, designed by Donald Boyd.

Length overall	38'-6"
Beam	6'-1"
Displacement	4.018 tons
L.W.L.	23'-6"
Draught	5'-6"
Sail Area	452.5 Sq. ft.

In moderate to hard weather the 30 square will beat a 6 Metre.

However, the square metre class is just the type of yacht that the International and Universal rules aim to discourage. In comparison to the old rater--the Square Metre has restrictions:- measured lengths, beam, depth and head room at certain points, and is also built to a scantling rule. The old rater had not restrictions except L.W.L. and sail area.

International Cruiser/Racer Classes.

The new Cruiser/Racer Rule is designed to give level racing in 7, 8, 9, 10.5 and 12 Metre classes in a type of yacht which has accommodation for the crew to live on board. The rule aims to produce boats with a full body, compact hull, good seagoing overhangs and ample freeboard.

"Sonda", designed by James McGruer, was one of the first of the class and a great success. Her dimensions are:-

Length overall	39.3 ft.
L.W.L.	26.8
Beam	8.5 ft.
Draught	6.2 ft.
Sail Area	825 sq. ft.

Displacement for L.W.L. is greater than the International Rules.

Displacement in cub. ft. $(.2 \text{ L.W.L.} + .623)^3$

In International Rules $(.2 \text{ L.W.L.} + 0.5)^3$

The Formual is:-

$$\frac{L + \sqrt{S} - F \pm B + D + P + A \pm H + C - K}{2} \times Pf = \text{Rating}$$

L = Length in linear units.

S = Sail Area sq. ft.

F = Freeboard in linear units.

B = Beam coefficient in linear units.

D = Draught coefficient in linear units.

P = Displacement coefficient in linear units.

A = Coefficient for overhang at bow in linear units.

H = Coefficient for profile under water.

C = Coefficient for abbreviated sterns in linear units.

K = Coefficient for iron keel in linear units.

Pf = Propeller factor.

L is measured in a plane 2 per cent of the Class rating above the waterline (called the "L" plane) plus the difference between the girth at the forward end of "L" and twice the vertical height from "L" plane to point 5 per cent of the class rating above "L" plane plus 1/3 of the difference between the girth at the stern ending of "L" plane from covering board to covering board and twice the vertical height at the side of the yacht from the "L" plane to top of coaming board.

The minimum difference to be added at the forward girth station is 3 per cent of class rating.

F. Normal freeboard is 8 per cent of Class rating plus .25 Metre.

Actual freeboard is one third of sum of freeboards at girth stations and .55 L.W.L. from fwd.

If freeboard is less than normal, difference is doubled and deduced from normal freeboard.

If freeboard is higher than normal the difference is halved before adding to normal freeboard.

B. Normal Beam .24(L + 1.24 Metres)

For beams greater than normal, there is an allowance and is entered as -B.

For beams less than normal the deficit is multiplied by 2 and entered as B.

D. Draught Maximum .16 L.W.L. + .40 Metres.

Waterline. Lower Limit 8 Metres 26.25 ft.

Upper Limit 27.40 ft.

Displacement P = $(.2\ L.W.L. + .19)^3$ cubic metres.

A. Bow profile coefficient. If in a yacht bow the profile horizontal distance between bow ending of the waterline and the bow ending of "L", is more than 5 per cent or less than 3 per cent of Class rating, the excess or deficit is entered in formula as +A

Profile under water. "H".

The normal or base depth of a yacht measured in a vertical plane 25 per cent of the length of "L" from the foremost end and measured from this plane to the underside of the stern or keel to be 7.5 per cent of the length of "L".

If measurement is smaller, the difference to be doubled and entered as +H.

If larger, but smaller than 12 per cent the difference to be divided by 3 and entered as -H.

Stern Coefficient "C".

If a yachts stern transom be cut by "L" plane, one half the distance from the edge of the transom to the centre line of the yacht to be entered in the formula as +C and the aft girth and the freeboard are to be taken where the L plane cuts the stern transom.

Propeller Factor "Pf".

$$Pf = 1 - \left(\frac{\text{Factor x Depth x Diam.}}{7 \text{ x Base Draft x } \sqrt[3]{\text{Disp.}}}\right)$$

Factor.

(a) 0.5 Folding on centre not in aperture.

(b) 2.0 Folding off centre.

(c) 0.75 Feathering 2 bladed on centre not in aperture.

(d) 1.0 Feathering 2 bladed on centre in aperture.

(e) 3.0 Feathering 2 bladed off centre.

(f) 1.0 Feathering 3 bladed on centre not in aperture.

(g) 1.5 Feathering 3 bladed on centre in aperture.

(h) 4.0 Feathering 3 bladed off centre.

(i) 2.0 Solid 2 bladed on centre not in aperture.

(j) 3.0 Solid 2 bladed on centre in aperture.

(k) 5.25 Solid 2 bladed off centre.

(l) 3.0 Solid 3 bladed on centre not in aperture.

(m) 4.5 Solid 3 bladed on centre in aperture.

(n) 6.0 Solid 3 bladed off centre.

Depth is depth to centre of boss below waterline in feet or metres.

Diameter is propeller diameter.

Base draught is draught at 55 per cent station.

Displacement is displacement in cubic feet and calculation of Pf to four decimal places.

Maximum Height of sail plan 1.65 Class Rating 1.6 Metre

I have dealt with this rate at length as it shows the modern trend in the development of a Restricted Rule.

The Ocean Racing Rules.

In 1922, the Cruising Club of America was formed, and two years later the English Ocean Racing Club, now the Royal Ocean Racing Club.

The problem facing the organizers of ocean racing was some handicap system for yachts of varying size, type, and rig. This seems an impossible task. However, the makers of the R.O.R.C. rule made a very good shot at it.

The way this has been obtained is by a rule which produces what is called a Time correction factor - T.C.F.

A yacht of 64 ft. rating has a T.C.F. of unity and one of 36 ft. rating a T.C.F. of 0.8. When the yachts elapsed time for the race has been arrived at, the T.C.F. is multiplied by the elapsed time and the "corrected time" for the race arrived at.

This works out surprisingly well, as the Sydney-Hobart race has shown and of course a yacht designed to the rule must be at an advantage.

Where yachts are racing on International Rule Rating, such as the Sayonara Cup Race, the system of time on distance works well. The system of time on time is now used in the handicap racing on Sydney Harbour, and works out fairly well.

It has this advantage that there is one handicaptime for a yacht. Previously there were at least three. Light Medium and Hard weather, and at one time, three for a working wind, and three for a leading wind. From the owner's point of view it has the disadvantage that he does not know his position in the race until all the yachts have finished.

The R.O.R.C. Rule:-

$$15 \frac{L\sqrt{S}}{\sqrt{B.D.}} + .2\,(L + \sqrt{S})$$

L is like all measurement rules, measured in such a way as to attempt to obtain the effective waterline length when heeled. The measured length is taken between two chain girths at bow and stern. The forward girth is where a chain, half the beam, can be passed round the hull under the bow and when lying in a vertical plane comes just to the gunwhales on either side. The after girth is similar except that the chain is equal to three quarters of the beam.

This length is subject to freeboard correction. There is a penalty for a mean freeboard which is less than the minimum.

The logical thing would be to use displacement as a divisor. This, however, is not practical in these large yachts.

It would have to be obtained by weighing or by placing the yacht in a calibrated tank, or from the designer's lines. This latter to a Naval Architect seems simple, but lines are not always available and also the yacht may not be accurately built to the lines.

The divisor, $\sqrt{B.D.}$, is therefore an attempt at a substitute for displacement.

Beam is maximum beam, but depth is measured in a special way which gives the average depth of the hull with fair accuracy.

Draught without a penalty is 16 per cent of L.W.L. plus 2 ft.

Sail area is modified for rig.

Cutters and Sloops	100 per cent.
Gaff Ketches	90 per cent.
Jib Headed Yawls	98 per cent.

The effect of the rule is: That in the case of high freeboard yachts, the L measurement became nearly an overall measurement and the boats had very little overhang. This can be seen in Peer Gynt which has twice won the Trans-Tasman race.

The rule has also produced a number of very successful light displacement yachts such as Myth of Mallam, and Nocturn.

The Cruising Club of America rule, is largely based on an optimum type with penalties for deviations from type, rather like the Cruiser Racer Rule.

The American yachts tend to be beamier and in a number of successful yachts have centreboards.

SUMMARY.

With few exceptions all rating rules are largely length and sail area rules.

The measured length is an attempt to assess the probable waterline length in a heeled condition.

The measurements are aimed at giving fast seaworthy yachts, and the various girth measurements are to control the length and shape of overhangs and to give a form of hull section which will give in the larger classes, good passenger accommodation.

Although displacement is only directly used in the Universal Rule, it is a restriction with maxima and minima in the other rules.

The International Rule gives good yachts - 8 metres and over, but is less successful in the 6 metre class, which have tended to the minimum beam of 6 ft, the maximum draught and a high ratio of ballast to displacement.

The R.O.R.C. rule has produced a variety of types but all seemingly able to perform well in open water.

It is probable that yachts to be built, will follow the American boats which have proved so successful. These are beamier and shallower than the British craft and in a number of cases have centreboards.

The Yachting Classes at the 1956 Games.

The classes were as follows:-

5.5 Metre Class	10 Competing Nations.
Dragon Class	16 Competing Nations.
Star Class	12 Competing Nations.
12 Sq. Metre Class	13 Competing Nations.
Dinghy Finn Class	20 Competing Nations.

Port Phillip bay is a large and very open piece of water and as the depth of water in the portion of the bay where the races were sailed, varies from 3 to 5 fathoms, a short steep sea quickly develops in strong winds.

During the Games we had five hard days, and two light days. The 5.5 Metre Class gave very close racing. All the yachts with the exception of Yeoman V, the South African entry, were of very straightforward design.

Most had wooden masts. The only masts to get down to the minimum weight were of Aluminium Alloy.

Two masts broke as the result of accidents, one being a metal mast.

Working sails were Dacron or Orlon and extras Nylon.

The yachts were all beautifully constructed and maintained.

Dragon Class. These yachts performed very well in the hard winds and steep seas. Bluebottle, a fairly old and hard raced yacht for a number of years, won on a very hard day.

Their gear, although it appeared very light, stood up to the hard conditions, and there were no major losses of gear or masts.

All the Dragons had an enormous number of sails. In some cases over thirty.

Star Class. These yachts managed to get round the course on the hard days in a surprising way. The skippers and crews, of course, were the World's best.

Crew weight was important in Melbourne with its hard weather. The American skipper who won this class, deliberately built up his weight for the Games.

12 Sq. Metre Sharpie Class. These half decked craft had a hard time in the windy, rough conditions. The great difficulty was to keep the boats from filling up. It is of interest that the winning N.Z. boat and the Australian boat second, were built by their skippers.

Olympic Dinghy Finn Class. These small one man boats sailed surprisingly well under the conditions.

Race was only cancelled on one day.

Here again crew weight was important.

Courses. Olympic courses are laid in a circle, the circumference being marked by eight flag buoys, and a flag buoy at the centre.

The 5.5 Metres and the Dragons sailed the same course two sea miles in diameter.

The Stars and 12 Sq. Metres, a course one and a quarter sea miles in diameter.

The Finn Class, a course one sea mile in diameter.

The start of all races is at the centre, and the start is always a "thrash" to windward, then a lead over two triangular legs, a "thrash" back to windward to the first buoy rounded, a run down wind, a "thrash" back, then a lead over two legs, and a short beat to the finishing line at centre.

POINTS MARKING.

There is a special system for marking the results of Olympic Yacht Races. This is:-

$101 + 1000 \log A - 1000 \log N.$

A = Total number of yachts entered.

N = Finishing position of yachts.

In the event of a tie, the highest finishing position will decide.

Seven races are sailed and the yachts discard the worst result, so six races count. Take the case of 12 Entries:-

1st	-	1080
2nd	-	879
3rd	-	703
12th	-	101

MEASUREMENT.

The Olympic Dinghy Finn Class have to be supplied by the Host country.

These were all built by one firm in Melbourne, and during construction were under constant supervision and measurement control by a single very experienced measurer.

All the other yachts - ten 5.5 Metres, sixteen Dragons, twelve Stars, and thirteen 12 Sq. Metres had to be measured in the ten days preceding the start of the races.

The measuring was carried out by a team of twelve measurers.

The yachts were based at five widely separated points, 5.5 metres at Williamstown, Star Class at St. Kilda, 12 Sq. Metre Class at Elwood, Dragons at Brighton, and Finn Class at Sandringham.

The measurers therefore had to be split into teams.

5.5 Metres being a Restricted Class were the most lengthy job. The yard of the Royal Yacht Club of Victoria at Williamstown has very good slips, and the yachts were quickly hauled up for shore measurements. Sail Measurements were carried out in the local drill hall. Flotation tests and weighing were carried out at H.M.A. Naval Dockyard at Williamstown, where the naval authorities gave every assistance. Weighing was carried out on a special scale sent out from England for the purpose.

Dragon Class. This being a very strictly controlled one design class, did not give much trouble. Difficulties were minor departures in fittings. The measurement of sails was, however, a major job as all the yachts had a great number, in some cases over thirty.

Star Class. Another one design Class, very strictly administered. It is interesting to note that although the Star Class is not strong in Australia, there were, in 1956, 3533 registered Stars in various parts of the World. Easily the most popular racing Class.

The measurement procedures are most clearly laid down in the Star Class Log. In consequence, this Class gave the least trouble in measurement.

Again, most boats had a large number of sails.

12 Sq. Metre Sharpies. This is another one design Class. Although the specification of hulls, sails and fittings is in great detail, this Class gave more trouble than any other.

The difficulties arose in the interpretation of the rules. For instance, Rule XIX states, "The sails consist of a mainsail and jib. For shortening sail, it is allowed to provide either reef points for the only foresail or use a smaller jib. The mainsail is fitted with three battens which divide each into four equal parts. Maximum length of battens 500 mm."

Some owners stated that this meant that the mainsail could not be reefed, although the plan shows roller reefing on the boom.

The greatest difficulty arose with the pumps. Pumps were of prime importance under the conditions they were racing in at Port Phillip Bay. The rules state, "Pumps must be loose and of plunger type. This was interpreted in all sorts of ways, all very ingenious. In some cases, very large, slipped into place, spring loaded and worked with a lanyard by a man hanging out, in other cases foot operated.

Finally it was ruled that a loose pump had to be worked with both hands. There were many minor difficulties of this nature.

A very efficient rig was fitted up for the measurement of the hulls. Hull dimensions in all cases very, very accurate.

Boats had to be weighed as weight had to be not less than 230 kgs. stripped of all movable gear and floor boards. Compensating weights not exceeding 15 kgs. could be fitted. This class is being replaced in the next Olympic Games. This new type is not yet decided, but will be either a "Flying Dutchman" or a "Five-O-Five." These are boats of half the weight of the squares and much more modern in design.

NOTES ON THE OLYMPIC CLASSES.

The International 5.5 Metre Class.

This is the largest of the Olympic Classes. The Class was adopted by the I.Y.R.U. in October, 1949.

The formula for the rule is:-

$$.9 \left(\frac{L \sqrt{S}}{12 \sqrt[3]{D}} + \frac{L + \sqrt{S}}{4} \right) = 5.5 \text{ Metres.}$$

L. is the length measured at a height of 1.5 per cent of class rating above the L.W.L. modified by girth measurements much like the International Rule.

S. is the actual sail area.

D. is the displacement in cubic ft. of 64 lbs. D. is obtained by weighing.

Maximum Draught is 4.43 ft. and minimum beam 6.23 ft.

The limits of "K" are 24.96 ft. to 26.80 ft.

" " " Sail Area 285 sq. ft. to 312 sq. ft.

The maximum height of sail plan 36.4 ft. above deck and fore triangle 29.12'.

Spinaker is restricted.

Luff or Leech not to exceed the height of the fore triangle, and breadth of half the foot not to exceed the base of fore triangle, multiplied by 1.25.

Minimum weight of mast is 77 lbs.

Cockpit size is Restricted.

Scantlings are controlled by Lloyds Register.

A COMPARISON OF TWO SYDNEY YACHTS BY DIFFERENT DESIGNERS.

	"ALTAIR"	"KIRRIBILLI"
L.O.A.	31.29 ft.	32.80 ft.
Measured Length	24.27 "	24.17 "
Sail Area	310.96 Sq. ft.	310.4 Sq. ft.
Weight	4370 lbs.	4313 lbs.
Mean Freeboard	2.10 ft.	2.08 ft.
Max. Beam	6.24 ft.	6.29 ft.
Max. Draught	4.406 ft.	4.42 ft.
Height of Sail Plan	36.40	36.40
Height of Fore Triangle	29.12	29.12

It will be seen that although this is a restricted class the yachts tend to be very nearly one design.

Crew is restricted to three, but they would probably be better with a larger cockpit which is restricted in size and four men in the crew. The photographs give a good idea of the form of these yachts.

The International Dragon Class.

The design of the Dragon was first produced in 1929, and was the work of the great Norwegian designer the late Johan Asker.

After the Star Class, this is the most popular fixed keel class in the World.

There are 250 Registered Dragons in Great Britain, and 65 in Australia.

The Class is managed by the I.Y.R.U. and the official language is English.

The original plans were re-drawn some years ago by Charles Nicholson Junior, and are very good.

The Dragons are a most excellent small racing yacht.

Dimensions are:-

L.O.A.	29.2 ft.
L.W.L.	18.7 "
Beam	6.3 "
Draught	3.9 "
Sail Area	236 Sq. ft.
Displacement	2 tons.

The International Star Class.

This class was founded in 1911, and is by far the most popular International Class. The class is not very popular in Great Britain or Australia, although there are a number racing at Pittwater, north of Sydney, and a few in Melbourne.

This is a very well regulated One Design Class.

There are fair tolerances allowed, for instance, Length $\pm \frac{1}{2}$", Half breadths at deck and chine $\pm$ 5/8" to $\pm \frac{1}{2}$"

Fin keel 870 to 900 lbs.

The Star is a chine boat, the Dimensions are:-

L.O.A. 22'-8½"

Beam at deck 5'-8¼"

Beam at chine 4'-6"

Waterline - approximately 15'-6" (not a specified dimension)

Draught - approximately 3'-4" (" " " ")

Mast 31'-9" above deck

Mainsail - Luff 30'-6", Foot 14'-7", Leech 31'-9"

Jib - Luff 20'-6", Foot 7'-2", Leech 17'-10"

Stars are not stiff boats. However, due to the fact that they are fully decked except for a small cockpit (approx. 6'-9" x 1'-0") and this can be self-draining, they can manage a course, even in strong winds and high seas as we had on two occasions in Melbourne.

Most of these yachts were beautifully finished.

<u>The International Twelve Square Metre Class.</u>

This is strictly a One Design Class, no variations are allowed in hull or sail plan. They are of sharpie design, and about half decked.

Dimensions are:-

L.O.A. 19.6'

L.W.L. 17.7'

Beam 4.7'

Draught (hull) .5'

Sail Area 129 sq. ft.

Weight 507 lbs.

Although there are a great number of 12 Sq. Metre boats in Australia, they have all been modified to suit local conditions, and boats to conform to Olympic rules had to be specially built.

The Australian boat which finished second was built by the Owner, and ex bank clerk, who also made the sails. The winning boat from New Zealand was also built by its owner.

Olympic Dinght Finn Class.

This being a One man boat, the class had more competing nations than any other Class. They are lightly constructed boats of bonded ply.

Dimensions are:-

L.O.A.	14.75'
L.W.L.	13.30'
Beam	4.90'
Draught	.52'
" with	
Centreboard	2.80'
Sail Area	107.64 Sq. ft.
Weight	360 lbs.

These boats are fast and performed surprisingly well in Melbourne under unfavourable conditions.

A number of these boats will be sailing in Sydney next season, and as they are a definite class for the 1960 Games competition in this should be keen.

The Danish skipper, P. B. Elvstrom has won in this class in the last three Olympic Games. The only man to win three consecutive gold medals.

The photos show the lines and sailplan.