NEW UNIVERSAL RULE OF MEASUREMENT
CLASS M

SUPPLEMENTS TO THE MEASUREMENT RULE

VERSION 3.1.0

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September 2017

SUPPLEMENTS to the MEASUREMENT RULE

USING THESE INTERPRETATIONS & CLARIFICATIONS

These Supplements to the New Universal Rule of Measurement for Class M are not part of the measurement rule itself, but rather clarify the rule, interpret parts of the rule that may be difficult to understand, and indicate the way in which the rule is to be interpreted or the methods by which it is to be applied. As such they have the same force and effect as if they were in fact part of the rule, but in some cases they will provide guidance which must be closely adhered to, but which does not set an absolute, exact limit.

Changes in Version 3.0.0

- Addition of Supplement 8 on expected equipment to be included for the interior of the boat, including air conditioning, heating, desalination, etc.
- Supplement 2 Revised to include drawings of a more recent “demo” boat.
- Miscellaneous minor changes in wording in Supplements 1, 4, 5, and 7 to bring them into line with the most up-to-date designs and Rule version 11.

Changes in Version 3.1.0

- Supplement 9 added to implement new method of determining what is a bulbed keel and what is not, following the change in that determination brought about by New Universal Rule of Measurement v. 11.3.0.
- Supplement 3 is now marked as obsolete due to the change in keel hollows rule and the resulting Supplement 9 which has now been added. Supplement 3 is left in the text for historical purposes.

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SUPPLEMENT 1

Hollows in the Stem of the Boat At or Below the LWL

The Universal Rule of Measurement used to read:

> "Any local concave jog or notch (curved or angular) at the plane of measurement of either end of the load waterline length, shall be bridged by a straight line and the L.W.L. shall be taken to the intersection of such lines with the established load waterline plane. The stem or stern profile lines where they cross the load waterline plane, may be **fair and easy curves**; but any concavity in the stem line shall be bridged by a straight line equal to one-third (1/3) of the greatest load waterline beam, placed equally above and below the waterline plane. The load waterline (L.W.L.) shall be measured to the intersection of this line with the established load waterline plane." -- Universal Rule of Measurement, 1927
>
> [emphasis added]

The clear implication of this statement is that the stem may be concave (although in the New Universal Rule for Class M, hollows in the profile are prohibited above the LWL in measurement trim). However, hollows close to the LWL were to be bridged.

The New Universal Rule for Class M also calls for bridging, but in the new rule, the bridge is a function of LWL, not beam.

In the section quoted above, it seems clear that "notches or jogs" in certain locations are uniformly to be bridged. However, "fair and easy curves" are permitted and are to be bridged only over the defined length. The fact that, however the meaning of this paragraph may have been understood, it clearly differentiates between a sharp "jog" and a "fair and easy curve" strongly suggests that the "notches and jogs" are discouraged, whereas "fair and easy curves" are acceptable unless they are located such that they influence the measurement of LWL, in which case they are not discouraged per se, but are bridged over a limited length.

Following on that, the New Universal Rule for Class M accepts a "fair and easy curve" but does not accept "notches or jogs" at the forward end of LWL and immediately aft thereof.

A "fair and easy curve" is not directly defined, but rather is taken to be a curve of a relatively large radius, such that it is clearly not a "notch" or a "jog", but rather a curve. The use of the word "fair" is now completely avoided in order avoid arguments over what one designer or measurer might consider a fair curve and another might not. Any gradual curve, with a minimum radius clearly far larger than that of a "notch" or a "jog", should ideally be accepted as satisfying this requirement, but that leaves a great deal of room for disagreement. As a guideline, **the New Universal Rule for Class M will accept a curve with a minimum radius of 0.95 * Class Rating or larger** as satisfying all requirements of this section, provided that none of the hollow extends above the LWL in measurement trim, *and provided that from the LWL to a point 3.00 feet (914 mm) below the LWL, the minimum radius as just defined in this paragraph may be located such that it contacts the stem anywhere in that region, without the stem having a smaller radius than 0.95 * Class Rating at that location.*

SUPPLEMENT 2

Engine & Gear Box Combinations Evaluated for Rule Minimum PIPA Value

With the determination that the boats should have good interior arrangements, it follows clearly that they would also need power for operation of appliances, and engines and propellers for maneuvering and motoring, as lack of these abilities would render the interiors useless for any practical purpose.

For the engine and propeller, the problem was how to limit what could be used so as to avoid one boat being advantaged or disadvantaged by its engine selection or its propeller or propeller mounting. The Universal Rule has always been a rule which was concerned with the major rating parameters such as length, displacement and sail area, not with very small elements such has propeller strut width or hub length. In order to maintain that focus and avoid the kind of constant manipulating which can be necessary when including tiny elements such as those just mentioned directly in the rating calculation, it was decided to avoid direct inclusion of an allowance for propeller or mounting drag in the rating calculation. To do that, though, it was necessary to have some way to keep the drag of propellers and mountings, and the influence of the engine weight on stability and sea-keeping, reasonably under control.

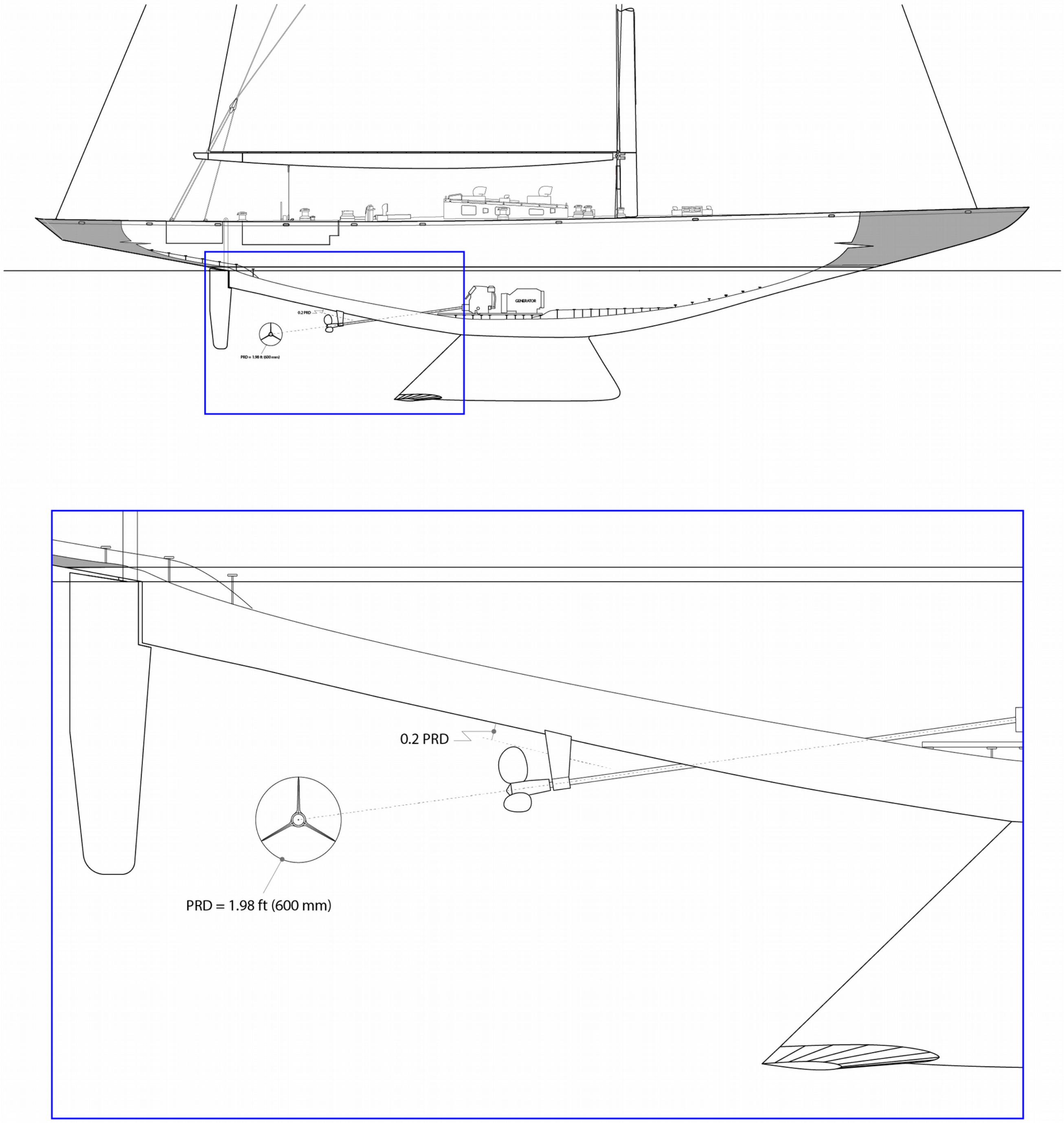
For the engine, the requirement is that the engine/propeller combination drive the boat at an appropriate speed. 9 knots was chosen. To keep the engine out of, and away from, the owner's cabin, the specific requirement was put in that the engine could not be in or adjacent to the owners cabin, which encourages – without absolutely requiring – that the engine be more or less in the middle of the boat. That should keep the impact of the engine on motion in a seaway and on stability reasonably consistent from one boat to another.

A 3 blade propeller was specified to reduce noise and vibration. Propeller drag was taken into account by means of a minimum value of PIPA which each boat has to meet or exceed. Data was developed for several different engines and propeller mounts, and -- while the value of PIPA, which is very sensitive, varied somewhat for the different combinations -- the predicted performance of each, evaluated on two different hulls, indicates that effects on performance are only about 1/10 of one boat length per leg of the course in winds over 8 knots, and only about 1/4 boat length per leg in most lighter wind speeds. This assumes legs of 6 or 7 miles, such as one would have in a windward/leeward course of two windward and two running legs.

The following pages contain the trial data for two Class M hulls, each with a combination of engines and propeller shaft arrangements. The data contain the PIPA data for each combination that was used, and the Vpp results for those combinations, on the two hulls. The propeller shaft configurations were considerably different, as the accompanying illustrations on a more recent boat show. While this is not one of the boats used in the data, the configurations shown on this boat are typical of the two different configurations evaluated.

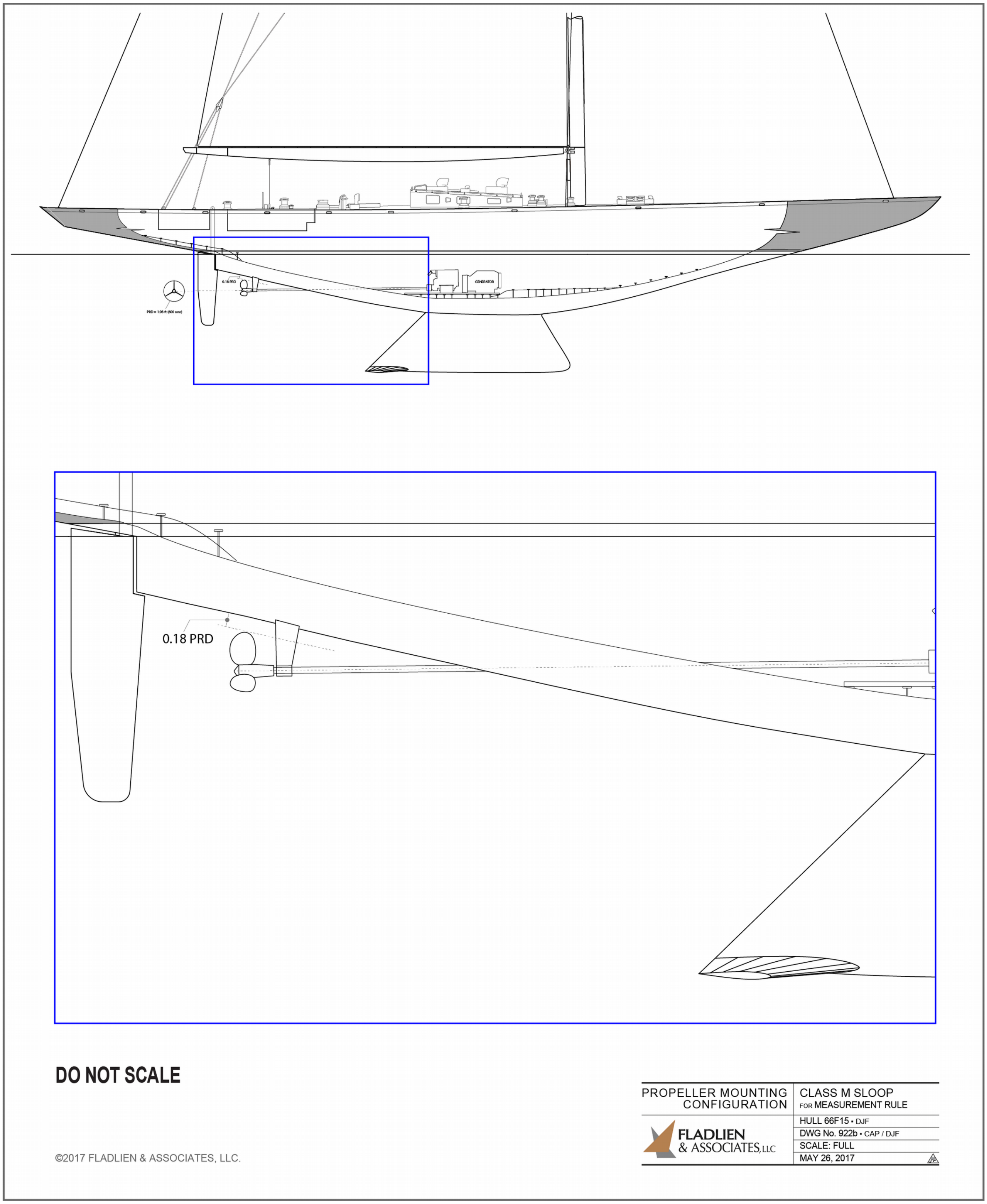
These all presume a 3-blade feathering propeller, which is a requirement in the rule.

Based on this work, it is considered clear that there are a number of engine and propeller arrangements which will all provide nearly identical performance for the boat when racing, so there is no need to include a calculation of PIPA or an engine allowance directly in the rating calculation. Specification of a minimum PIPA, along with the engine location and boat speed under power requirements, should be more than adequate.



DO NOT SCALE

PROPELLER MOUNTING CONFIGURATION	CLASS M SLOOP FOR MEASUREMENT RULE
FLADLIEN & ASSOCIATES, LLC	HULL 66F15 • DJF
	DWG No. 922a • CAP / DJF
	SCALE: FULL
	MAY 26, 2017



GENERATOR
0.18 PRD
DO NOT SCALE
PROPELLER MOUNTING CONFIGURATION
CLASS M SLOOP
FOR MEASUREMENT RULE
FLADLIEN & ASSOCIATES, LLC
HULL 66F15 • DJF
DWG No. 922b • CAP / DJF
SCALE: FULL
MAY 26, 2017
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A1

Hull "A" Per Dwg 354 Rev 15d **Yanmar 4J H4-TE with KM4A -2 Gear Box**

Item	Symbol	English	Metric
Hull : Prop Gap % of PRD		20%	20%
Propeller Shaft Angle	PSA	21.28	21.28
Propeller Shaft Length	ESL	3.837	1.170
Min Strut Thickness	ST1	0.082	0.025
Min Strut Width	ST2	0.394	0.120
Max Strut Width	ST3	0.481	0.147
Strut Hub Diameter	ST4	0.260	0.079
Strut Length	ST5	0.997	0.304
Propeller Shaft Diameter	PSD	0.112	0.034
Propeller Hub Length	PHL	0.694	0.212
Base Propeller Shaft Angle		7.000	7.000
Propeller Diameter	PRD	1.970	0.600
Blade Width	PBW	0.672	0.205
Propeller Hub Diameter	PHD	0.328	0.100
Propeller Hub Length	PHL	0.694	0.212
PIPA per WinDesign v4			0.0118372

A2

Hull "B" Dwg 403 -15d **Yanmar 4J H4-TE with KM4A -2 Gear Box**

Item	Symbol	English	Metric
Hull : Prop Gap % of PRD		20%	20%
Propeller Shaft Angle	PSA	22.75	22.75
Propeller Shaft Length	ESL	3.430	1.045
Min Strut Thickness	ST1	0.082	0.025
Min Strut Width	ST2	0.395	0.120
Max Strut Width	ST3	0.481	0.147
Strut Hub Diameter	ST4	0.260	0.079
Strut Length	ST5	0.935	0.285
Propeller Shaft Diameter	PSD	0.112	0.034
Propeller Hub Length	PHL	0.706	0.215
Base Propeller Shaft Angle		7.000	7.000
Propeller Diameter	PRD	1.970	0.600
Blade Width	PBW	0.672	0.205
Propeller Hub Diameter	PHD	0.327	0.100
Propeller Hub Length	PHL	0.706	0.215
PIPA per WinDesign v4			0.0120172

B1

Hull "A" Per Dwg 354 Rev 13e Volvo Penta D2-75 with MS25 Transmission

Item	Symbol	English	Metric
Hull : Prop Gap % of PRD		20%	20%
Propeller Shaft Angle	PSA	21.62	21.62
Propeller Shaft Length	ESL	3.735	1.138
Min Strut Thickness	ST1	0.082	0.025
Min Strut Width	ST2	0.395	0.120
Max Strut Width	ST3	0.492	0.150
Strut Hub Diameter	ST4	0.260	0.079
Strut Length	ST5	0.985	0.300
Propeller Shaft Diameter	PSD	0.114	0.035
Propeller Hub Length	PHL	0.699	0.213
Base Propeller Shaft Angle		8.000	8.000
Propeller Diameter	PRD	1.970	0.600
Blade Width	PBW	0.672	0.205
Propeller Hub Diameter	PHD	0.328	0.100
Propeller Hub Length	PHL	0.699	0.213
PIPA per WinDesign v4			0.0119557

B2

Hull "B" Dwg 403 -13e Volvo Penta D2-75 with MS25 Transmission

Item	Symbol	English	Metric
Hull : Prop Gap % of PRD		20%	20%
Propeller Shaft Angle	PSA	22.98	22.98
Propeller Shaft Length	ESL	3.444	1.050
Min Strut Thickness	ST1	0.082	0.025
Min Strut Width	ST2	0.395	0.120
Max Strut Width	ST3	0.492	0.150
Strut Hub Diameter	ST4	0.260	0.079
Strut Length	ST5	0.963	0.294
Propeller Shaft Diameter	PSD	0.114	0.035
Propeller Hub Length	PHL	0.683	0.208
Base Propeller Shaft Angle		8.000	8.000
Propeller Diameter	PRD	1.970	0.600
Blade Width	PBW	0.672	0.205
Propeller Hub Diameter	PHD	0.327	0.100
Propeller Hub Length	PHL	0.683	0.208
PIPA per WinDesign v4			0.0121598

C1

Hull "A" Per Dwg 354 Rev 13e Lombardini LDW 2204 MT with TM 345 A Transmission

Item	Symbol	English	Metric
Hull : Prop Gap % of PRD		20%	20%
Propeller Shaft Angle	PSA	21.62	21.62
Propeller Shaft Length	ESL	3.735	1.138
Min Strut Thickness	ST1	0.082	0.025
Min Strut Width	ST2	0.395	0.120
Max Strut Width	ST3	0.492	0.150
Strut Hub Diameter	ST4	0.260	0.079
Strut Length	ST5	0.985	0.300
Propeller Shaft Diameter	PSD	0.114	0.035
Propeller Hub Length	PHL	0.699	0.213
Base Propeller Shaft Angle		8.000	8.000
Propeller Diameter	PRD	1.970	0.600
Blade Width	PBW	0.672	0.205
Propeller Hub Diameter	PHD	0.328	0.100
Propeller Hub Length	PHL	0.699	0.213
PIPA per WinDesign v4			0.0119557

C2

Hull "B" Dwg 403 -13eL Lombardini LDW 2204 MT with TM 345 A Transmission

Item	Symbol	English	Metric
Hull : Prop Gap % of PRD		20%	20%
Propeller Shaft Angle	PSA	22.98	22.98
Propeller Shaft Length	ESL	3.444	1.050
Min Strut Thickness	ST1	0.082	0.025
Min Strut Width	ST2	0.395	0.120
Max Strut Width	ST3	0.492	0.150
Strut Hub Diameter	ST4	0.260	0.079
Strut Length	ST5	0.963	0.294
Propeller Shaft Diameter	PSD	0.114	0.035
Propeller Hub Length	PHL	0.683	0.208
Base Propeller Shaft Angle		8.000	8.000
Propeller Diameter	PRD	1.970	0.600
Blade Width	PBW	0.672	0.205
Propeller Hub Diameter	PHD	0.327	0.100
Propeller Hub Length	PHL	0.683	0.208
PIPA per WinDesign v4			0.0121598

D1

Hull "A" Per Dwg 354 Rev 13e	**Lombardini LDW 2204 MT with TM 260 Transmission**		
	at ~4 Degree Angle		
Item	Symbol	English	Metric
Hull : Prop Gap % of PRD		22%	22%
Propeller Shaft Angle	PSA	19.42	19.42
Propeller Shaft Length	ESL	4.413	1.345
Min Strut Thickness	ST1	0.082	0.025
Min Strut Width	ST2	0.395	0.120
Max Strut Width	ST3	0.492	0.150
Strut Hub Diameter	ST4	0.260	0.079
Strut Length	ST5	1.060	0.323
Propeller Shaft Diameter	PSD	0.114	0.035
Propeller Hub Length	PHL	0.692	0.211
Base Propeller Shaft Angle		0.000	0.000
Propeller Diameter	PRD	1.970	0.600
Blade Width	PBW	0.672	0.205
Propeller Hub Diameter	PHD	0.327	0.100
Propeller Hub Length	PHL	0.692	0.211
PIPA per WinDesign v4			0.0117419

D2

Hull "B" Dwg 403 -13eL Angle	**Lombardini LDW 2204 MT with TMC 260 Transmission**		
	at ~4 Degree Angle		
Item	Symbol	English	Metric
Hull : Prop Gap % of PRD		20%	20%
Propeller Shaft Angle	PSA	20.63	20.63
Propeller Shaft Length	ESL	3.871	1.180
Min Strut Thickness	ST1	0.082	0.025
Min Strut Width	ST2	0.395	0.120
Max Strut Width	ST3	0.493	0.150
Strut Hub Diameter	ST4	0.260	0.079
Strut Length	ST5	0.990	0.302
Propeller Shaft Diameter	PSD	0.114	0.035
Propeller Hub Length	PHL	0.692	0.211
Base Propeller Shaft Angle		0.000	0.000
Propeller Diameter	PRD	1.970	0.600
Blade Width	PBW	0.672	0.205
Propeller Hub Diameter	PHD	0.327	0.100
Propeller Hub Length	PHL	0.692	0.211
PIPA per WinDesign v4			0.0117

E1

Hull "A" Per Dwg 354 Rev 13e	**Lombardini LDW 2204 MT with TMC 260 Transmission**		
	Engine Mounted at ~4 Degree Angle		
Item	Symbol	English	Metric
Hull : Prop Gap % of PRD		24%	24%
Propeller Shaft Angle	PSA	19.42	19.42
Propeller Shaft Length	ESL	4.501	1.372
Min Strut Thickness	ST1	0.082	0.025
Min Strut Width	ST2	0.395	0.120
Max Strut Width	ST3	0.492	0.150
Strut Hub Diameter	ST4	0.260	0.079
Strut Length	ST5	1.100	0.335
Propeller Shaft Diameter	PSD	0.114	0.035
Propeller Hub Length	PHL	0.691	0.211
Base Propeller Shaft Angle		0.000	0.000
Propeller Diameter	PRD	1.970	0.600
Blade Width	PBW	0.672	0.205
Propeller Hub Diameter	PHD	0.328	0.100
Propeller Hub Length	PHL	0.691	0.211
PIPA per WinDesign v4			0.0118235

E2

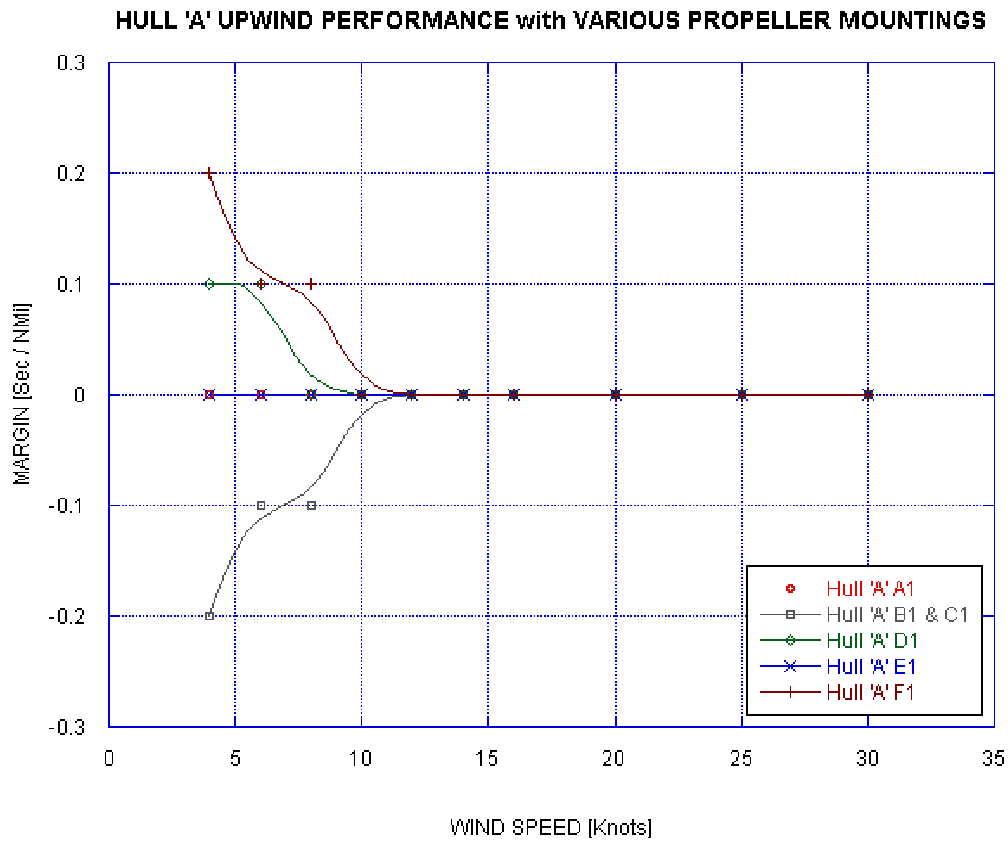
Hull "B" Dwg 403 -13eL Angle 2	**Lombardini LDW 2204 MT with TMC 260 Transmission**		
	Engine Mounted at ~4 Degree Angle		
Item	Symbol	English	Metric
Hull : Prop Gap % of PRD		28%	28%
Propeller Shaft Angle	PSA	20.5	20.5
Propeller Shaft Length	ESL	4.267	1.301
Min Strut Thickness	ST1	0.082	0.025
Min Strut Width	ST2	0.395	0.120
Max Strut Width	ST3	0.492	0.150
Strut Hub Diameter	ST4	0.260	0.079
Strut Length	ST5	1.139	0.347
Propeller Shaft Diameter	PSD	0.114	0.035
Propeller Hub Length	PHL	0.693	0.211
Base Propeller Shaft Angle		0.000	0.000
Propeller Diameter	PRD	1.970	0.600
Blade Width	PBW	0.672	0.205
Propeller Hub Diameter	PHD	0.327	0.100
Propeller Hub Length	PHL	0.693	0.211
PIPA per WinDesign v4			0.012038

F1

Hull "A" Per Dwg 354 Rev 13e	**Lombardini LDW 2204 MT with TMC 260 Transmission**		
	Engine Mounted at ~0.6 Degree Angle		
Item	Symbol	English	Metric
Hull : Prop Gap % of PRD		22%	22%
Propeller Shaft Angle	PSA	17.96	17.96
Propeller Shaft Length	ESL	5.024	1.531
Min Strut Thickness	ST1	0.082	0.025
Min Strut Width	ST2	0.395	0.120
Max Strut Width	ST3	0.492	0.150
Strut Hub Diameter	ST4	0.260	0.079
Strut Length	ST5	1.093	0.333
Propeller Shaft Diameter	PSD	0.114	0.035
Propeller Hub Length	PHL	0.691	0.211
Base Propeller Shaft Angle		0.000	0.000
Propeller Diameter	PRD	1.970	0.600
Blade Width	PBW	0.672	0.205
Propeller Hub Diameter	PHD	0.328	0.100
Propeller Hub Length	PHL	0.691	0.211
PIPA per WinDesign v4			0.0117133

F2

Hull "B" Dwg 403 -13eL Angle 2	**Lombardini LDW 2204 MT with TMC 260 Transmission**		
	Engine Mounted at ~1.0 Degree Angle		
Item	Symbol	English	Metric
Hull : Prop Gap % of PRD		29%	29%
Propeller Shaft Angle	PSA	17.99	17.99
Propeller Shaft Length	ESL	5.018	1.529
Min Strut Thickness	ST1	0.082	0.025
Min Strut Width	ST2	0.395	0.120
Max Strut Width	ST3	0.492	0.150
Strut Hub Diameter	ST4	0.260	0.079
Strut Length	ST5	1.224	0.373
Propeller Shaft Diameter	PSD	0.114	0.035
Propeller Hub Length	PHL	0.693	0.211
Base Propeller Shaft Angle		0.000	0.000
Propeller Diameter	PRD	1.970	0.600
Blade Width	PBW	0.672	0.205
Propeller Hub Diameter	PHD	0.327	0.100
Propeller Hub Length	PHL	0.693	0.211
PIPA per WinDesign v4			0.117487



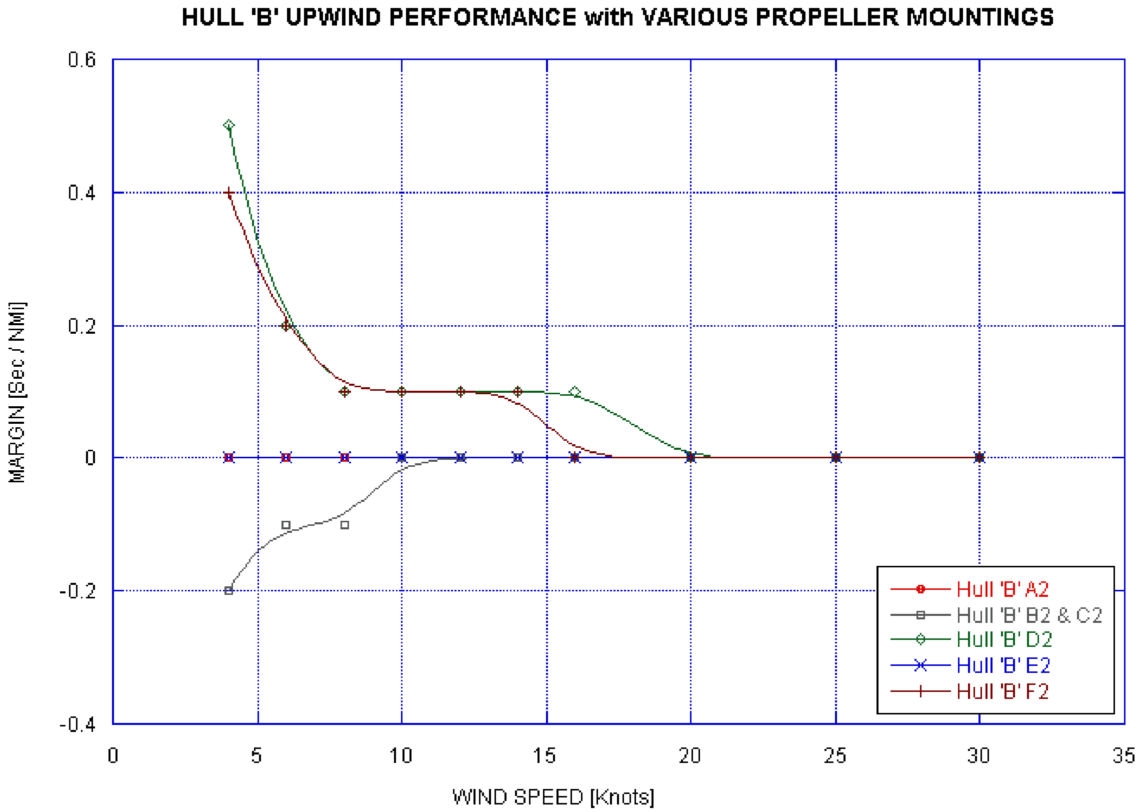
Above is the output of WinDesign v.4 for each of the propeller mountings evaluated, as used on Hull 'A', which is Hull 66F2, our original "demo" boat.

Please note that the margins on the left-hand column are in tenths of a second per mile, not seconds per mile.

Since 1.0 seconds per mile is very roughly 1 boat length per weather leg (actually less in very light wind as it takes a given boat longer to go a given distance), the difference between the "best" and the "worst" propeller mounting evaluated on this hull was 0.4 seconds / mile, or considerably less than ½ boat length per weather leg. For most practical purposes, the difference is negligible.

If one were to modify those poorer mountings to lower the PIPA to an value closer to the rule minimum 0.0117 value, the performance difference between the various mountings would be even less.

In short, on this hull the use of a minimum PIPA value, as opposed to incorporating that PIPA value into the rule, is definitely satisfactory, even where mounting differences are considerable.



Above is the output of WinDesign v.4 for each of the propeller mountings evaluated, as used on Hull 'B', which is a much faster hull than Hull 'A' and is, therefore, not surprisingly a bit different from Hull 'A'.

Again noting that the margins in the left side of the graph are tenths of second per mile, it is clear comparing with the graph on the previous page that Hull 'B' is twice as susceptible to performance changes due to propeller mounting as is Hull 'A'.

However, again allowing for the fact that the high value differences in performance occur only in the lightest of wind, the difference between the "best" and the "worst" propeller mountings on this boat are still only about ½ boat length over a windward leg. By working those mountings down to a lower PIPA, that difference could probably be reduced somewhat. So again it seems valid to use the minimum PIPA value rather than including PIPA in the boat's rating.

Most racing is in 8 to 25 knots of wind, at least for this kind of boat, and there the largest difference is about 0.2 sec / mile, or about two tenths of one boat length per weather leg.

SUPPLEMENT 3

Clarification of Hollows Rule for Keels Where NACA 6-Digit or Similar Foils Are Used

This supplement is now obsolete beginning with Rule version 11.3.0. See Supplement 9

The New Universal Rule specifies as follows:

> “Below a plane parallel to the line of flotation, 6 in (152.4 mm) below the lowest exposed point of the hull, a keel shall have no hollows. This means that the perimeter profile of the keel may not have hollows, nor may any transverse section through the keel.”

The purpose of this section is to prevent the creation of any bulbs or fin-and-bulb keel configuration, and to require that, while a keel may be of the inverted type (taper ratio > 1.0), there may not be any bulbs at the bottom of, or elsewhere along, a keel. This in effect draws a line at saying that boats can have a keel configuration that is a development of the 1983 12-Metre keel originated by Ben Lexcen, but may not go “beyond” that into bulbs to further lower the vertical center of gravity (VCG), or to permit a far smaller keel than is needed to house the ballast at an acceptable VCG.

While the rule's first sentence (above) actually says “...no hollows”, the sentence following it clarifies that this means no hollows in a transverse (that is, athwartship) plane, or in the keel profile.

A question could arise in the use of the NACA 63-, 64-, 65-, or similar sections, which have a hollow in the trailing portion of their form. These would be longitudinal sections, not transverse sections, and would therefore avoid the prohibition in the rule which applies to transverse sections or profile, but which could conceivably create a hollow in a transverse section when combined with some form or other of keel profile, which would be legal in itself if the longitudinal section used were a 63A, 64A, 65A, or some similar section which does not have a hollow in the trailing portion.

It is not the intent of the rule to prevent the use of the “non-suffix-A” sections, or similar sections with hollows in the trailing 30% of the profile. Therefore, the use of the “non-suffix-A” section would be legal, notwithstanding the creation of a transverse section hollow, *providing that the hollow in the transverse section results immediately and solely from the hollow in the form of the longitudinal section*. In all cases, it will be the obligation of the designer or keel designer of the boat to demonstrate that the hollow in transverse section results immediately and solely from the permitted longitudinal section hollow. In practice this is probably best done by providing precise drawings of the same keel with the “A” section used instead, and demonstrating by projecting a number of transverse sections that there is no hollow in any transverse section when the “A” form of the longitudinal section is used.

SUPPLEMENT 4

Thin Flow-Directing Plates

The New Universal Rule of Measurements specifies that there can be only 1 set of winglets on a keel. This could raise a question about small, thin flow directing plates, such as were used on the 12-Metre *Intrepid* in 1967. The very fact that they were used on a pre-1983 keel is itself a suggestion that it would be legal to use them today, but it is not clear if they would count as winglets.

For the purpose of this interpretation, a flow-directing plate will be considered to be a plate which appears on both sides of a keel or rudder, and which has an area *per side* of not more than 1 ft^2 (0.093 m^2), and which has a maximum thickness not exceeding 0.5 in (12.5 mm), and is made of a material not heavier than aluminum.

Flow directing plates may be placed anywhere on a keel or rudder. In case of doubt as to whether the location is in fact on a keel or rudder, a location below a point 5.900 ft (1.798 m) below the line of flotation in measurement trim shall be considered to be on a keel; a location such that all of the flow-directing plate is aft of the aft end of the LWL shall be considered to be on a rudder. For a location to be deemed below or aft of a certain point, all of the flow-directing plate must lie below or aft of that point.

A flow-directing plate which complies with the above restrictions may have any shape, but must be fixed in orientation (that is, it must not move or rotate, nor may it be allowed to move or rotate, *though the rudder to which it is attached may move in any manner in which a rudder is allowed to move*).

Flow-directing plates are not permitted on hulls, or on appendages other than rudders, trim tabs or keels, as defined in the New Universal Rule of Measurement.

NOTE: a flow-directing plate is not a turbulence stimulator for purpose of this interpretation.

SUPPLEMENT 5

Legality of Hollows in Waterlines, Diagonals and Buttocks

There are several sections of the New Universal Rule of Measurement which deal directly with hollows other than those in the above-water profile and above-water deck planform of the hull, and other than those in the keel. In other words, these sections deal with hollows in the surface of the hull but which do not create hollows in the edges of the surface such as the sheerline planform or the above-water stem or counter profile of the boat.

A question could arise about these hollows since some of them seem to appear in boats built prior to 1960 and others do not, and in many cases it is not clear, or at least not readily clear, whether they did in fact occur historically in the time period with which we are concerned in Rule Appendix 1, which considers how to determine the legality of proposed hull shapes.

The guiding principle here is whether the traditional overall appearance and sailing characteristics of the boat is significantly compromised by the proposed shape. But as that requires -- in any given case -- some kind of formal determination by the Class M Rules Committee, the following guidance is offered with the view that it is meant to be relied upon by the designer in determination the legality of shapes which include hollows in waterlines, diagonals or buttocks, *in cases where they do not create hollows in the above-water profile or sheerline planform of the boat, and where they do not extend into the keel.*

As a general statement, hollows are permitted in waterlines, in diagonals and in buttocks, even if those hollows are severe or sharp, and regardless of their location. However it should be noted that they are often subject to bridging, as specified in the Rule, and that the forward end of QBL may not under any conditions be taken as further aft than 0.12 x LWL aft of the forward end of LWL.

In terms of historical precedent, the famous R-boat *Lady Van*, designed by Charles E. Nicholson, demonstrates deep hollows in the forward diagonals, for example, and – while they are not nearly as severe as more “modern” hollows, there do seem to be hollows in the after diagonals of historical boats as well. Thus, while this Supplement indicates that even severe hollows are to be permitted if they meet the requirements of the above paragraphs, this Supplement is not in most ways grossly out of keeping with the tradition of the Universal Rule, as later shapes developed under the International Rule indicate. Those later shapes, while not covered by the historical sections of Appendix 1 of the New Universal Rule, do strongly suggest that it was only because the concepts had not yet been envisioned that they were not used in the relevant historical period.

Finally, as seen in the later International Rule boat development, such as the 12-Metre *Courageous* in its original form, even sharp notches in diagonals did not alter the inherent appearance or performance characteristics of the boat.

SUPPLEMENT 6

Spade Rudders Located in the Wake of Skegs

A question arose about the application of the rule concerning definition of a skeg when there is a rudder immediately aft of the skeg, which complies with all the rules about a rudder at the aft end of the LWL, but which, because the skeg is small, is constructed as a spade rudder, and is therefore not actually attached to or supported by the skeg.

A literal reading of the rule would render such a rudder illegal, and would require that the designer arrange a minimal attachment of the rudder to the skeg, simply for compliance with the rule, even though such attachment is in no way related to the strength of the rudder or to the proper attachment of the rudder, and in fact might even be detrimental.

The need for such artificial attachment is not the intent of the relevant sections of the measurement rule, which were instead intended to prevent lack of clarity and thereby cause argument about how rudders at or aft of the aft end of the LWL are being used to increase the sailing length of the boat. The ability of a skeg, or a rudder trailing in the wake of a skeg, to add length to the boat is subject of the requirement that a rudder must be attached to a skeg in order for a skeg to be considered a skeg.

Where the only purpose of attachment of the rudder to the skeg would be to render the skeg legal under the rule, and otherwise the rudder would be fully satisfactory as a spade rudder, then the requirement that the rudder actually be physically attached to the skeg can be ignored. However, it is the responsibility of the designer to show that both the rudder and the skeg are, in fact, exactly the same as they would be if the rudder were attached to the skeg (ignoring very minor differences required to install the actual attachment mechanism). In general, this requirement can be met by providing drawings showing the installation with an attachment, then by showing that the shape of the rudder and the skeg remain unchanged (except for the direct consequence of removing the attachment) when the rudder is a spade rudder, and by showing the design calculations for the rudder as a spade rudder.

In case of serious doubt, the rudder will need to be attached to the skeg.

SUPPLEMENT 7

Guidance with Respect to Breadth of Stern

The guiding principle for the New Universal Rule of Measurement is that the contemporary boat should maintain the same basic appearance and performance characteristics as the original M Class boats, but with modernized design concepts, construction methods, and equipment. It is further stated by way of clarification in Appendix 1 of the Rule that the profile of the boat above water must adhere fairly closely to the appearance of the above-water profile of the earlier M Class or other Universal Rule or International Rule boats built prior to 1960 (though the stem and counter angles are to be regulated by the minimums set in the Rule itself), but that the planform of the boat's sheerline could have considerably greater flexibility and still meet the requirements of the Rule.

The possibility has arisen that this freedom of shape in the planform of the hull could be abused, intentionally, or even unintentionally out of differing interpretations of the limits on form. Therefore the following is offered as guidance on maximum breadth of the stern of the boat.

The maximum beam of the boat, taken at any height in the transverse plane, at a horizontal distance 12% of the Class Rating (46.0 ft) aft of the aft end of LWL, shall be not greater than 10.25 ft (3.124 m).

The Class Rating is used as the basis for determining this location rather than B or LWL. At least with boats which have a vertical profile at the aft end of LWL, this methodology then avoids the problem where the boat is floated higher due to change in ballasting, and the LWL becomes shorter and B becomes narrower as a result of the higher flotation. The result would then be that the plane for measuring the breadth in question would move forward and the breadth with which the boat was built becomes too large, without anything other than the flotation having changed. As the Class Rating is not a function of flotation, this problem is for most boats avoided.

If it appears that for some reason having to do with the shape of the profile of the boat at or near the aft end of LWL, the particular boat in question is not treated fairly, the matter should be referred to the Rules Committee immediately.

This requirement is placed in the Supplement, not in the Rule itself, as it is meant to be a close guidance, which is to be enforced in the case of any significant violation. There is no penalty because this is not a restriction which is intended to be subject to violation as part of a legitimate development of a faster boat, in which case a penalty would be taken. Therefore, a tiny and inadvertent violation of this limit is to be ignored, as its impact on performance and appearance is insignificant, but any significant violation, even if very small, must be corrected.

SUPPLEMENT 8

Expectations With Respect to Interior Equipment

While it is not the intention of this rule to specify every piece of equipment in the interior of the boat, it is desired to make it clear what the general expectations are, so that there is no confusion on this point.

These concepts are included in the Supplement, rather than in the Measurement Rule, as there is no specific hard and fast requirement about the individual items, but rather simply the understanding that high quality, off-the-shelf equipment shall be installed on board, which provides the functions indicated below.

1. Water Systems

    It is expected that the boats built to this rule will be capable of a 4 day cruise in coastal waters with a minimum of 8 persons on board. This will require the following capabilities in some form:

    a. ability to generate sufficient fresh water for cooking, personal hygiene, drinking, and any other routine needs, as it is neither desirable nor practical to be able to store this quantity of fresh water on the boat;

    b. water heating capability sufficient for a boat of this size to have a reasonable quantity of hot water delivered at a reasonable rate;

    c. facilities for personal hygiene, taken in this case to be sufficient room in the heads to facilitate routine cleanliness, and also sufficient facilities to permit showering or bathing in some acceptable form. These facilities may be included in, or separate from, the heads required by the Rule, but in any case shall be fully functional when the boat is at rest upright;

    d. appropriate water removal and storage capabilities (including ability to store and remove both gray and black water) in sufficient quantities to permit the boat to function fully overnight in areas where pump-outs are not permitted, until the boat can go the next day sufficiently far offshore to permit legal pumping, or to a pump-out station;

    e. pumping system capable of providing hot and cold water to the galley, each head, and the shower facilities, though the capacity of the system may be limited by a reasonable rate of fresh water production.

2. Environmental Systems

    Sufficient heating and air conditioning systems shall be provided to permit the boat to have a comfortable interior over a reasonable range of conditions that might be found in common cruising grounds. For guidance, but not as a rigid requirement, it is assumed that the boat can deal properly with external temperatures from 50 degrees F to 85 degrees F (10 degrees C to 30 degrees C).

    Each area of the boat that is routinely inhabited, that is, the owner's cabin, each guest cabin, crew quarters, and the galley area, should have a controllable heating/air conditioning system, which may be a standalone system, or a separately-controllable branch of a central system.

SUPPLEMENT 9

Keels, Bulbs and Winglets

Effective with New Universal Rule of Measurement v. 11.3.0, the prohibition against hollows in the transverse sections of keels is eliminated. With that change, Supplement 3 is now obsolete.

However, the prohibition against bulbs on keels, and more generally, against fin-and-bulb keels, remains. The fin-and-bulb prohibition is already covered on page 22, Rule v. 11.3.0, in the text and in its accompanying Figure 6. All of this was in place previously, and is carried forward unaltered. The method of determining whether some shape constitutes a bulb in a keel which complies in profile with Rule 11.3.0 Figure 6, which was previously to define a bulb as a keel with a transverse section containing a hollow in the vertical plane, has now been changed (see Rule 11.3.0, Page 21, *Keels* subsection of *Characterization of Appendages)*. This subsection now directly prohibits hollows in keel profiles, as it had done previously, but removes the transverse section requirements.

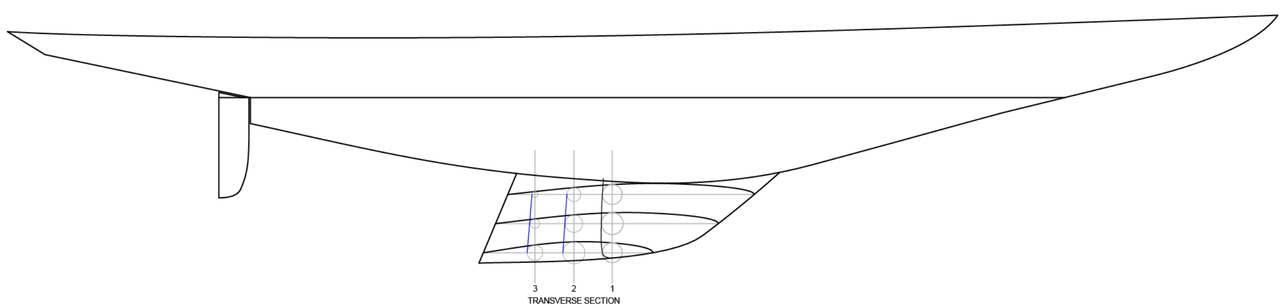


FIGURE 1a — LEGAL KEEL CONFIGURATION #1

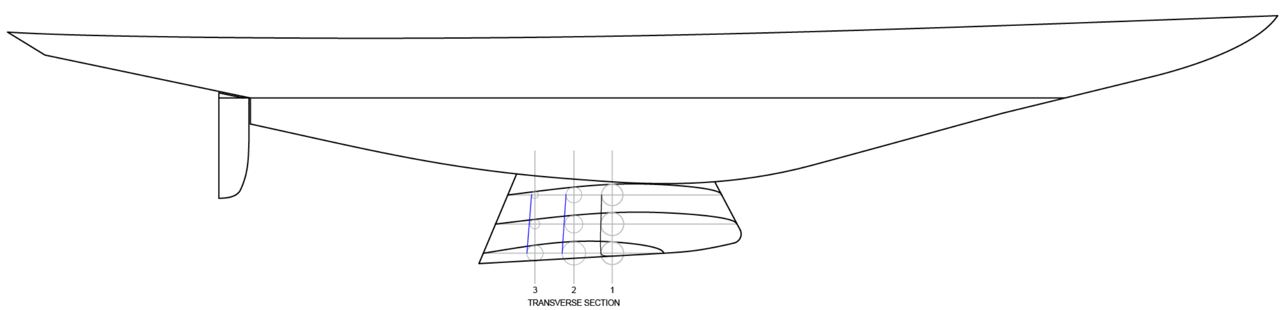


FIGURE 1b — LEGAL KEEL CONFIGURATION #2

The new wording specifically identifies that bulbs are prohibited, but that tip chord sections greatly thicker (in thickness percentage and/or dimension) than the root chord are permitted, provided that the increase is gradual, not sudden. Even with this wording a certain amount of ambiguity is unavoidable, and legitimate questions could arise. In an effort to provide a basis for resolution of those questions, and also to provide a workable and uniform guidance to designers without asking them to divulge confidential design concepts in order to obtain a ruling, the following history and guidelines are offered. Note that these, being in a supplement, are to be considered normative, as if part of the rule, but not considered absolute, such that even a very tiny deviation would be prohibited or penalized as it would be under the Rule itself. As is the case with supplements, a very tiny and apparently unintentional violation would be ignored, while any significant, substantial, or apparently deliberate attempt to circumvent the intent of the supplement would be definitely disallowed.

Figure 1a and Figure 1b show two examples of keels with legal planforms where transverse hollows could arise, and would always have been shapes the Rule wished to permit, though in fact the wording prior to v. 11.3.0 would have prohibited them because of the resulting transverse section hollows. If the reader looks closely at transverse section 3 of each keel, he/she will see the hollow at the middle foil section, as the circle indicating the breadth of the foil at that transverse section is narrower than the straight line (blue) connecting the upper and lower foil sections. This is not due to a hollow in the trailing portion of the foil section itself. Figure 2 shows an enlarged version of the foil section. As the blue line indicates, there is no hollow in this foil, which was drawn deliberately to illustrate this point.

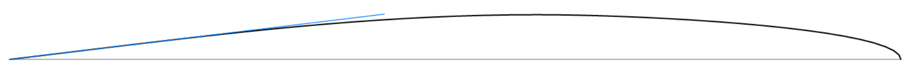


FIGURE 2 — EXAMPLE FOIL SECTION

The question is then, what constitutes a bulb for purposes of this supplement, and how is some proposed shape determined definitively to be, or not be, a bulb.

Figure 3 shows five possible keel transverse sections. Some of these are legal shapes, and some are illegal. These shapes will form the basis for defining a bulb, in terms of a methodology which can be used simply and quickly by either a designer drawing a boat, or a measurer verifying the compliance of a boat.

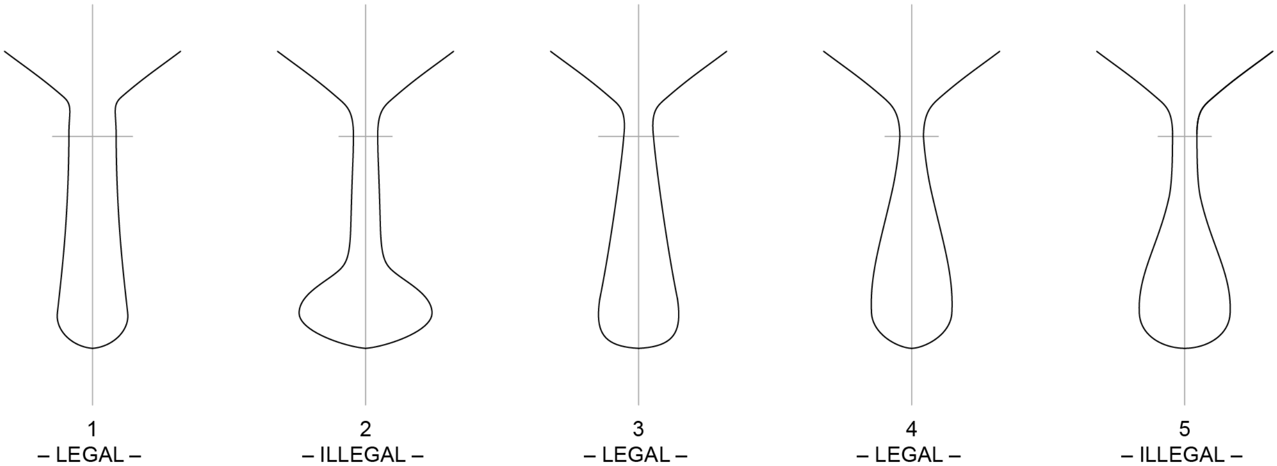


FIGURE 3 — LEGAL AND ILLEGAL KEEL TRANSVERSE SECTIONS

Transverse section 1 is a slightly hollow simple airfoil configuration, as was just encountered in Figure 1a and 1b. Section 1 is clearly legal. Transverse section 2 is the exact opposite extreme, a shape which is clearly a bulb, and as such is illegal under the New Universal Rule, Class M. The legality of the remaining three shapes is not so easy to determine.

Transverse section 3 is a nearly straight-sided section, but one with a breadth near the tip chord of the keel which is substantially thicker than the keel's root chord. There is, however, nothing bulbous about this transverse section, and it is considered to be an airfoil, not a bulbed airfoil, and hence it is legal.

Even more questionable are transverse sections 4 and 5. With section 4 there is a clearly bulb-like increase in chord thickness nearing the tip, but it isn't a sudden or dramatic change. It is much like section 3 in that the keel simply gets thicker as it nears the tip chord. What differentiates it from section 3 is that the sides are not nearly linear as is the case with section 3, but rather are clearly “bowed” outward to move the center of gravity lower in the keel by narrowing more of the keel below the root chord. This is arguably the “beginning” of a bulb, which it does seem to be, but still it is primarily a plain keel as opposed to a bulb keel. Section 5 goes further, having a sharp change in curvature in the section about 1/4 of the span down the keel section from the reference waterline, the -6.50 ft. waterline (-1.981 m).

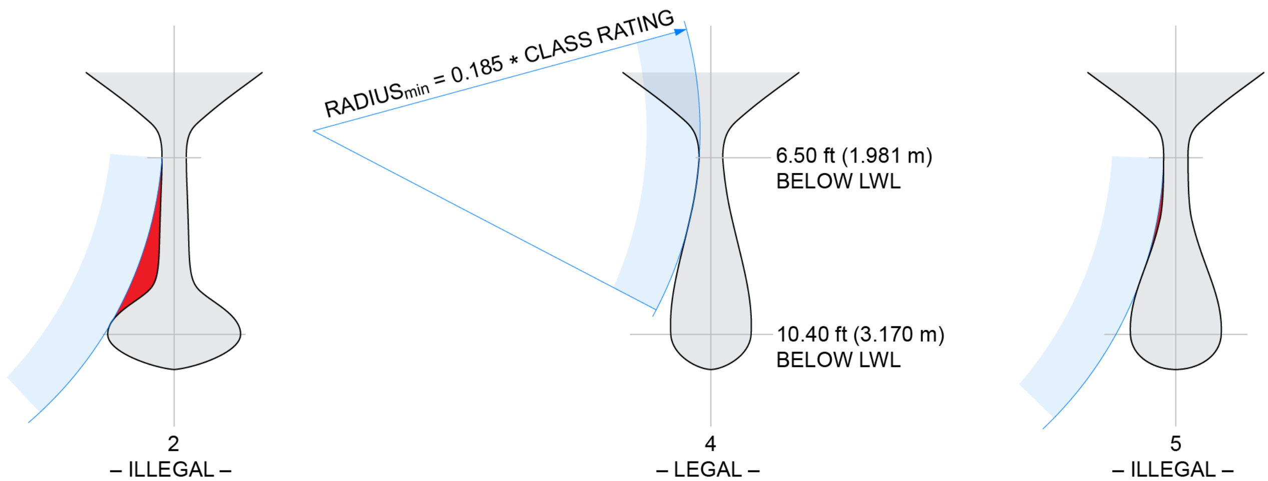


FIGURE 4 — DETERMINATION OF LEGALITY OF KEELS WITH GREATER BREADTH NEAR TIP

The determination of where a bulb actually begins will be a function of this rapid thickening as one moves down the keel span from the reference waterline. In the case of the keel section (section 4) which showed the beginning of a bulb, but still was basically a plain keel section, the minimum radius of curvature of the side of the keel section, in the vertical plane, is about 18.5% of the class rating. As section 4 seems to exemplify the dividing line between a bulb and non-bulb keel, that radius, 18.5% of class rating, is taken to be the limit line for a keel. Therefore, if a keel has, as does transverse section 2, a region of curvature less than 18.5% of class rating, taken between the -6.50 ft. (-1.981 m) waterline and the -10.40 ft. (3.170 m) waterline, then that keel is deemed to be a bulbed keel, and is illegal. If, in the region between the -6.50 ft. waterline and the -10.40 ft. waterline, there is no place with a transverse hollow whose radius less than 18.5% of class rating, then that keel is deemed to be a non-bulb keel, and is deemed to be legal in that particular regard.

Figure 4 illustrates the regions in which the two illegal keels have transverse section curvature radii which are below the legal minimum, as indicated by the red areas (note that in section 5, the region of curvature with radius less than 18.5% of class rating is small and difficult to see in the drawing, but it does render the section 5 shape illegal).

The keels in Figure 3 have been drawn with essentially equal cross-sectional area in the region from the -6.50 ft. waterline to the bottom of the keel. Note though that the surface areas differ greatly, making it unlikely that some would ever be used, but note also that the surface areas of section 3, 4, and 5 are all fairly similar, such that this distinction about bulbs becomes very important, since any of those sections might readily be used.

In addition to questions about bulbs, there arises also the possibility that someone might attempt to use narrow, long winglets to simulate a bulb. Clearly this attempt to circumvent the intention of this Supplement 9 would be illegal, but it might be difficult for a designer or a measurer, or even the Rules Committee, to be sure just how this would be determined.

The New Universal Rule of Measurement, Class M, v. 11.3.0, defines a winglet as follows:

> “winglets are airfoil surfaces mounted to the keel near the bottom of the keel, and projecting outward very approximately perpendicular to the surface of the keel.”

Therefore, to be a winglet, the structure in question must be an airfoil surface. A streamlined raised portion would, therefore, automatically be a bulb since it is not an airfoil surface, and hence not a winglet.

It is also possible that someone might make a very long, very narrow winglet, with an airfoil shape, and at or near the maximum thickness ratio of 15% of chord length. Here some judgement is needed, and that judgement will depend to some extent on the actual length of the winglet, and to some extent on the weight of the winglet.

As a basic norm, a winglet – as the airfoil surface requirement indicates – is a device intended to influence the flow of water over, and aft of, the lower portion of the keel. It may, as a secondary purpose, also house some heavy material which will exert a small influence on the boat's stability. As long as those are the functions that the winglet fulfills, and it fulfills (or attempts to fulfill) the aerodynamic function as well as the ballasting function, then it is probably still a winglet. This is clear in the case of a winglet which is more-or-less rectangular or tapered rectangular in planform, even when it has an area of increased sweep angle where it is attached to the keel (though this area must not extend beyond 6 in. (152 mm) from the winglet).

In the case of a delta wing type of winglet, a less rigid application of the principle in the previous paragraph would be called for, but the requirement that the winglet continue to be an airfoil surface, and that it have enough breadth to give a reasonable possibility of it behaving as a winglet, would have to be met.

An even more questionable case is the possible use of a “Concord” style of wing planform as a winglet. In this case, the winglet, like the delta wing winglet, would have to be an airfoil surface, and have enough breadth to have a reasonable chance to behave as a winglet. Additionally, the narrower (forward) part of the winglet would have to be of a size appropriate to that kind of planform, not a gross extension which clearly is primarily to add weight to the keel.

In both the case of the delta wing winglet, and the case of the “Concord” planform winglet, the deciding principles are going to be whether the winglet is clearly an effort to make an efficient winglet which may also add some low ballast, or whether it is clearly an attempt to use a winglet concept primarily as a source of ballast addition. If it seems definitely an attempt primarily to make an efficient winglet, then it is probably legal; if it seems a clear or probable attempt mainly to add ballast, then it is effectively a bulb, and is illegal.

Finally, designers and owners are again reminded of the warning in Appendix 1 of the New Universal Rule of Measurement, that obvious attempts to circumvent the clear intentions of the Rule will be disallowed, notwithstanding their compliance with the letter of the Rule.