

Midwest PHRF

Handicapping Rules, Credits, and Penalties (HRCP^{*})



2022 Sail Area Rules – Summary

The following changes have occurred this year:

- 1) You are now required to provide **Sail Certificates** for all “specialty sails”:
 - All Asymmetrical Spinnakers with an SHW less than 80% of the SFL.
 - All Asymmetrical Spinnakers with an SFL less than TPS.
 - All Headsails that are ‘Set Flying’, i.e.: a sail with no edge attached to the forestay, set forward of the Headstay.
 - All Headsails with an LP greater than 110% of J that have positive roach
- 2) Oversized sail adjustments will now be made in 1 sec/nm increments once the adjustment exceeds a 3 sec/nm minimum.
- 3) Adjustments are now being calculated based on the ratio of the subject sail to the total sail area.
 - The new formulas will hit an oversized spinnaker a bit harder than before but may allow larger mainsail area increases within the 3 sec/nm increment.
- 4) There will be credits for an undersized headsail.

This document contains:

- **Sail Area Rules and Formulas**
- **Sail Area Penalties and Credits**
- **Rig Penalties and Credits**
- **Other Rig, Hull and Appendage Adjustments**
- **Random Leg Handicap**
- **Non-Spinnaker Handicap Offset**
- **Sail and Rig Acronyms**

^{*} For the purposes of this document...

‘**Credit**’ is a positive (+) adjustment to a Boat’s rating reflecting a speed potential decrease (meaning the Rated Boat will be slower than the Base Boat).

‘**Penalty**’ is a negative (-) adjustment to a Boat’s rating to reflect a speed potential increase (meaning the Rated Boat will be faster than the Base Boat).



Sail Area Calculations

Calculations for **rated** areas use owner supplied values. If owner supplied values are missing, PHRF maximums will be used.

Calculations for **base boat** areas are made using sail dimensions derived from rig dimensions.

See the **APPENDIX** for the definition of all acronyms. These formulas are used as the baseline for any Penalties or Credits.

Mainsail Sail Area

Rated Mainsail area calculation uses the greater of the subject boat declared width measurements or the Base Boat Default widths.

Base Boat mainsail area calculation uses **Base Boat Default** widths unless specified otherwise in the base boat definition.

In cases where the subject boat declared MQW is between 85 and 90% of E and an MQW measurement is not defined in the Base Boat definition, the Base Boat mainsail area calculation will substitute the subject boat declared MQW or the Default MQW.

Mainsail Maximum Widths			
Measurement	Description	PHRF Maximums	Base Boat Default
MHB	Headboard	Greater of 0.04*E , or 0.5 feet	Greater of 0.04*E, or 0.5 feet
MUW	7/8 Width	0.22*E	0.22*E
MTW	3/4 Width	0.38*E	0.38*E
MHW	1/2 Width	0.65*E	0.65*E
MQW	1/4 Width	0.90*E	0.85*E

Both Mainsail areas are then calculated using the trapezoidal rule for approximating the area of the sail, applying that rule to each of the vertical portions of the sail using this formula:

$$\text{Main S.A.} = (\text{MHB} + \text{MUW}) * (\text{P} - \text{MUWH}) + (\text{MUW} + \text{MTW}) * (\text{MUWH} - \text{MTWH}) + (\text{MTW} + \text{MHW}) * (\text{MTWH} - \text{MHW}) + (\text{MHW} + \text{MQW}) * (\text{MHW} - \text{MQWH}) + (\text{MQW} + \text{E}) * (\text{MQWH} - 0) / 2$$

The Width measurement locations are defined by these formulas:

$$\text{MUWH} = (\text{P} + \text{MTWH}) / 2 + \text{MTW} / (\text{P} - \text{MTWH}) * (\text{MUW} - \text{MTW} / 2)$$

$$\text{MTWH} = (\text{P} + \text{MHTW}) / 2 + \text{MHW} / (\text{P} - \text{MHTW}) * (\text{MTW} - \text{MHW} / 2)$$

$$\text{MHW} = (\text{P} / 2) + (\text{E} / \text{P}) * (\text{MHW} - \text{E} / 2)$$

$$\text{MQWH} = (\text{MHW} / 2) + ((\text{E} - \text{MHW}) / \text{MHW}) * (\text{MQW} - (\text{E} + \text{MHW}) / 2)$$



Headsail Sail Area

Rated Headsail S.A. is calculated using the trapezoidal rule for approximating the area of the sail, applying that rule to each of the vertical portions of the sail using this formula:

$$\text{Headsail S.A.} = 0.1125 \cdot \text{HLU} \cdot ((1.445 \cdot \text{HLP}) + (2 \cdot \text{HQB}) + (2 \cdot \text{HHW}) + (1.5 \cdot \text{HTW}) + (1 \cdot \text{HUW}) + (0.5 \cdot \text{HHB}))$$

Rated Headsail S.A. calculations use the following default Widths when the owner has not supplied them. If the Headsail Luff length measurement is not declared, the default for **HLU** is the **I** measurement.

Measurement	Description	PHRF Maximums
HHB	Headboard	0.020 *HLP
HUW	7/8 Width	0.875 *HHB + 0.125 *HLP
HTW	3/4 Width	0.750 *HHB + 0.250 *HLP
HHW	1/2 Width	0.500 *HHB + 0.500 *HLP
HQB	1/4 Width	0.250 *HHB + 0.750 *HLP

Base Boat Headsail S.A. calculations use **I** and **HLP**. If HLP is not defined in the Base Boat definition, HLP default is $1.55 \cdot J$.

If the HLP is greater than 110% of J, Headsail S.A. = $(I \cdot \text{HLP}) / 2$

If the HLP is not greater 110% of J, Headsail S.A. = $(I \cdot \text{HLP}) / 2 \cdot 1.1$

Spinnaker Area

The area of a Spinnaker is calculated as:

$$\text{Rated Spinnaker S.A.} = (\text{SLU} + \text{SLE}) \cdot ((4 \cdot \text{SHW}) + \text{SFL}) / 12$$

For a **Symmetric Spinnaker** where the Base Boat definition does not specify a maximum SFL, the maximum of the declared values of SHW and SFL is substituted for both SHW and SFL.

Base Boat Spinnaker S.A. uses the same formula as the Rated Spinnaker Area where specific maximums are defined. Where specific values are not assigned the following defaults apply:

$$\text{ISP} = I$$

$$\text{TPS} = J$$

$$\text{SPL} = \text{TPS}$$

$$\text{SLE} = \text{SLU} = 0.95 \cdot \text{SQRT}(\text{ISP}^2 + \text{SPL}^2)$$

$$\text{SHW} = \text{SFL} = 1.8 \cdot \text{SPL}$$

Using all default values, the Spinnaker S.A. = $\text{SQRT}(\text{ISP}^2 + \text{TPS}^2) \times \text{TPS} \times 1.425$.



Penalties and Credits

Sail Area Changes

All rig and area adjustments are to be rounded down to the next whole number.

The an adjustment of -3.4 seconds per mile for an oversized sail would round down to -4 and an adjustment of +3.6 seconds per mile for an undersized headsail would round down to + 3.

If the result is a -1 or -2 second penalty, then it is increased to **-3** seconds so that the minimum penalty for an increase in sail area is always -3 seconds.

Over-Size Sail Area Penalty – Mainsails, Headsails, and all Spinnakers

For the purposes of calculating over-size sail area rating adjustments, formulas that utilize the 4th-root of a ratio of sail areas are used.

This calculation uses the Sail Area Ratio, which is the **rated** sail area of the individual boat (the numerator) and **design** area for the **base boat** (the denominator)*. The 60% Upwind + 40% Downwind (**S64**) Sail Area is used for the calculation of this Ratio. The '**S64**' Area is also referred to as the boat's "Total Sail Area", which is defined as 60% of the Largest Headsail Area + 40% of the Largest Spinnaker Area + the Mainsail area.

$$\begin{aligned} \text{S64} &= \text{Boat's T.S.A.} = \text{Mainsail S.A.} \\ &+ (0.60 * \text{Largest Headsail S.A.}) \\ &+ (0.40 * \text{Largest Spinnaker S.A.}) \end{aligned}$$

$$\text{SAR} = \text{Boat's Sail Area Ratio} = (\text{Rated Boat S64} / \text{Base Boat S64})$$

The formulas for headsail, mainsail and spinnaker adjustments are:

$$\begin{aligned} \text{Mainsail Adjustment} &= 450 * (1 - \text{SAR}^{\wedge 0.25}) \\ \text{Headsail Adjustment} &= 380 * (1 - \text{SAR}^{\wedge 0.25}) \\ \text{Spinnaker Adjustment} &= 310 * (1 - \text{SAR}^{\wedge 0.25}) \end{aligned}$$

* **Note:** If a rig penalty is applied, then all oversized sail area calculations will compare the sail area of the subject boat with the adjusted sail area used to determine the rig adjustment

Increased Mainsail Area Adjustment

There are two parts to this adjustment: (1) **Width** penalty and (2) **Area** penalty. The penalties are not additive, the total penalty shall be the greater of the Width penalties and the Area penalty.

If any of the individual Width measurements exceed the PHRF maximums, a -3 second **Width** penalty will be applied for each width over the allowable maximum.

MHB	Headboard:	Greater of 0.04*E , or 0.5 feet
MTW	7/8 Width:	0.22*E
MUW	3/4 Width:	0.38*E
MHW	1/2 Width:	0.65*E
MQW	1/4 Width:	0.90*E

The **Area** penalty is based upon the change in total boat sail area (**S64**) in -1 second increments with a minimum penalty of -3 seconds. (i.e.: -1 and -2 second calculated penalties result in a -3 second certificate penalty.)

The adjustment is based upon the formula described in the sail area calculation section above, and repeated here: **Mainsail Adjustment = 450*(1-SAR[^]0.25)**



Increased Headsail Area Adjustment

The penalty is based upon the change in total boat sail area (**S64**) in **-1** second increments with a minimum penalty of **-3** seconds.

The adjustment is based upon the formula described in the Headsail area calculation section above, and repeated here:

$$\text{Headsail Adjustment} = 380 * (1 - \text{SAR}^{*0.25})$$

Under-Size Head Sail Area Credit

Except for **Headsails**, there is no credit for undersized sails.

The credit for under-sized headsails is based upon the change in total boat sail area (**S64**) in **1** second increments. No credit is awarded until the credit reaches a minimum of **3** seconds.

The formulas for undersized headsails are the same as for oversized headsails, and repeated here:.

$$\text{Headsail Adjustment} = 380 * (1 - \text{SAR}^{*0.25})$$

Increased Symmetrical & Asymmetrical Spinnaker Area Adjustment

The penalty is based upon the change in total boat sail area (**S64**) in **-1** second increments with a minimum penalty of **-3** seconds. (i.e.: -1 and -2 second calculated penalties result in a -3 second certificate penalty.).

The adjustment is based upon the formula described in the Spinnaker sail area calculation section above, and repeated here:

$$\text{Spinnaker Adjustment} = 310 * (1 - \text{SAR}^{*0.25})$$

Specialty Sails

- Asymmetrical Spinnakers with a **SHW** of less than 80% of **SFL**.
- Headsail with an **HLP** greater than 110% of **J** and a **HHW** > 50% of **J**.
- Any Headsail tacked forward of the Headstay.

Sailmaker Certificates are required for each sail of this type.

For many classes, these sails may be assumed as part of the standard inventory and there would be no adjustment made to the general handicap (HCP). However, there are some specialty sails that are not considered as part of the normal inventory for that class and improve the upwind performance as well as the Random Leg performance. These sails may result in adjustments both the the general handicap as well as the Random Leg Handicap.

All Specialty Sails will be rated on a case-by -case basis.



Rig Changes

Any changes to the boat's rig must be declared when applying for a MWPHRF handicap.

Roller Furling Headsail Credit

+3 for boats that have a roller furling headsail with an above-deck drum.

A furling Headsail must be used at all times for this credit.

Note: This credit does not apply if above deck roller furling was assumed for the Base Boat. However, for most it is assumed that a factory or dealer installed furling drum is removed for races.

Roller Furling Mainsail Adjustment

+3 for in-boom furling (pocket booms do not qualify)

+3 for in-mast furling with "full" roach.

+6 for in-mast ruling is roach is 50% of "full" roach.

+9 for in-mast furling if no roach.

A furling Mainsail must be used at all times for this credit

Note: This credit does not apply if a furling mainsail is included in the boat's original configuration as specified in the Base Boat definition. If this is the case, the boat class typically as an RFM suffix appended.

Asymmetric Spinnaker Tacked on Centerline Adjustment

0 seconds if the individual boat's D/L ratio is less than 90.

+3 seconds if the individual boat's D/L ratio is 90 – 150.

+6 seconds if the individual boat's D/L ratio is 150 – 250.

+9 seconds if the individual boat's D/L ratio is over 250.

Note: This adjustment applies to boats where the Base Boat was defined assuming a spinnaker tacked to a spinnaker pole and the spinnaker is now being tacked only on centerline. The spinnaker pole may be carried to "pole out" a headsail but may not be used with the spinnaker.

Over-Size Rig Adjustments

The rated sail areas resulting from an increase in rig size will be calculated using the base boat default sail size assumptions for the subject boat and compared to the rated areas of the base boat. Adjustments will be calculated as defined in the **Sail Area Changes** section.

If both I and P are changed, the adjustment is listed as the general **Rig Size Adjustment**. If I and J are changed, it will be listed as a **Headsail** Rig Adjustment, ISP, SPL or TPS as **Spinnaker** Rig Adjustment, and P and E as **Mainsail** Rig Adjustment.

In the event that multiple rig changes such as an increase in I, ISP and P, the rating adjustments will be added before rounding. The resulting adjustment will be a minimum of **-3** seconds and then in **-1** second increments above that.

Note: If a rig penalty is applied, all additional sail area calculations will use the adjusted sail areas that result from individual boat rig measurements.



Other Rig, Hull and Appendage Adjustments

Any changes to the boat's hull or appendages must be declared when applying for a MWPHRF handicap.

Fixed Prop Adjustment

- +6** for a two-bladed prop not in an aperture.
- +9** for a three bladed prop not in an aperture.
- +3** for a three bladed prop in an aperture.

Carbon Fiber Mast Adjustment

- 3** if aluminum mast is replaced with carbon fiber mast.
- +3** if carbon fiber mast is replaced with aluminum mast.

Shortened Boom Adjustment

There is no specific credit for a shorter E dimension. However, the Technical Committee may choose to evaluate a shorter E dimension on a case-by-case basis.

Synthetic or Non-Circular Shroud Adjustment

- 3** if shrouds (excluding the backstay) are changed to synthetic fibers.

Keel and Rudder modifications

Any changes to the boat's keel or rudder must be declared when applying for a MWPHRF handicap. These modifications will be addressed on a case by case basis by the Chief Handicapper and the Head of the Technical committee.



Random Leg Course Handicap

These adjustments only apply to races that specify the use of the Random Leg Handicap (DHCP). The DHCP accounts for advantages or disadvantages that some boats have on a random leg courses versus a 'Windward/Leeward' course.

Specialty Sail adjustment (Code 0 and Large Roach Headsail)

Regardless of whether the specialty sail is assumed for the Base Boat, if the inclusion of the sail in the inventory results in a significant advantage for random leg courses versus the base boat assumptions, an adjustment may be assigned. The size of the adjustment will be determined based on a case-by-case basis

Adjustment for Shallow Draft

Either **-3** or **-6** seconds for any boat with a shallow draft keel.

If $LOA^{0.75}/\text{maximum draft}$ is > 2.8 but ≤ 3.5 , a **-3** adjustment is applied.

If $LOA^{0.75}/\text{maximum draft}$ exceeds 3.5, then a **-6** adjustment is applied.

Adjustment for Using an Asymmetric Spinnaker Tacked on The Centerline

-3 unless the individual boat's D/L ratio is less than 90.

Adjustment for Large LOA and Large BHCP

If $\text{SQRT}(2*LOA)*(BHCP+500)/100$ is greater than 56 but ≤ 60 , a **-3** adjustment is applied.

If $\text{SQRT}(2*LOA)*(BHCP+500)/100$ is greater than 60, a **-6** adjustment is applied.

Adjustment for Sportboats

-3 adjustment if the individual boat's **SA/D** is > 50 and the **D/L** ratio is < 100 .

Moveable Ballast Adjustment

-3 or **-6** adjustment if the boat has movable ballast based on review by the Technical Committee.



Jib & Main (Non-Spinnaker) Handicap Offset and Handicap

The **NSHCP Offset** is based on the ratio of the total downwind sail area with a spinnaker to the total downwind sail area without the spinnaker. There are two parts: a class offset based on the Base Boat definition which is the same for all boats of a class and an adjustment to reflect the specific headsail size of the subject boat.

The **Non-Spinnaker Handicap** is equal to the Base Handicap which includes all adjustments except those related to the spinnaker plus the NSHCP Offset.

NSHCP Class Offset Ratio

For pole tacked spinnaker boats: $(\text{Spinnaker S.A.} + \text{Mainsail S.A.}) / (\text{Headsail S.A.} + \text{Mainsail S.A.})$

For centerline tacked spinnaker boats: $(\text{Spinnaker S.A.} / 1.25 + \text{Mainsail S.A.}) / (\text{Headsail S.A.} + \text{Mainsail S.A.})$.

For non-spinnaker base boats, the ratio is defined as 1.00.

NSHCP Class Offset

$[\text{Maximum of (NSHCP Class Offset Ratio} ^{.25} - 1) * 202 - 12] \text{ or } 0$.

The NSHCP Class Offset is rounded to the nearest 3 s/m increment using normal rounding rules (.5 and up rounded up) and recorded on the Base Boat record.

NSHCP Offset

$\text{NSHCP Offset} = \text{NSHCP Class Offset} + 0.6 \times (\text{headsail rig adjustment} + \text{headsail area adjustment})$

Other Adjustments

Missing Data Adjustment

-15 if any data is missing that is required to generate a handicap.

Other situation adjustments

There are many unique situations where a boats configuration does not lend itself to handicapping based on the rules presented in this document. The Regional handicapper will then address the unique situation on an individual case basis and determine the correct adjustments for this unique configuration.



Sail Acronyms used by Midwest PHRF

The following are the acronyms used to record a boat's sails and Rig Dimensions. The ORC definitions are included to assist with ORC Certificate comparisons.

Measurement Name & Acronyms				
HULL Dimensions				
LOA	Length Overall		LWL	Length of Waterline
Beam	Maximum Hull Width	Base Boat		The standard boat used for a base HCP
Common RIG Dimensions				
P	Main Hoist, Boom to Band		I	Jib Hoist from Sheer Line
E	Main Foot, Mast to Band		J	Mast to Forestay, at Sheer Line
PY	Mizzen Hoist, Boom to Band		SPL	Sym. Spin. Pole Length, Mast to Tack
EY	Mizzen Foot, Mast to Band		TPS	Sprit Length, Mast to Tack
ISP	Spinnaker Hoist		S.A.	Sail Area
S64	S.A. 60% Upwind, 40% Downwind*		SAR	Sail Area Ratio*
	* S64 = Using the Mainsail, Largest Headsail, and Largest Spinnaker = ‘Total Sail Area’			
	* SAR = (S64 Rated Boat / S64 Base Boat)			
SAIL DIMENSIONS Acronyms & Definitions				
PHRF	PHRF Definition*		ORC	ORC Definition*
	*For reference only, for Old Timers. ;)		* Preferred MWPHRF terminology.	
MAINSAIL Dimensions				
MHB	Mainsail Headboard Width	1	MHB	Mainsail Headboard
MGT	Mainsail Girth Top	7/8	MUW	Mainsail Upper 7/8 Width
MGU	Mainsail Girth Upper	3/4	MTW	Mainsail Three-Quarter Width
MGM	Mainsail Girth Middle	1/2	MHW	Mainsail Half Width
MGL	Mainsail Girth Lower	1/4	MQW	Mainsail Quarter Width
MFL	Mainsail Foot Length*	0	MFL	Mainsail Foot Length*
	* Not an ORC measurement, assumed to equal ‘E’.			
zMGT	Mainsail Girth Top Height	7/8	MUWH	Mainsail Upper 7/8 Width Height
zMGU	Mainsail Girth Upper Height	3/4	MTWH	Mainsail Three-Quarter Width Height
zMGM	Mainsail Girth Middle Height	1/2	MHWH	Mainsail Half Width Height
zMGL	Mainsail Girth Lower Height	1/4	MQWH	Mainsail Quarter Width Height



HEADSAIL Dimensions				
HHB	Headsail Headboard Width	1	HHB	Headsail Headboard
HGT	Headsail Girth Top	7/8	HUW	Headsail Upper Width
HGU	Headsail Girth Upper	3/4	HTW	Headsail Three-Quarter Width
HGM	Headsail Girth Middle	1/2	HHW	Headsail Half Width
HGL	Headsail Girth Lower	1/4	HQW	Headsail Quarter Width
HFL	Headsail Foot Length	0	HFL	Headsail Foot Length*
HLU	Headsail Luff Length		HLU	Headsail Luff Length
LP/LPG	Headsail Luff Perpendicular		HLP	Headsail Luff Perpendicular
			HLE	Headsail Leech measured as SLE*
* Not an ORC measurement but used by MWPHRF for 'Large Roach Headsail' calculations				
zHGT	Headsail Girth Top Height*	7/8	HUWH	Headsail Upper Width Height
zHGU	Headsail Girth Upper Height	3/4	HTWH	Headsail Three-Quarter Width Height
zHGH	Headsail Girth Middle Height	1/2	HHWH	Headsail Half Width Height
zHGL	Headsail Girth Lower Height	1/4	HQWH	Headsail Quarter Width Height
SYMMETRICAL SPINNAKER Dimensions				
SL	Symmetric Luff/Leach Length		SLU	Symmetric Luff/Leach Length
			SLE	Symmetric Luff/Leach Length
SMG	Symmetric Maximum Girth		SHW	Symmetric Half Width
SMW	Symmetric Maximum Width		SMW	Symmetric Maximum Width*
SF	Symmetric Foot Length		SFL	Symmetric Foot Length
* Not an ORC measurement but used by MWPHRF.				
ASYMMETRICAL SPINNAKER Dimensions				
ALU	Asymmetric Luff/Leach Length		SLU	Asymmetric Luff Length
ALE	Asymmetric Maximum Width		SLE	Asymmetric Leach Length
AMG	Asymmetric Maximum Width		SHW	Asymmetric Half Width
AF	Asymmetric Foot Length		SFL	Asymmetric Foot Length
ASL	Asymmetric Luff Length*			
* Calculated as = 0.5 * (ALU + ALE)				

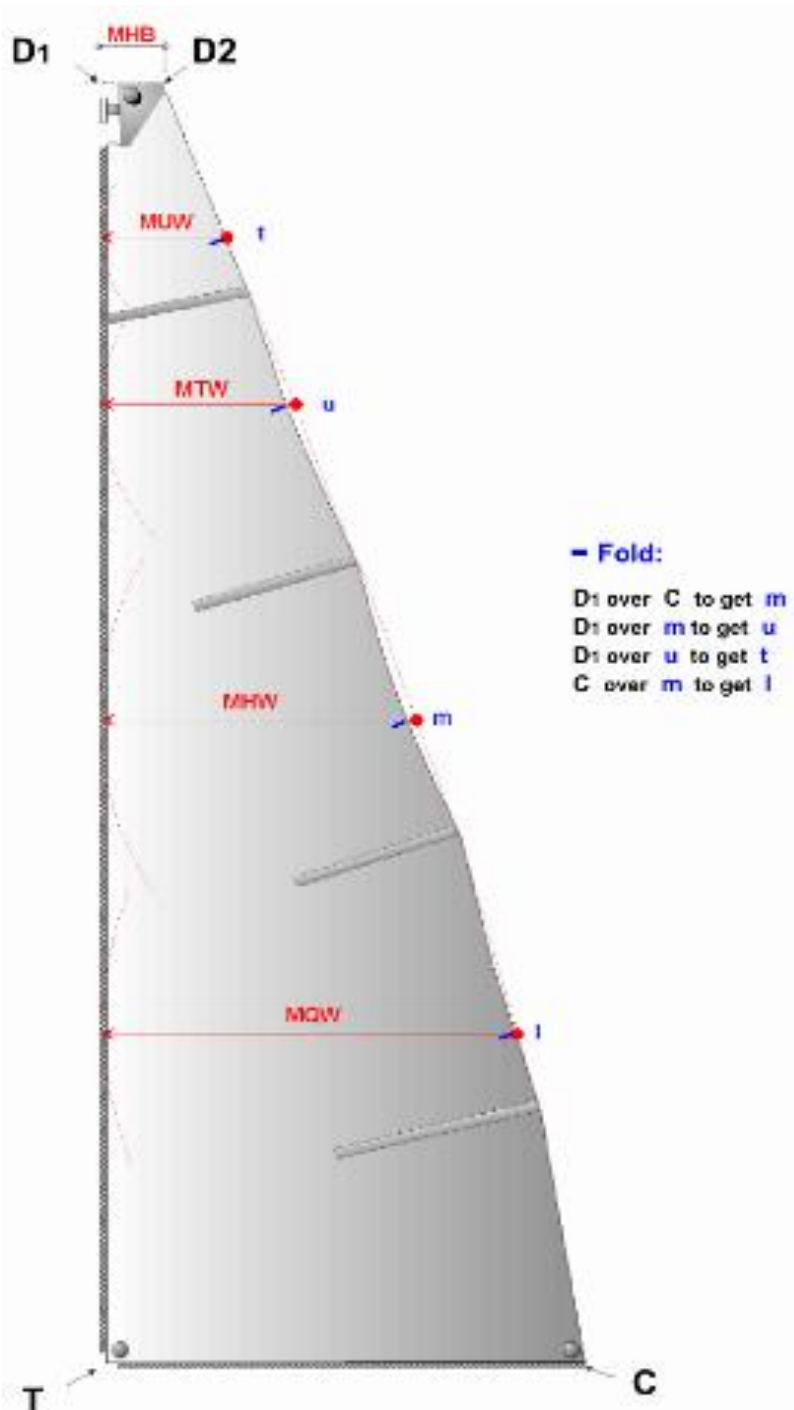


MWPHRF Handicaps				
	DRYA Handicaps*			MWPHRF Handicaps
	* For Region 9 reference only.			
PHRF	Racing Handicap		HCP	Racing Handicap*
--	No equivalent in DRYA		DHCP	Distance Racing Handicap
JAM	Jib & Main Handicap		NSHC P	Non-Spinnaker Handicap
	* Includes Base Boat Rating, – Penalties, + Credits			
MATH Acronyms				
SQRT	Square Root		^	Raised to the Power of...

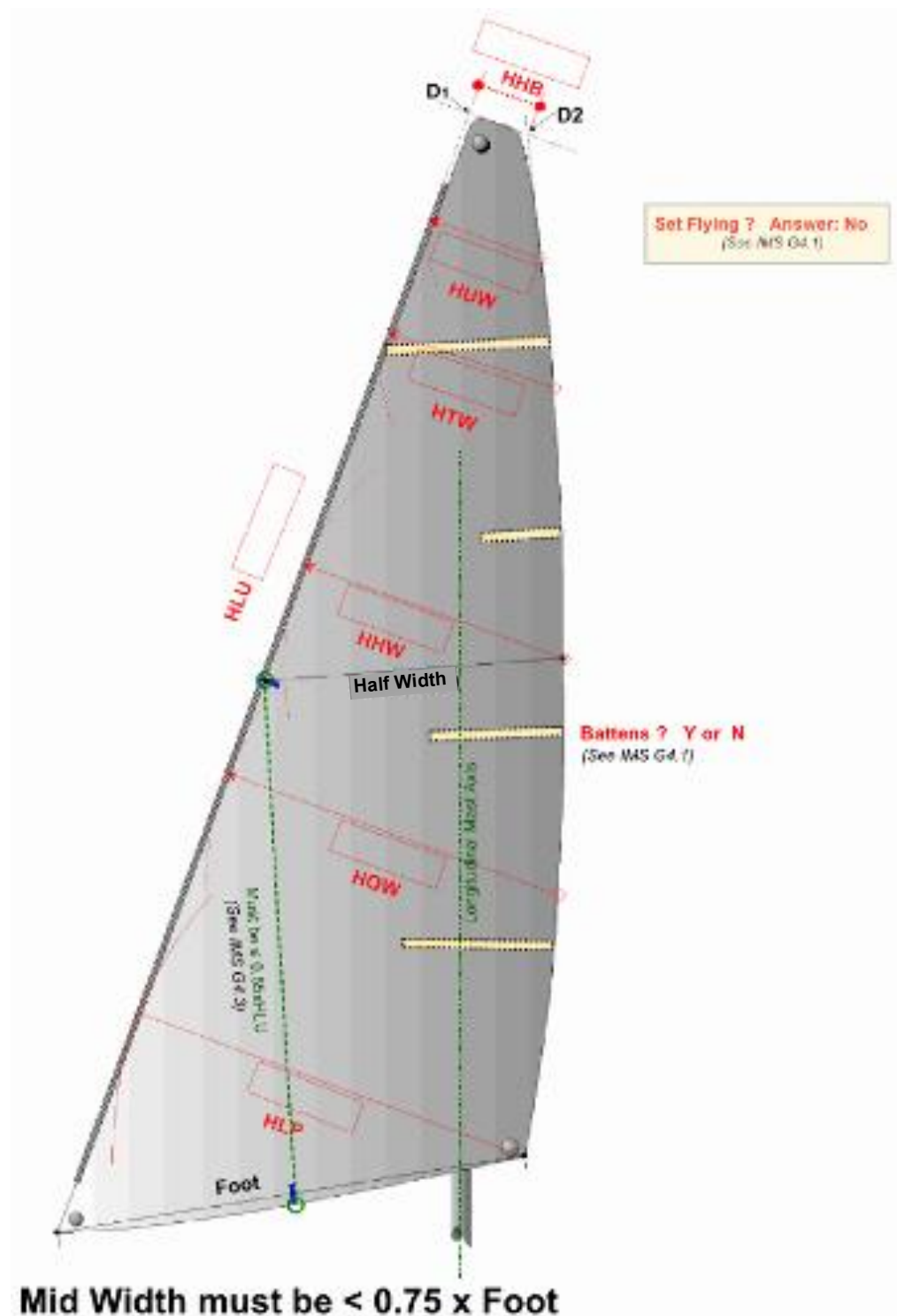
Sail Measurements Diagrams

The following are pictures from the Offshore Racing Congress (ORC) web site to help explain the sail measurements terms.

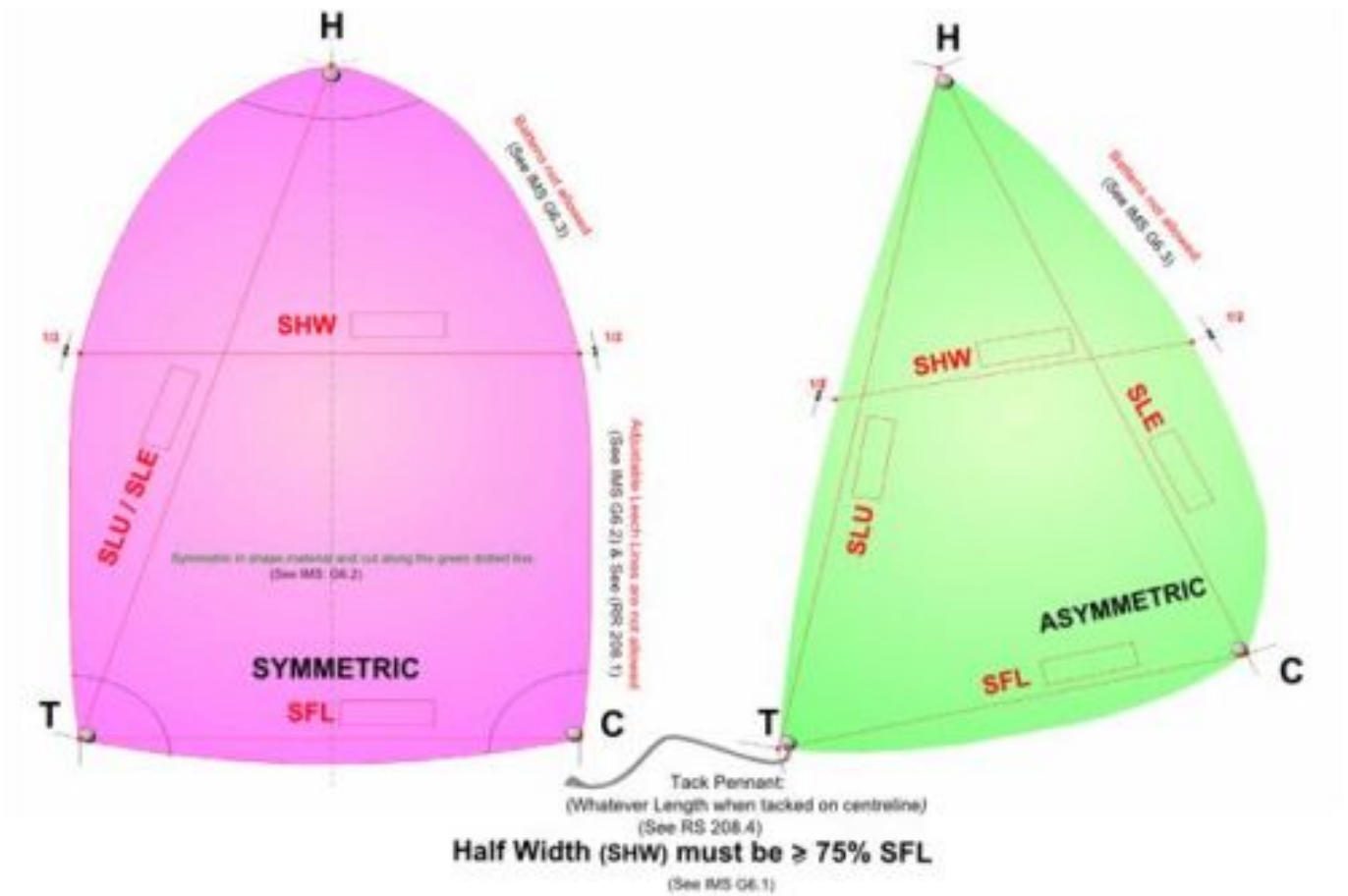
Mainsail



Headsail



Spinnakers



Flying Headsails



Mid Width must be $< 0.75 \times \text{Foot}$

*Mid Width: The distance between half luff point and half leech point
(See IMS G6.1)*