2025

ORC

The Equal Chance to Win

OFFSHORE RACING CONGRESS


2024 Cyclades Cup, Kurt Arrigo

ORCsy VPP Documentation

Table of Contents

1 Introduction

This document contains a short description of the modifications made to the ORC INT VPP to create the new ORC SY VPP.
Please refer to the following documents (available for downloading at the www.orc.org/rules web site) for any further information about ORC rules and VPP's:

1. **INTERNATIONAL MEASUREMENT SYSTEM – IMS 2025**
2. **ORC RATING SYSTEMS 2025**
3. **ORC VPP DOCUMENTATION 2025**
4. **ORC SUPERYACHT RULE 2025**
5. **ORC SY MEASUREMENT GUIDANCE 2022 – Release 1.0**

The ORC SY VPP 2025 does not implement the following new features of ORC VPP 2025:
-the change in aerodynamic coefficients of spinnakers and hsf
-the change in non manual power credit
-the modified credit in aerodynamic coefficients of jib with furler

2 Hydrostatics

2.1 Lightship and Sailing Trim Displacement

For non-measured boats the lightship displacement and VCG are deduced from the stability booklet. The sailing displacement is calculated from lightship DSPL by adding the following:

- Default crew weight
- Default gear weight
- Default sail weight
- Declared liquids
- Declared anchors

The default crew weight is calculated as:
$creweight = ORC\_DEF\_CW \cdot cw_{mult}$
With
$ORC\_DEF\_CW = 25.8 \cdot LSM0^{1.4262}$
$cw_{mult} = 1.0625 - 0.00125\ DSP0/1000$

DSP0 is the lightship displacement.
The factor cw_{mult} is bounded in the range [0.3 , 1.0].

The defaults weights of mainsail and other sails are (in kg):
$mainsail \quad = 0.1709 \cdot LSM0^{2.1821}$
$headsail \quad = 0.0677 \cdot (LSM0)^{2.3493}$
$spinnaker = 0.1426(\mathrm{LSM0})^{2.0568}$

while the default gear weight is 16% of the *ORC_DEF_CW*.
For anchor and chain an adjustment of the gyradius is calculated too, using the existing ORC model.

For measured boats the inventory list made during floatation is used to derive the lightship trim displacement. Moreover, in the same list the items carried on board while sailing that are added for the calculation of sailing displacement are reported too. Liquids are declared by the captain before the race.
In addition the following default weights will be accounted:

- Default crew weight

The default crew weight is calculated as:
$\mathrm{creweight} = \mathrm{ORC\_DEF\_CW} \cdot \mathrm{cw_{mult}}$
With
ORC_DEF_CW$= 25.8 \cdot \mathrm{LSM0}^{1.4262}$
$\mathrm{cw_{mult}} = 1.0625 - 0.00125\ \mathrm{DSP0}/1000$

DSP0 is the lightship displacement.
The factor $\mathrm{cw_{mult}}$ is bounded in the range [0.3 , 1.0].

- Default Racing gear weight (16% of the *ORC_DEF_CW)*
- Default sails weight:

$\mathrm{mainsail} \quad = 0.1709 \cdot \mathrm{LSM0}^{2.1821}$
$\mathrm{headsail} \quad = 0.0677 \cdot (\mathrm{LSM0})^{2.3493}$ multiplied by the declared number of headsails (max 3 will be accounted, min 2)
$\mathrm{spinnaker} = 0.1426 \cdot (\mathrm{LSM0})^{2.0568}$ multiplied by the declared number of spinnaker (max 3 will be accounted, min 2)

The complete procedure is described in the Measurement Guidance document.

2.2 Righting Moment

The measured righting moment is used by the VPP, not the averaged righting moment with a statistical default RM, like in the ORC International.
The ORCI optimization of the crew transverse position is not implemented.

2.3 Fresh Water Ballast

The SY VPP takes into account the possibility of carrying ballast filled with fresh water that is not discharged sailing downwind.
So the displacement is increased by the water ballast weight in any conditions while a double run is performed, one with ballast only on one side and one with ballast equally distributed on the windward and leeward sides.

3 Aerodynamics

3.1 Aerodynamic Model

The ORC SY VPP aero model makes use of a global sailplan approach.
Initially global aero coefficients for three rigs (sloop, ketch, schooner) have been assembled by Martyn Prince from the Wolfson Unit database, along with typical values of effective height. After noticing that the performances were much faster than those

obtained with ORC INT VPP aero model, the coefficients have been re-modulated trying to reproduce similar handicaps for typical boats. In doing this, the relative ratios of coefficients among different rigs have been maintained.
Beside the above mentioned rigs, gaff sloop, gaff schooner and gaff50 schooner have been introduced. This last represents a rig with one triangular mainsail and one gaff mainsail. They differ from the Marconi essentially for a different value of the effective height and for a different lower boundary of the depowering *flat* parameter. While the default value for the minimum flat is 0.62, for the gaff schooner it is 0.85, and for gaff sloop and gaff50 schooner it is 0.78. This setting tries to reflect in the mathematical model the lesser ability of the gaff rigs in reducing the camber of the sails as the wind increases.

Three sets of global coefficients are included into the aero model:

- one for the upwind configuration with luffed headsails (mainsail+upwind luffed headsails, or main+mizzen+upwind luffed headsails)
- one for the upwind configuration with non-luffed headsails (mainsail+upwind non-luffed headsails, or main+mizzen+upwind non-luffed headsails)
- one for downwind configuration (main+spinnaker, or main+mizzen+spinnaker+ mizzen staysail). The mizzen staysail area is multiplied by an *efficiency factor* which takes into account the shadow effect of the mizzen, and also the distance between the main and mizzen mast. The factor is

$$k_{mizstaysail} = 0.7 + 0.4\left(\frac{A_{mizstaysail}}{A_{mizzen}}(1 + f_{gap}) - 1\right)$$

Where

$$f_{gap} = 0.2\,\frac{gap-1.1}{0.4}\ ,\ gap = \frac{EB-0.4E+0.4EY}{\_E}\ .$$

The value of $k_{mizstaysail}$ is bounded between 0.7 and 1.0, and it depends on the room available between the masts, as it can be appreciated in Figure 1. The above formulation is the slightly modified one in 2025.

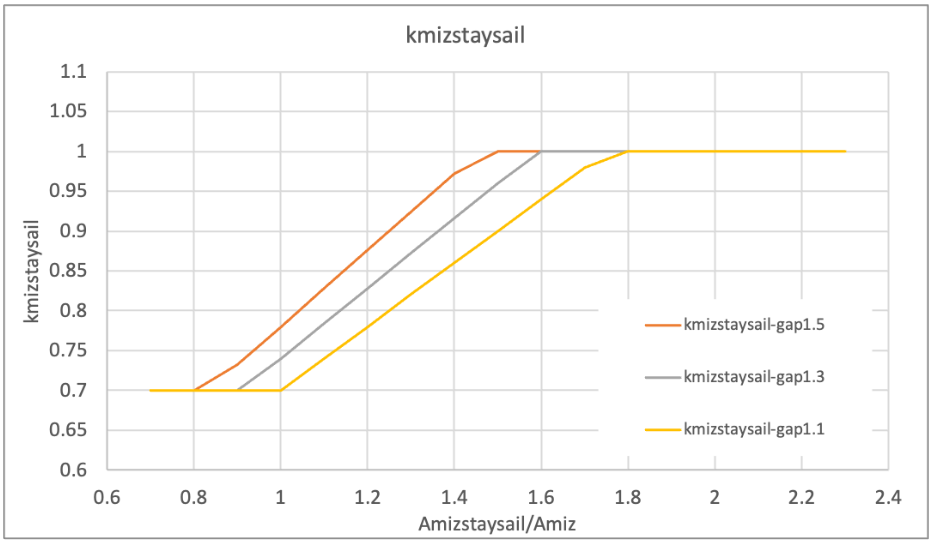

Figure 1: plot of the efficiency factor for mizzen staysail, for different values of the gap *parameter.*

A mizzen staysail hoisted with headsail could also be taken into account in the configuration with luffed or non luffed headsails. Its effect is smoothly decreased starting at apparent wind angle of 50 degrees, so to be completely nullified at apparent wind angles equal to 20 degrees.

Also, the area of this mizzen staysail hoisted with headsail is reduced proportional to a factor measuring the negative effect of the proximity of the mainsail:

$$t = \frac{EB - E}{EB}$$

When the mainsail boom is very long and occupies most of the space between the two masts, the factor is close to zero and the efficient area is taken as the 50% of the measured area. On the other side when the boom is short, and the factor *t* exceeds the value of 0.4, the efficient area is equal to the measured area. In between these two extremes a linear blending is computed for the specific value of *t*.

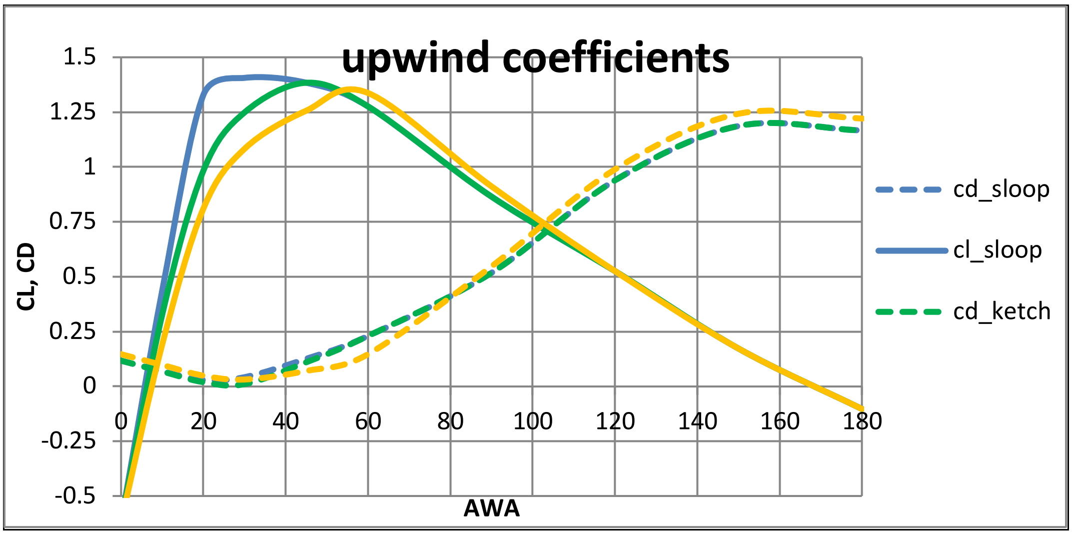

Figure 2: upwind aerodynamic coefficients.

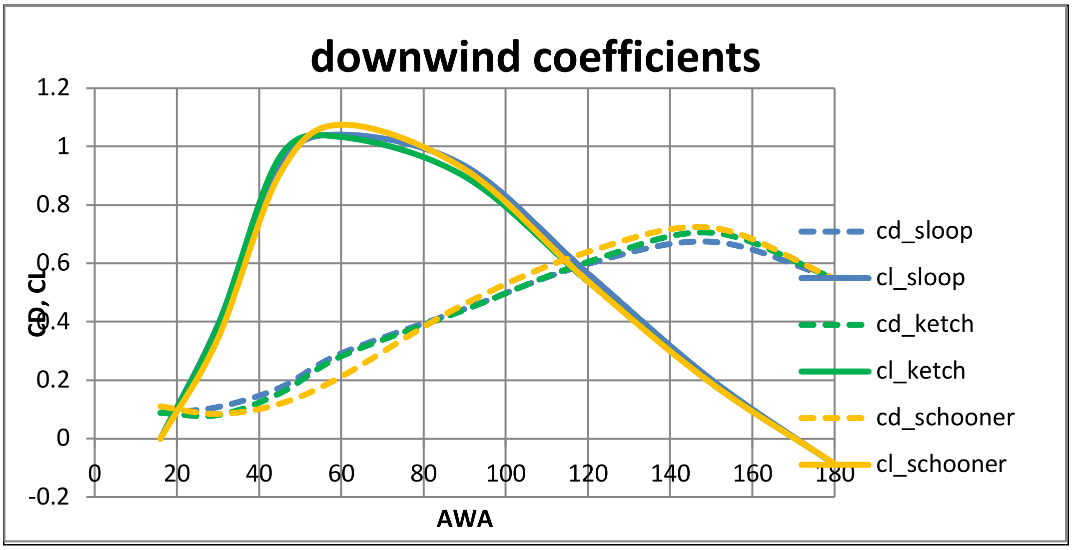

Figure 3: downwind aerodynamic coefficients.

Regarding the luffed headsails, two different upwind runs are taken into account:

1. One with the largest headsail declared in the inventory. If the sail is an overlapping jib (overlap>115%), there is no depowering (no reefing and no flattening), and a degradation of the performance upwind is applied, related to the chainplate width (see par.3.2). If the sail is a non overlapping jib (overlap≤115%), the depowering is active (on the global sailplan including the mainsail and mizzen)
2. In case the first run was with an overlapping genoa, a second one is performed with the largest declared non overlapping jib, with normal depowering (reefing and flattening). The jib area in this case is lower bounded by a minimum computed as

$$area = 0.405 \cdot J \cdot \sqrt{J^2 + IM^2}$$

In the most complete case, the VPP will calculate:

- an 'upwind' polar (including upwind VMG) using the sail area of the sails carried when beating upwind with the largest luffed headsail. No depowering is applied, and the sail is used up to a maximum of apparent wind speed of 22 knots
- a second 'upwind' polar with the sail area calculated using the headsail with the non overlapping jib, with depowering
- a 'flying headsail' polar, using the flying headsail area. The sail is used up to a maximum of apparent wind speed of 16 knots.
- a 'downwind' polar using the sail area of the sails carried when running.

Then, for each wind speed and angle (TWS, TWA) the 'best' performance is extracted, selecting from among the three the one with largest boat speed (or VMG if for the best upwind and downwind cases).

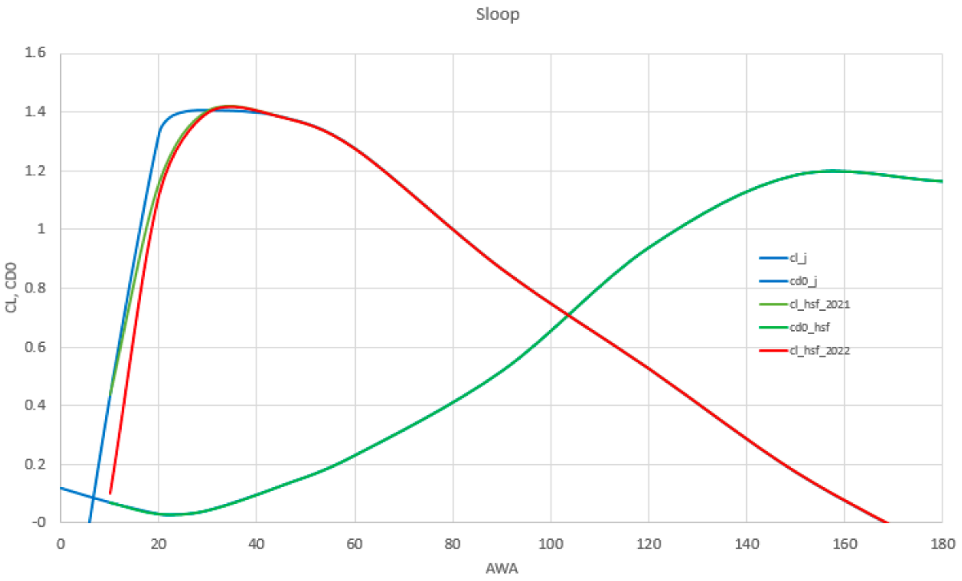

Figure 4: example of global lift-drag coefficients of luffed headsails (cyan) vs. flying headsails (green), sloop rig. The red line shows the Cl coefficients as modified in 2022

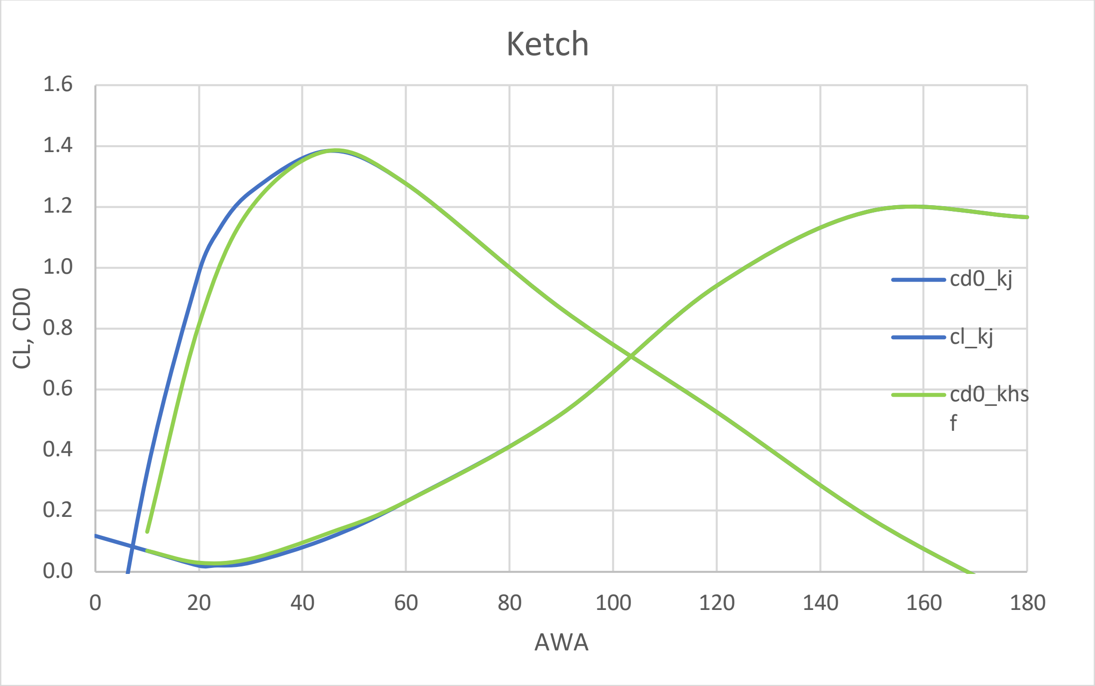

Figure 5: example of global lift-drag coefficients of luffed headsails (cyan) vs. flying headsails (green), ketch rig.

Regarding the difference of spinnaker on CL and spinnaker on pole, the ratio of ORC coefficients has been reproduced, weighting the modification only on the portion of the sailplan area pertaining to the spinnaker.

Non-spinnaker boats, when they don't carry any flying headsail, get from the VPP dummy spinnaker area with the same surface as the biggest headsail on board.
A 'default' minimum spinnaker area is computed, equal to 85% of the 'minimum' spinnaker area in ORCI, so to avoid so any rush versus non-spinnaker configurations.
The minimum spinnaker area is:

$$minimum\ spi\ area = 0.538 \cdot \sqrt{J^2 + ISP^2} \cdot \max\left(1.8 \cdot J, 1.6 \cdot TPS, 1.8 \cdot SPL\right)$$

3.2 Effective Height

Regarding the induced drag, the effective height is modeled as

$$Heff\ = Heff0 + heff_{corr} * be(AWA)$$

where $Heff0$ is the base term, equal to 1.0 the mast height for sloops, and 0.98 for ketches, 0.92 for schooners, 0.82 for gaff schooners, 0.88 for gaff sloops and gaff50 schooners.
$heff_{corr}$ is the correction term, the formulation for sloops and ketches is:

$$heff_{corr} = 0.10 + 0.2 \cdot (roach - 0.20) + 0.1 \cdot (roachy - 0.20)$$

where *roachy* is the mizzen roach, if present.
The roach, as reported in the ORC VPP documentation is computed as:

$$ROACH = \frac{\frac{upper\_3/4\_area}{0.375 \cdot P \cdot MQW} - 1}{0.844}$$

The reason why only the upper ¾ area of the mainsail is involved is to avoid any influence in the roach of the E measure which is not a sail measurement.
For schooners (and also gaff sloops) the term 0.10 becomes null and a default roach of 0.20 is assumed. Roach is the excess of mainsail area over the triangular area.
The function $be(AWA)$ is a shape function being 1 below 30 degrees and smoothly going to 0 at 60 degrees.
Since there is a large variety in the mizzen/main mast ratio in ketches, the effective height varies following the (PY+BASY)/(P+BAS) ratio. Moreover, it is acknowledged that the distance between the two masts is a key factor for the ketch rig efficiency. The distance between the centers of effort of main and mizzen is modelled by the following parameter:

$$gap = \frac{EB - 0.4 \cdot \ E + 0.4 \cdot \ EY}{E}$$

If the boat sails with an overlapping headsail, the factor multiplying E is increased to 0.5.
The term 0.10 in the $heff_{corr}$ formula for ketches is replaced by a coefficient *dheff* that is variable depending on the mizzen ratio and on the gap above defined. The plot below shows the base curve of *dheff* for an average gap (1.3), as function of mizzen ratio. Beside the base curve, two additional curves are plotted, one for a large gap (greater than 1.5), the other for a small gap (smaller than 1.1).
In 2025 the curves have been slightly modified in the range close to *mizratio=1.*

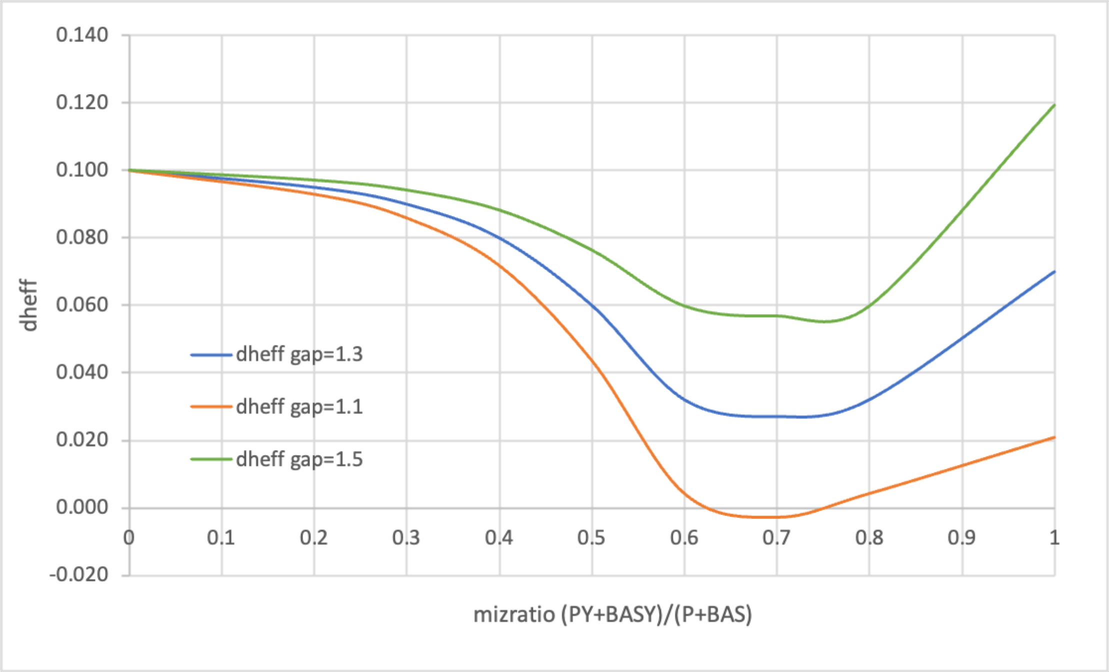

Figure 6: effective height correction for ketch rigs.

It is increased, smoothly blending to that of a sloop when PY/P goes from 0.7 to 0.3. The CEH of the sailplan is at present based on a fraction of the mast height (0.36 for the upwind and reaching sailset, 0.46 downwind). For ketches the mast height is calculated weighting 80% the main and 20% the mizzen, while for schooners the weight is 50% - 50%.

In 2020 it has been also introduced a function taking into account the decreased ability in beating for overlapping jibs with rigs having a large chainplate width. This is done by introducing a reduction if effective height based on the function

$$dheffcpw = 0.0177 \cdot fcpw \cdot (1 + 0.1\, f\_ov)$$

where *fcpw* is a factor linearly increasing from 0 to 1, being 0 when the angle between the centerline and the line connecting the side end of chainplate base to the tacking point is equal to 11.7 degrees, and it is equal to 1 when the same angle is equal or greater than 14 degrees, and f_ov is a factor linearly depending on the overlap: it is 1 for overlap equal or smaller than 115%, and it is 0 for overlap equal or greater than 150%.

3.3 Phi_up

The so called PHI_UP (see ORC VPP Documentation, 5.5.1), that is the artificial reduction of heeling angle used by the VPP aerodynamic model when searching the solution, was introduced in order to avoid the typeforming toward low stability boats. Since there is no worry about this trend in the SY fleet, the heel used by the VPP solver has been modified to be the average between the boat heel and the PHI_UP.

3.4 Windage

3.4.1 Furled Headsail Windage

Instead of measuring a diameter for each furled sail, it seemed preferable to derive a default diameter from rig & sail data, that is luff and area of the furled sail: JL_k and Jib_area_k.

Assuming that the sail cloth has a thickness *t*, and is furled around a circular luff of initial diameter D_0 , it can be shown that the number of turns around the stay to furl all the LP of the sail is

$$N = \frac{-\pi D_0 + \sqrt{(\pi D_0)^2 + 4\pi t \cdot LP}}{2\pi t}$$

and therefore the max diameter of the furled sail is

$$D_{max} = 0.8(D_0 + 2Nt)$$

The frontal area is $A_{fr} = 0.6 \cdot IG \cdot D_{max},$ while the side area is $A_{side} = 0.6 \cdot JL \cdot D_{max},$ the 0.6 factor is taking into account the tapering of the furled sail.

The two basic parameters *t* and D_0 are simply related to IG.

$t=0.00015*IG$

$D_0 = 0.002\ IG$.

With the above model the only measures affecting the furling credit are the **IG** and **J** of the considered stay. No more input is needed. When not known, JL is derived from IG and J, and LP is assumed to be 1.1*J.

3.4.2 Superstructures: Cabin Trunk, Doghouses

The present windage model for superstructures needs the following inputs:

- a superstructure frontal area,
- a superstructure side area.

The areas are calculated above the sheerline.

3.4.3 Superstructures: Domes

The input is the dome(s) frontal area. CEH is assumed 0.25*IG.

3.4.4 Superstructures: Generic Windage Element

The windage of the superstructures and domes can be evaluated knowing the frontal and side area, and LCG and VCG. Then, a Cd has to be assigned.
The formulation of the Cd resulting from the composition of frontal and side areas is coded as follows:

$$Cd = (Cd_{front} * A_{fr} * \cos\beta + \ Cd_{side} * A_{side} * \cos\varphi * \sin\beta\ ) \,/A\_ref$$

Where the coefficients Cd_{front} and Cd_{side} for cabin trunk and doghouses are modulated depending on the ratio of the superstructures area to the hull windage area:

$$ratio_{areas} = \frac{Asstructures_{front} + Asstructures_{side}}{Ahull_{front} + Ahull_{side}}$$

When the ratio of areas is smaller or equal to 0.20, the coefficients are $Cd_{front} = 0.63$, and Cd_{side}=0.84, while for ratios larger than 0.25 the coefficients are $Cd_{front} = 0.79$, and Cd_{side}=1.05. For areas ratio in the range between 0.20 and 0.25 the coefficients are obtained as a weighted average of the above ones. The reference area is simply the sum of $A_{front} + A_{side}$.
For domes and furler we have $A_{fr} = A_{side}$; for domes $Cd_{front} = Cd_{side} = \ 0.63$, and for furlers $Cd_{front} = Cd_{side} = \ 0.60$.

3.4.5 Mast Diameter

When mast diameters (MDL1,MDT1, MDT2, MDL2, MW, GO, TL) are not provided a default mast diameter dimension for windage calculations has been introduced.
The default MDL and MDT are derived from RM curve (as is in the ORC default mast weight calculation). They are increased by 15% if there is a mainsail furler.

$$MDL1 = 0.45 \cdot 0.036 \cdot (IG \cdot RM@25)^{0.25}$$

$$MDT1 = 0.5 \cdot MDL1$$

Default MDTL2, MDT2,TL, MW and GO are derived by the two above
For Ketches and Schooners also the second mast is considered for windage, with a diameter increase/decrease proportional to the second mast height ratio to the first mast.

3.4.6 Rigging Windage

The presence of running backstays does not alter the aerodynamic coefficients, due to the very large variety of rigs. On the other side, it's not taken into account for the sake of rig windage calculation.
The lenticular rigging is taken into account by reducing the wire diameter by 50%.
Due to the large amount of standing and running rigging, for the gaffers the rigging windage is increased by 3.125 times compared to the standard.

3.4.7 Crew Windage

The windage of the crew is neglected in the VPP.

3.5 Bowsprit Length (Power Function)

The power function works in a way that it is a multiplier of the spinnaker area.
It is based on the ratio between the gennaker (or spinnaker) area and the available room ISPxTPS (or SPL if there is a pole). The smaller the area compared to the available room, the sail is considered more efficient, and the larger the power function:

$$power = 1.08 + \left(1.391 \cdot \frac{ISP \cdot TPS}{Area} - 1\right)^{1.5}$$

The power factor is bounded to a maximum value of 1.18, and a minimum of 1.08.

3.6 Multiple Headsails

When multiple headsails are set together (especially in schooners) a dummy headsail is created with the maximum JL and LPG from the forward stay to the more aft clew.
This area is less than the sum of the 2 or 3 jibs.
A further efficiency factor of 90% for boats with 3 headsails or more is introduced.
If the inner jib or staysail is set with the clew forward of the outside bigger genoa the inner staysail is for free.

3.7 Sails Inventory Credit/Penalty

The composition of the sail's inventory is taken into account.
The VPP applies a credit/penalty depending on the size of the inventory. Moreover, this allowance is further adjusted taking into account if a boat can effectively change its headsail during a race, i.e., whether the headstay is equipped with a furler, with hanks or with a headfoil.
The presence of a furler for the headsails is credited 0.5%, and if the furling headsail is an overlapping sail and is the only one in the inventory, this is credited by an additional 0.5%.
For luffed headsails like jibs, there is a penalty of 0.5% for each sail when the headsail count becomes larger than two. For more than one headsail set flying there is a similar penalty of 0.5%. For downwind sails, having more than two sails means getting a 1% of penalty for the third sail and a 0.5% for each additional sail after the third one.
All the above allowances are applied globally and cumulative to the entire handicap numbers.

3.8 Boom Furling Systems

It is recognized that when having a boom furler the mainsail area is evaluated on the mandrel position instead of the top of the boom. For this reason a deduction of 0.5% on the mainsail area is applied when there is a boom furler.

3.9 Headsails Tacked on a Sprit

For boats fitted with headsails tacked on a sprit the ratio J/SFJ has been taken into account to address the loss of efficiency due to the absence of deck endplate effect. The headsail area is slightly reduced by a factor

$$f_{sfj} = 0.96 \cdot \left(1 - t_{sfj}\right) + 1 \cdot t_{sfj}$$

where

$$t_{sfj} = \frac{\frac{J}{SFJ} - 1}{5}$$

is the parameter that measures the bowsprit influence, and it is bounded between 0 and 1.

4 Hydrodynamics

4.1 Residuary Resistance

The ORCY VPP adopts since 2024 the new residuary resistance model adopted by the ORCI in 2023, based on fourteen geometric parameters. The only difference is that for Superyachts the resistance calculated with such model is not averaged with the “old” model based on LVR and BTR ratios. Please refer to ORCI VPP documentation for details about the model.

4.2 Added Resistance in Waves

Following the decision of simplifying the handicaps composition (see section 7), the rough water handicap has been eliminated, and for the flat water the wind strength dependency of the added resistance is the same used for ORC.
In addition (taking into account the formulations explained in ORC VPP Documentation chapter 6.5.2) the dimensional factor has been modified from L*log(L/30) to L^(1.15)*log(L/30), thus helping slightly the larger boats.
The effect of this term is that a 60 m boat has its resistance in waves 20% higher than a 30 m boat, compared to the ORCi VPP.
Moreover, the gyradius term f(Kyy) = 0.01575*(GYR-0.23) was increased by 33% in the rough water run, to amplify the effect on big and heavy boats that have very high gyradius values.
The mast gyradius adjustment modification of ORC VPP 2019 is neglected.

4.3 Induced Drag of Very Shallow Draft Boats

The relationship between the effective draft has been modified by multiplying it by a factor Teff_mult, which reduces the draft for boats having very shallow draft (low D/L ratio), as shown in Figure 6. A reduction has been applied also to very deep draft, since there are indications that such configurations were less efficient than predicted.
In 2020, 2021, 2023 and 2025 the curve has been smoothed and slightly adjusted, keeping the overall shape and effect.

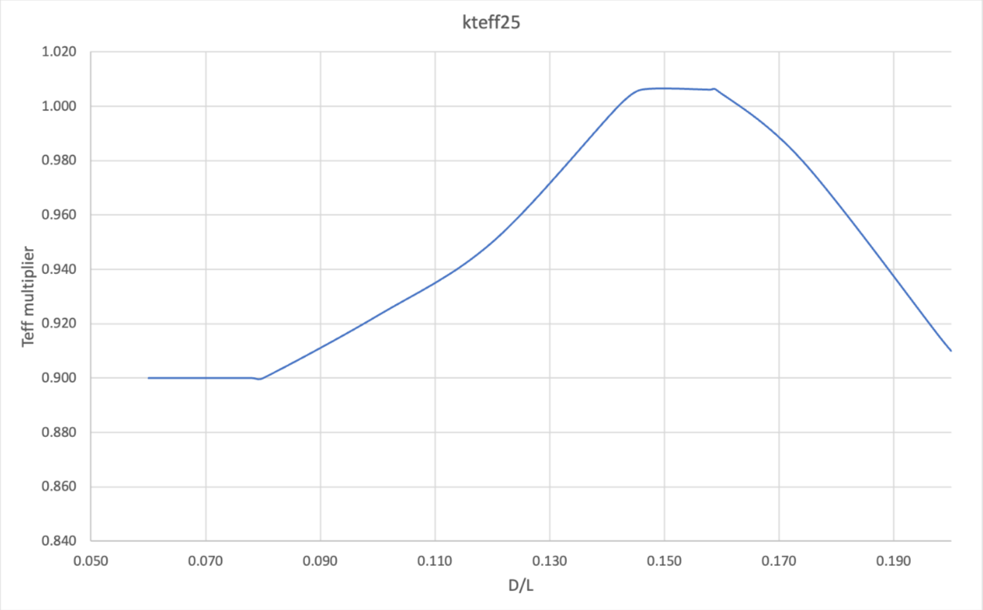

Figure 7. Shallow and very large draft credit.

4.4 Centerboards: Slot Added Resistance and Effective Draft

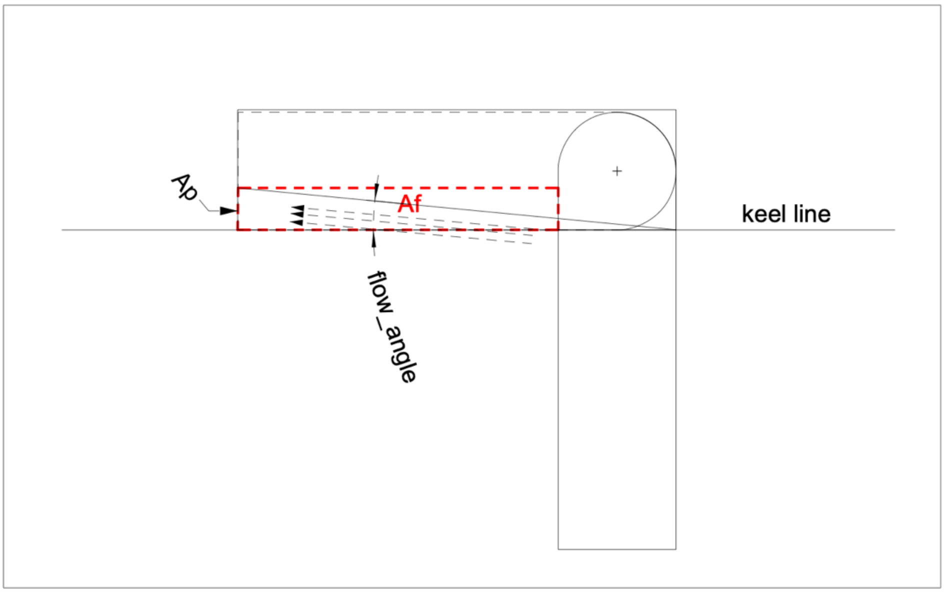

Figure 8. Sketch of centerboard model and definitions.

The rotating centerboards suffer by added drag due to the not perfect sealing of the slot when the board is down.

A simple model has been developed that makes an estimate of the added drag of the open centerboard case.
The estimated drag is made by a pressure contribution due to the impact of the flow on the aft face of the centerboard case, and by a viscous contribution due to the flow sliding along the internal case lateral sides.

$$Dp = 0.5\rho v^2 \cdot \ C_{Dp} \cdot Ap$$
$$Dv = 0.5\rho v^2 \cdot \ C_{Dv} \cdot 2 \cdot Af$$

The drag coefficients are assumed as $C_{Dv} = 0.0035$ and $C_{Dp} = 1.1$, while the areas *Af* and *Ap* are computed assuming a flow angle of 7.5 degrees.
When the appendage is down, the total drag is computed as

$$D = D_p + 1.2\ D_v$$

While when the centerboard is up, a residual drag equal to $0.3\ D_v$ is assumed.
Is the centerboard is lifting vertically, the drag is always equal to $0.3\ D_v$, since there is no pressure drag due to the open slot.

4.5 Centerboard effective draft

Following the results of a CFD study on a number of centerboard configurations, a correction is applied to the effective span used of the fixed keel+centerboard appendage, when computing its aspect ratio which is then used in the induced drag routine (see ORC VPP documentation for further details about the induced drag model).
This correction is applied differently based on the aspect ratio of the fixed keel:

1- for aspect ratio < 0.135, the effective span b_k (corresponding to 0.92IMSD) is corrected as follows:

$$b_k = (0.516 + 0.208 \cdot x1) \cdot 0.926 \cdot IMSD$$

2- for aspect ratio ≥ 0.135 the effective span b_k (corresponding to 0.92IMSD) is corrected as follows:

$$b_k = (0.579 + 0.145 \cdot x1) \cdot 0.926 \cdot IMSD$$

3- for lifting centerboards (having either no fixed keel or a rather deep and narrow fixed keel compared to boats with rotating centerboards), the effective span b_k (corresponding to 0.92IMSD) is corrected as follows:

$$b_k = 0.8 \cdot 0.926 \cdot IMSD$$

where *x1* is a ratio between the lift slope area of the centerboard and the sail area upwind:

$$x1 = \frac{\frac{0.11}{1 + 2/AR_e} \cdot A_{centerboard}}{A_{sailplan}}$$

4.6 Centerboard not Lifted Downwind

A flag has been introduced for accounting for the configuration of some boats that do not lift their centerboard in the reaching/downwind runs. In this case the additional resistance of the board down is taken into account

4.7 Bow Thrusters

Only open tunnel thrusters are taken into account (no retractable or closed tunnel thrusters are accounted).
The computed credit is an added hull wetted area equal to 3 times the bow thruster tunnel area.

5 Dynamic and Tacking Allowance

5.1 Dynamic Allowance

The ORC INT Dynamic Allowance (DA) formulation has been completely revised and a new customized one introduced to take into account the characteristics of the Super Yacht fleet.
It is composed by different terms: the first term K1 is

$$K1 = \left[\frac{DISPL}{120000}\right]^{0.375}$$

which is lower bounded by 1 (for DISPL ≤ 120t). Moreover, for sloop rigs it is taken equal to 1 if the ratio SA/(DISPL/1025) is greater than 5.2.
The second term K2 is

$$K2 = \left[\frac{6.5}{LVR}\right]^{0.75}$$

Which is also lower bounded by 1, for LVR ≥ 6.5, being LVR= L / $(DSPL/1025)^{0.333}$
The third term K3 is based on SA/DSPL ratio:

$$K3 = \left[1 + \left(\frac{5 - SA_{DISPL}}{5}\right)\right]^{1.5}$$

Where

$$SA_{DISPL} = \frac{\sqrt{SA}}{\left(\frac{DPSL}{1025}\right)^{.33}}$$

K3 too is lower bounded by 1 (for SA_DISPL ≥ 5).
The fourth term K4 is

$$K4 = \left[1 + \left(\frac{0.45 - SA2_{DISPL}}{0.45}\right)\right]^{0.4}$$

Where

$$SA2_{DISPL} = \frac{\sqrt{SA}}{\left(\frac{DPSL}{1025}\right)}$$

Putting all the four terms together we have:

$$DA(\%) = \frac{[(K1 \cdot K2 \cdot K3 \cdot K4)^{0.25} - 1]}{0.41} \cdot 0.08 \cdot 100$$

DA is bounded to a max of 8% and a minimum of 0.
The sail area calculated takes into account the sailset used upwind (jib and genoa, the headsails set on the forestay).
For split rigs, ketch or schooners, the smallest mainsail is accounted for 40% of its area.
DA Allowance is applied full strength up to 10 kts TWS then is linearly decreased at 70% at 20 kts TWS

5.2 Tacking Time Loss

The tacking time loss is based on the sail area-displacement ratio, on the draft/length ratio and on the sail area to wetted area ratio and on the yacht displacement:

$$TA(\%) = TA1 + TA2 + TA3 + TA4$$

$$TA1(\%) = 0.03 \cdot \frac{0.16 - DLr}{0.07} \cdot 100$$

$$TA2(\%) = 0.03 * 1.2 \cdot (5 - SA_{DISPL}) \cdot 100$$

$$TA3(\%) = 1 - \frac{SAws - 2}{4}$$

$$TA4(\%) = 0.885 \left(\frac{DISPL - 120000}{120000}\right)^{0.333} \cdot \frac{14 - TWS}{14 - 6}$$

$$DLR = \frac{DHK + 0.3ECM}{LSM}; \quad SA_{DISPL} = \frac{\sqrt{SA}}{\left(\frac{DPSL}{1025}\right)^{.33}}; \quad SA_{WS} = \frac{SA}{WS}$$

being SA the sail area upwind, WS the wetted surface area.
TA1, TA2 and their sum are bounded between 0 and 3%, TA3 between 0 and 1%. TA4 is effective only for yachts of more than 120 t of displacement, and is used with the above formula only up to TWS=10, above it’s taken as zero. Moreover, TA4 is not applied when the ratio SA/(DISPL/1025) is greater than 5.2.
When a headsail is furled more than 50% when tacking another term is added, based on the size of the headsail, with a base allowance of 1% modulated as follows:

$$ksyfx(\%) = 1 + \frac{\max(14 - TWS, 0)}{14 - 6} \frac{lpg - 1}{0.5}$$

$$lpg = \frac{A_{headsail}}{A_{foretriangle}}$$

and reduced by an amount between 25% and 50% when an inner jib is unfurled to help the tacking. The amount of this reduction is computed based on the size of the inner jib, it’s 50% when the size if equal or greater than 95% of the foretriangle, while it’s 25% when the inner jib area is equal or smaller than 85% of the foretriangle. For an area in between 85% and 95% of the foretriangle, the reduction is calculated as a linear weighed average of the two extreme cases.
Another 1% is added when a full height skeg is present in front of the rudder
The above allowance is used only in upwind conditions.

6 Other Modifications

6.1 MCA Approved Boats

MCA approved boats have a heavier displacement because of the enhanced requirements, but this is taken into account into the empty displacement evaluation. However, the weight distribution is not accounted for, so a gyradius increment (over rated L) of 0.012 is added to all MCA boats (same as the gyr decrement for having an aramid core in the composite). This affects the performance, particularly in rough water, when having more weight at the extremities is a negative factor.

6.2 PIPA (Propeller Projected Area)

6.2.1 Default for Exposed Shaft

A new default PIPA for exposed shaft has been introduced working on the database of the measured installation.
These are the formulations used:

Solid 2 blades
$PIPA = 0.113 \cdot PRD^2 - 0.006 \cdot PRD$

Feathering 2 blades
$PIPA = 0.064 \cdot PRD^2 - 0.021 \cdot PRD$

Folding 2 blades
$PIPA = 0.053 \cdot PRD^2 - 0.011 \cdot PRD$

Solid 3 blades
$PIPA = 0.138 \cdot PRD^2 - 0.006 \cdot PRD$

Feathering 3 blades
$PIPA = 0.75 \cdot (0.1013 \cdot PRD^2 - 0.0344 \cdot PRD)$

Folding 3 blades
$PIPA = 0.056 \cdot PRD^2 - 0.012 \cdot PRD$

Solid 4 blades
$PIPA = 1.17 \cdot (0.138 \cdot PRD^2 - 0.006 \cdot PRD)$

Feathering 4 blades
$PIPA = 0.75 \cdot (0.1128 \cdot PRD^2 - 0.0393 \cdot PRD)$

Folding 4 blades
$PIPA = 1.044 \cdot (0.056 \cdot PRD^2 - 0.012 \cdot PRD)$

6.2.2 Measured Propeller Installations

For measured propeller installations, the approach of ORCI is used. The resistance of a 4 blade propeller is taken into account by modifying as follows the relevant formulas (ORC VPP Documentation, 6.2):

Shaft installation:
Folding :

$$PIPA = IPA + 0.75 \cdot (0.9 \cdot PHD)^2$$

Solid:

$$PIPA = IPA + 0.14 \cdot (0.9 \cdot PHD)^2$$

Feathering:

$$PIPA = IPA + 0.70 \cdot (0.9 \cdot PHD)^2 + 2Cd_{bl} \cdot A_{bl}$$

being

$$Cd_{bl} = 0.02 + 1.5[\sin(0.9PSA)]^2$$

and

$$A_{bl} = 0.15 \cdot \pi \cdot (0.5PRD)^2$$

The three blades feathering also is modified using the same approach of the feathering 4 blades:

$$PIPA = IPA + 0.65 \cdot (0.9 \cdot PHD)^2 + 2Cd_{bl} \cdot A_{bl}$$

where Cd_{bl} is calculated for an angle equal to $0.866 \cdot 0.9 \cdot PSA$

Strut installation:
Folding and feathering:

$$PIPA = 0.06 \cdot ST1 \cdot (ST5 - 0.5ST4) + 0.44 \cdot (0.8ST4)^2$$

Solid:

$$PIPA = 0.06 \cdot ST1 \cdot (ST5 - 0.5ST4) + 0.144 \cdot (PRD)^2$$

In aperture and out of aperture installation:
Moreover, for the “in aperture” installation, a difference also between the 2 and 3 blades has been introduced. Following what is modelled for other installations, each additional blade of a feathering propeller produces an increment of 6% of the 2-blades PIPA, while a solid propeller blade produces an increment of about 17% of the 2-blades PIPA. For the “out of aperture” also the feathering 3 and 4 blades are differentiated from the 2 blades taking into account an increment of 5 % of PIPA for each blade.

6.3 Winch Speed and Power

The credit has been revised with three terms:

a) Tacking, related to primary winches speed
b) Gybing, related to primary winches speed
c) Hoisting , related to halyard winches speed

The allowance in percentage for each component is:

$$allowance = \frac{dtr}{7200} \cdot 100$$

where

$$dtr = \frac{length \cdot NTIMES}{vw} \cdot 0.15$$

NTIMES=5 for tacking and gybing components, while NTIMES=3 for hoisting component. *dtr* is an estimation of the time increase along the course due to slowing down during the manouvers. The *length* is *J, TPS, ISP* for tacking, gybing and hoisting respectively, *vw* is the winch speed. Very low speeds winches get maximum credit of 0.6% per component while winches above 210 m/min speed have minimum credit, just below 0.1%, as shown by the plot.

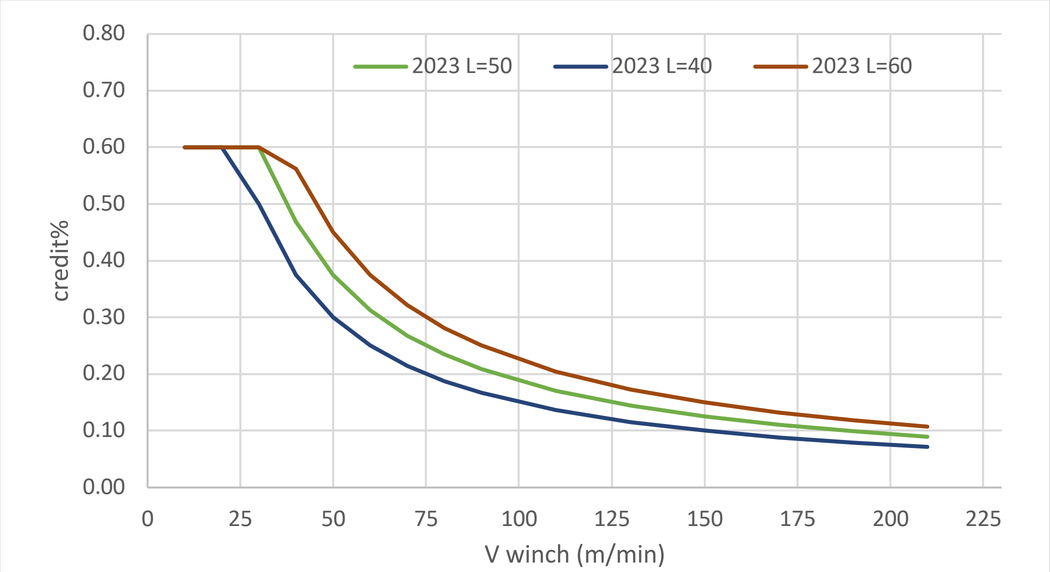

Figure 9. Credit for speed loss due to hoisting/sheeting, for different hoisting/sheeting length.

6.4 Age Allowance

The age allowance since 2024 is computed in the SY VPP with an allowance per year equal to the ORCI (0.0325%), extended to 30 years, therefore with a maximum of 0.975%.
The date used to compute the allowance for boats with LOA greater or equal to 30.48 m is the *age date*.

6.5 Light Stanchions

There is no penalty for light stanchions in the SY VPP.

7 Handicaps Composition

Handicaps are now based on 5 time allowances: light (TWS<8kts), light-moderate (8<=TWS<11), moderate (11<=TWS<14), moderate-strong(14<=TWS<17) and strong (TWS>=17kts). Each handicap is calculated as the allowance in sec/nm based on the circular random performance curve, at the following TWS respectively: 7.25, 9.5, 12.5, 15.5, 18.5 knots. Since 2022 the operation of *wind-averaging* on the circular random performance curve has been eliminated.
Both TOD allowances in sec/nm (as it is now) and the corresponding TOT TMF multipliers (TMF=500/allowance) are printed on the ORCsy certificates.