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ORCSY VPP 2020
Documentation

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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 2020**
2. **ORC RATING SYSTEMS 2020**
3. **ORC VPP DOCUMENTATION 2020**
4. **ORC SUPERYACHT RULE 2020**
5. **ORC SY MEASUREMENT GUIDANCE 2020 – Release 1.0**

The ORC SY VPP 2020 does not implement the following new features of ORC VPP 2020:

- New headsail set flying treatment
- New sails and gear weight model

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):

$mainsail = 0.1709 \cdot LSM0^{2.1821}$

$headsail = 0.0677 \cdot (LSM0)^{2.3493}$

$spinnaker = 0.1426(\mathrm{LSM0})^{2.0568}$

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)
$\mathrm{spinnaker} = 0.1426 \cdot (\mathrm{LSM0})^{2.0568}$ multiplied by the declared number of spinnaker (max 3 will be accounted)

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 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: $k_{mizstaysail} = 0.7 + 0.2\left(\frac{A_{mizstaysail}}{A_{mizzen}} - 1\right)$. The value of $k_{mizstaysail}$ is bounded between 0.7 and 0.9.

A mizzen reacher could also be taken into account, but its effect is smoothly nullified at apparent wind angles lower than 60 degrees.

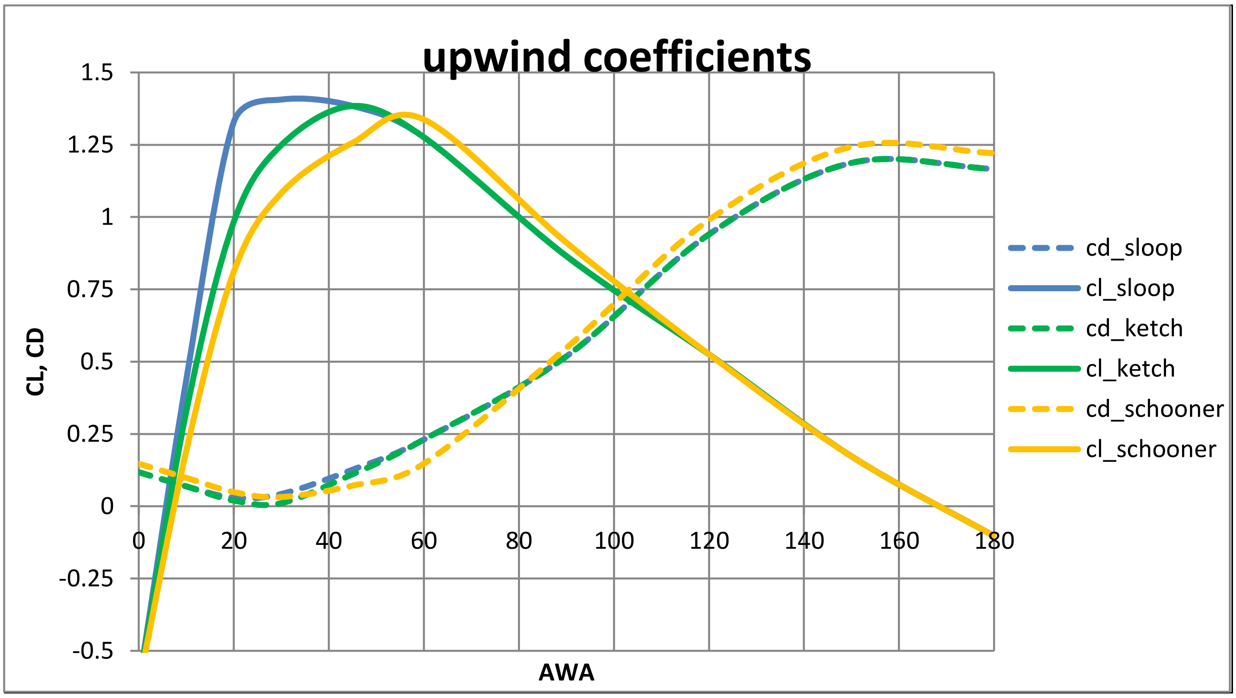

Figure 1: upwind aerodynamic coefficients.

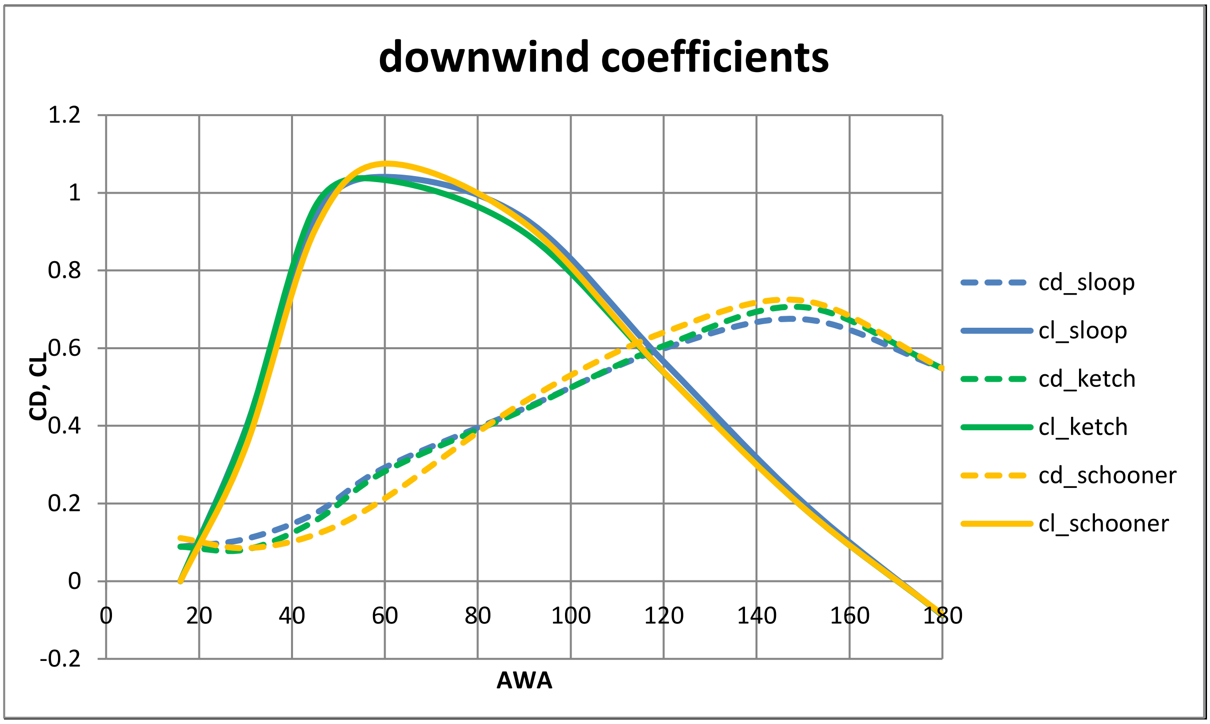

Figure2: downwind aerodynamic coefficients.

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

1. One with the largest headsail declared in the inventory (normally an overlapping jib in big cruising boats) treated without any depowering (no reefing and no flattening)
2. A second one with the second largest jib declared (if any) treated with normal depowering (reefing and flattening). If this jib is smaller than the minimum jib area, the minimum jib is taken into account for this run, where the minimum jib area is:

$$Areamin = 0.300 \cdot J \cdot \sqrt{J^2 + IM^2}$$

If a boat declares only one headsail with overlap greater than 115% there is a double run as above, where the second run is made with the minimum jib.
If the boat has no overlapping headsail, the first run is not performed and there is only a normal run with depowering made with the biggest non-overlapping headsails.

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.
- a second ‘upwind’ polar with the sail area calculated using the headsail with the second largest luff, with depowering
- a ‘flying headsail’ polar, using the flying headsail area
- 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).

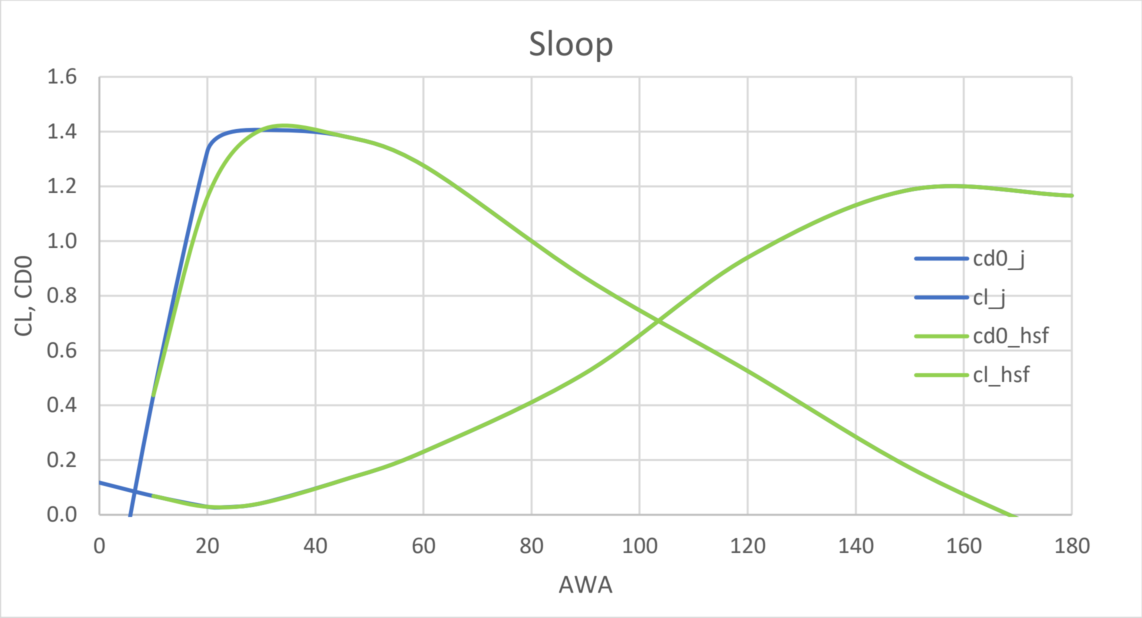

Figure 3: example of global lift-drag coefficients of luffed headsails (cyan) vs. flying headsails (green), sloop rig.

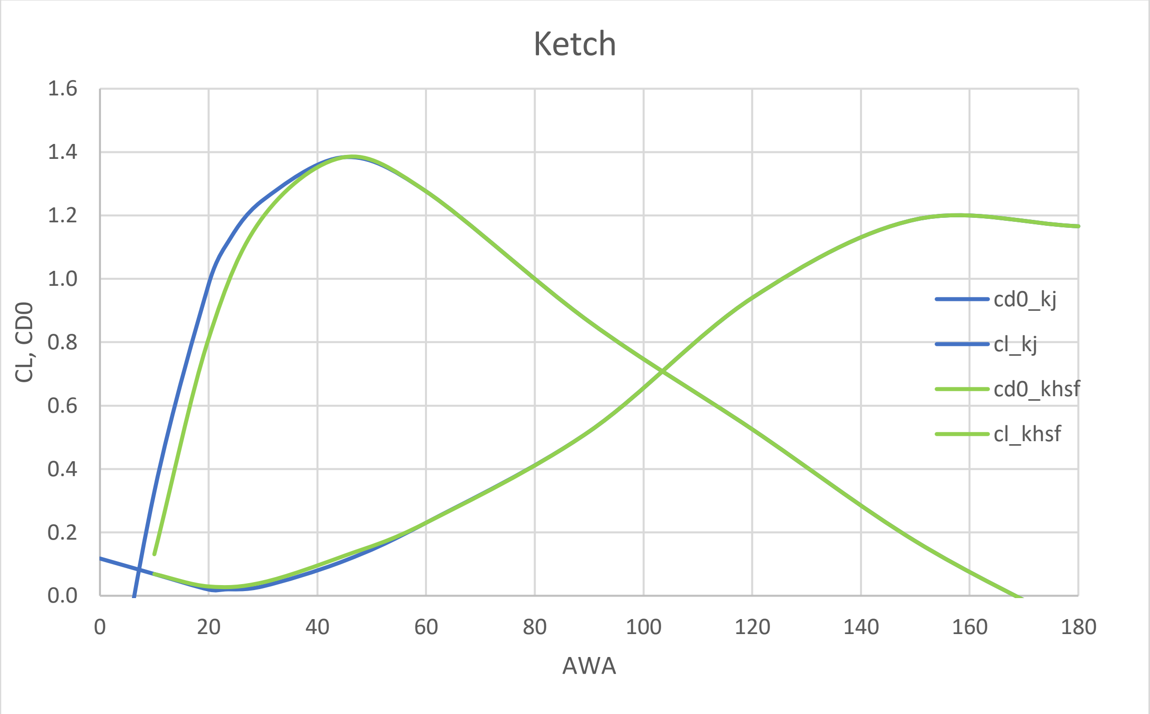

Figure 4: example of global lift-drag coefficients of luffed headsails (cyan) vs. flying headsails (green), ketch rig.

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 get from the VPP dummy spinnaker area with the same surface as the biggest headsail (luffed or set flying) on board.
A 'default' minimum spinnaker area, equal to 85% of the 'minimum' spinnaker area in ORCI is computed, 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, 0.95 for schooners, 0.83 for gaff schooners, 0.89 for gaff sloops and gaff50 schooners.
$heff_{corr}$ is the correction term, the formulation for sloops is:

$$heff_{corr} = 0.10 + 0.08 * (roach - 0.20)$$

For schooners (and also gaff sloops) the term 0.10 becomes null. 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:

$$gap = EB - 0.4 \cdot\ E + 0.4 \cdot\ EY$$

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). The curve of the model used up to 2019 is also plotted for reference.

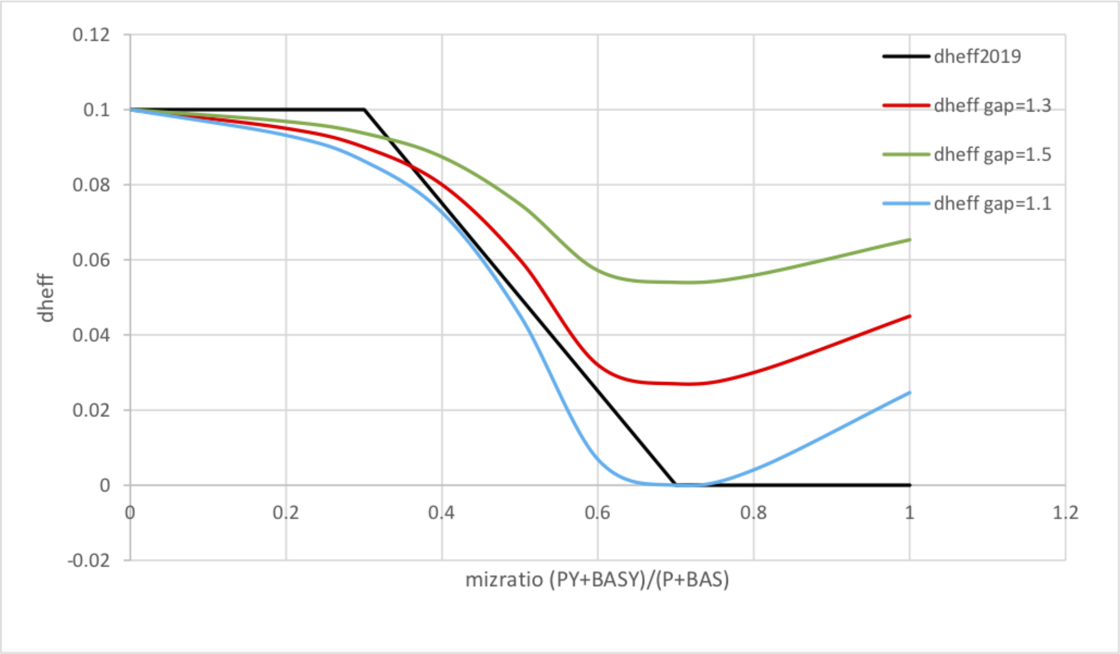

Figure 5: effective height correction for ketch rigs.

it is increased, smoothly blending to that of a sloop when PY/P goes from 0.7 to 0.3, while on the contrary it is decreased smoothly blending to that of a schooner when PY/P is in the range between 0.7 and 1.0.

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

$$dheffcpw = 0.01 * fcpw$$

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 13 degrees.

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 a line 600 mm 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 $Cd_{front} = 0.63$, and Cd_{side}=0.84 for cabin trunk (modified in 2019), while
$Cd_{front} = Cd_{side} = 0.9$
for domes and furlers, and $A_{ref} = A_{fr} + A\_side$. For domes it is assumed $A_{fr} = A\_side$.

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% (in ORCI it’s reduced by 75%).
Due to the large amount of standing and running rigging, for the gaffers the rigging windage is increased by 2.5 times compared to the standard.

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%. 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

A slight correction has been introduced, affecting boats with LBR (length/beam ratio) above 4.5 and LVR (length/volume ratio) above 7.0:

$$RR = RR0 \cdot (1 + 0.05 \cdot t_{LVR} t_{LBR} t_{Fn} + 0.10 \cdot s_{LVR})$$

where RR0 is the base residuary resistance, and

$$t_{LVR} = \frac{LVR - 7.0}{7.5 - 7.0} \;;\; t_{LBR} = \frac{LBR - 4.5}{5.5 - 4.5} \;;\; t_{Fn} = \frac{Fn - 0.43}{0.48 - 0.43} \;;\; s_{LVR} = \frac{LVR - 7.4}{7.8 - 7.4}$$

Are the three parameters that quantify the increase. All of them are bounded between 0 and 1. The last term is a further correction introduced with VPP 2017 version 1.04.

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 the curve has been smoothed, keeping the overall shape and effect.

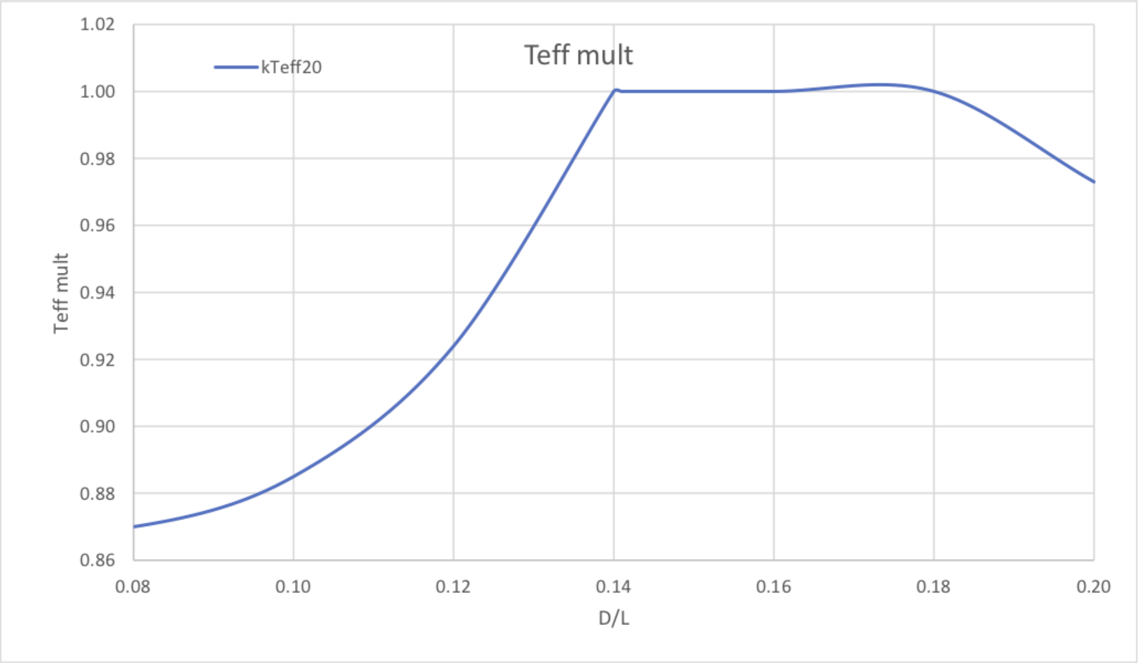

Figure 6. Shallow and very large draft credit.

4.4 Centerboards: Slot Added Resistance and Effective Draft

The rotating centerboards suffer by added drag due to the not perfect sealing of the slot when the board is down. This additional resistance has been taken into account without going into the details of the slot, that would have been impossible. A simple factor which increases the frictional drag of the centerboard by 2.25 times has been applied. This factor is not applied to vertically lifting centerboards.
The contribution of the centerboard to the effective draft is quantified as 40% of span of the centerboard.

4.5 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.

4.6 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

$$K1 = \left[\frac{DISPL}{1200000}\right]^{0.35}$$

which is lower bounded by 1 (for DISPL ≤ 120t).
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:

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

Where

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

K3 too is lower bounded by 1 (for SA_DISPL ≥ 5).
Putting all the three terms together we have:

$$DA(\%) = \frac{\left[\sqrt[3]{K1 \cdot K2 \cdot K3} - 1\right]}{0.41} \cdot 0.08 \cdot 100$$

DA is bounded to a max of 8% and a minimum of 0.
The sail area calculated takes into account the sailset used upwind.
For split rigs, ketch or schooners, the smallest mainsail is accounted for 40% of its area.

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:

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

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

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

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

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

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

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.
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 25% when an inner jib is unfurled to help the tacking.
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
$PIPA = 0.113 \cdot PHD^2 - 0.006 \cdot PHD$

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

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

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

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

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

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

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

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

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

A model has been introduced based on the winch speed (m/min) for both halyard and jib sheet winches.
A reference ‘fastest’ which speed is considered, equal to 210 m/min. Then an allowance is calculated based on the effective which speed:

$$winches_{credit}\% = 0.45 \cdot (v\_max \quad - v)/v\_max$$

The maximum allowed credit is 0.45 %. Below the plot of credit as computed in 2020 and as it was up to 2019.

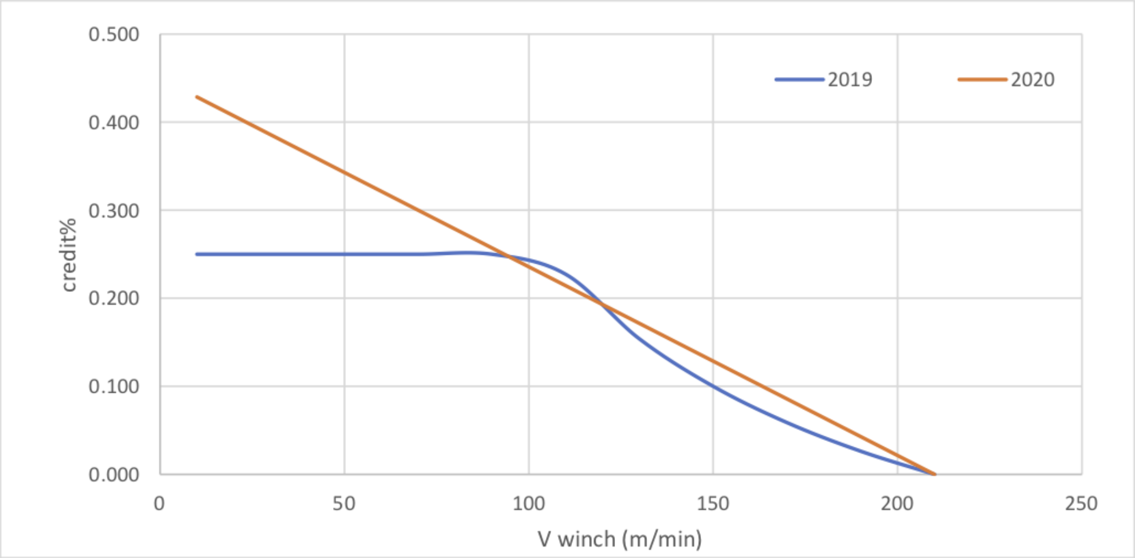

Figure 7. Credit for winches speed.

6.4 Age Allowance

There is no age allowance in the SY VPP.

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.
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.