Corbin 39 Study – Theoretical Analysis
Sailing Performance & Velocity Prediction Programs (VPP)

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1 Working document

This is a working document setting out the interim results of an ongoing study into various aspects of the Corbin 39. Conceptually this document is one of a series:

1. A study of the anecdotal evidence in respect of weather helm.
2. A theoretical analysis of weather helm and various options for owners.
3. A reproduction of the lines plans, the hull form, and analyses of displacement, trim, and static stability.
4. **This document,** which is a study of the **sailing performance**, including the results from Velocity Prediction Programs (VPPs)

Future areas of interest are hoped to include dynamic seaworthiness (e.g. STIX). Because this is a working document it may contain errors, and will likely change.

The authors are the same three as explained in the previous studies, with the vast bulk of the work being carried out by Jean-Francois Masset. Many Corbin 39 owners have contributed to this by reporting actual performance which gives much important information.

This is also the first full use of Jean-Francois Masset's new "SA-VPP" and comparison with other VPP.

2 Summary

Background:

This builds on the previous studies of the Corbin 39 models. There are many different spar and sail arrangements for the Corbin 39 models, and they are scattered all over the world, so it is unrealistic to carry out a set of sailing experiments to directly compare sailing performance with each other. Nonetheless owners would like guidance on how they can extract the best possible sailing performance from their particular model, and purchasers would like guidance on how important it is to choose between the available models when considering sailing performance.

Process:

Computer tools called Velocity Prediction Programs (VPP) were used. One of these, SA-VPP (the home made one) was first refined and calibrated against others to minimise differences in values. Results of different VPP programs are compared with many performance reports that were contributed by Corbin 39 owners, and refined to minimise errors.

Then the performance of each of the Corbin 39 model was computed over a range of courses and windspeeds, always assuming a cruising displacement of 14,000kg and an unfouled hull. As usual with VPPs, the heel angle, due to the heeling moment balanced by the righting moment, is also output in the results. Moreover, when upwind sailing, the effect of the true wind angle, of the sail flatness, and of the sail area reduction were all explored.

Aspects that were not explored were the effect of the cut or of the material of different sails, or the effect of waves and swell. All this analysis assumes calm water – so the results will tend to be over-optimistic regarding beating to windward, and under-optimistic regarding running downwind. In the

initial part of the study the effect of spinnaker use was not explored, nor a staysail, nor was the effect of mast rake.

Effects of different propellers are not incorporated. These typically impose a performance penalty of between 1/3 and 1 knot, depending on the amount of propeller, skeg, and shaft, and the propeller configuration. Therefore the VPP results will tend to be high.

The effect of reefing and of flattening the sails were explored. The effect of any mk1 weather helm was not allowed for, i.e. it was assumed that the desired upwind course could be maintained in all conditions, and as will be seen reefing is in any case desirable so any weather helm becomes irrelevant.

As a cruising boat in the SA-VPP there is no account taken of shifting crew weight to the windward rail. In contrast the USVPP is intended for calculating racing handicaps and assumes that a numerous racing crew will sit on the rail. Therefore USVPP predicts a slightly better upwind performance than SA-VPP.

Detailed results were generated for each of the Corbin 39 models with the exception of the mk2 ketch for which the sail and spar arrangements were uncertain. The performance of the mk1 cutter models was evaluated both in their original design configurations, and with the more common modifications that alleviate the mk1 cutter weather helm.

The difference in performance from use of a spinnaker was explored. Then the effect of increasing displacement by 1,000kg, from 14-tonnes to 15-tonnes was also assessed.

Finally typical wind speed conditions were generated and an overall performance evaluation was made so as to allow for comparison between all the different Corbin 39 models. This was extended to allow for comparison with or without spinnakers.

In all these analyses the wind is assumed to blow steadily at the windspeed of interest. Clearly this is a simplification as the real wind is seldom absolutely steady. The response of the boat to transient wind conditions was not explored, only the steady-state performance.

Results:

Good accordance was found between owners' real-world reports, and the VPP models' results. Corbin 39 performance is in general consistent with most heavy displacement conventional cruising monohulls of a similar size. They are fair performers upwind, good performers on a beam reach, and not so fast when running downwind without a spinnaker. They are sluggish in light windspeeds without a spinnaker, better at moderate windspeeds, and can reach practical hull limiting speed of 8-1/2 knots in higher windspeeds. A spinnaker is very worthwhile downwind in most windspeeds to get closer or reach the practical speed limit of about 8.0 - 8.5 knots mentioned here after.

For optimum performance reefing should commence when heel angle reaches 22-24 degrees, rather than at any given windspeed, and if reefing is not carried out then additional wind thrust will not create an appreciably faster boat, it will simply heel over more. Depending on various factors the typical onset of reefing for optimum speed performance when beating upwind occurs at between approximately 14-knots and approximately 18/20-knots, and always at 22-24 degree heel. The two primary factors that influence the actual moment for optimal reefing within this range 14 – 18/20 kts are firstly the sail condition and construction (old baggy sails, or new stiff sails); and secondly the ability of the crew to flatten the sails, most especially by trimming the mainsail (i.e. management of the halyard, cunningham, outhaul, mastbend, mainsheet, traveller, vang). It is worth trying to flatten the sails when beating upwind at any windspeed above 10-knots, and the better you can flatten the sail the longer you can postpone reefing for. The steady-state heeling angle of 22-24 degrees is always a reliable indicator of the optimum reefing moment irrespective of whether it is a first, second, or third reef.

Interestingly reefing of the unmodified mk1 for the purpose of heel control should occur at approximately the same windspeed as the upwind weather helm would otherwise become significant. This means that in steady state winds there is no advantage whatsoever to not reefing a mk1 cutter, and if one does reef at that windspeed then significant weather helm would never be observed. However weather helm would be observed in transient gust responses of a unmodified and unreefed mk1, but less marked in a modified and unreefed mk1 cutter. (Reminder: there is no weather helm in the ketches or the mk2, and the modified mk1s greatly alleviate or eliminate it).

The fastest point of sail is on a beam reach, e.g. all Corbin models approach 7,2 – 7,4 knots water speed in winds of 14-knots, 8,0 – 8,1 knots in winds of 20 Knots. Note that these are steady-state hull speeds in calm water. Approximately 8-1/2 knots is the hull limiting water speed. Therefore in practical terms, once a Corbin has reached ≥ 8 Knots average speed, it is not beneficial to carry too much sail for too long – the risks increase without any corresponding reward.

Both VPPs clearly show that "pinching" (pointing too high to windward) a Corbin is counter-productive when beating upwind in very light wind conditions. In light winds it is better to maintain a natural cambered sail, and fall off the wind (specifically to 50-degrees twa), and thereby achieve the best velocity-made-good (vmg). As winds rise one can progressively point higher with a concern about flattening the sails from about 10 -12 knots to maximise vmg.

Comparison of overall performance of the various Corbin 39 models using the parameter of daily miles run for typical wind conditions suggests that for all normal operating geographies there is very little overall performance difference between the various models, no more than 3% in aggregate. The example summary table below shows how many miles each Corbin 39 model would sail if in one 10-hour day it were exposed to windspeeds ranging from 0 – 20 metres/second (0 – 40 knots) in a way that is statistically equivalent to a location that has a mean annual average windspeed of 6.5m/s (13 knots) which would be a fairly normal coastal location. This computation assumes that an equal time is spent beating to windward, beam reaching, and running downwind. It is similar to how many handicap systems operate.

Annual avge windspeed (m/s) Annual avge windspeed (kts) Sailing hours	6.5 12.6 10	All courses TOTAL Distance (nm)
ketch mk1 46' shortmast	100%	47
sloop mk1 51' tallmast	102%	48
sloop mk1 46' shortmast	100%	47
sloop mk2 49' bowsprit	103%	49
ketch mk2	-	-
sloop mk1 46' shortmast + bowsprit	101%	48
sloop mk1 51' tallmast + bowsprit	103%	49
sloop mk1 51' tallmast + shortboom	101%	48
Spinnaker		**no**

In all the analysis above the Corbin was assumed to be carrying a single foresail (a genoa), and a single mainsail. In the VPPs that were used for this study it is not possible to include a second foresail (a staysail). In more recent VPPs multi-jibs sailplan can now be evaluated as the big modern racing yachts use that configuration when beam reaching. It is important to keep in mind that the staysail can be sometimes very efficient in conjunction with the genoa but that this advantage can be limited to a small range of incidences. With a high clew jib (i.e. a "yankee") the advantage should be more obvious as the masking effect of the main foresail on the secondary foresail is reduced.

Similarly in all the analysis above it was assumed that no spinnaker was used. The Corbin is relatively slow downwind without a spinnaker, and so the effect of a spinnaker was also explored.

Two spinnakers were modelled. Firstly a symmetrical of 81m2 (872 sq ft) in USVPP, and secondly an asymmetrical cruising chute of 96.57m2 (1040) in SA-VPP which can be sailed up to an apparent windspeed of 13-knots and through an angular range of 70° to 150°.

In performance terms it was found that both spinnakers behave almost identically. A gain of speed of around + 0,5 Knots is noticeable from twa 100° , becoming + 1,0 to + 1,5 Knots with increasing twa on all the range of wind speed 6 to 20 Knots. Very little additional heel is observed. Use of the spinnaker (when at 135°) is possible up to wind ~ 18 Knots, beyond which the apparent wind can be too great (> 13 Knots) for the spinnaker material strength.

A general rule could be to use a spinnaker up to a hull speed of ~ 8,0 – 8,2 Knots (wind and twa permitting). Once these hull speeds are reached, there is no need to increase the sails surface anymore, and with a spinnaker this point would normally be reached at around 18 Knots of wind. Comparison of overall performance with a spinnaker, for boats that sail all points of sail equally, suggests about a 7% advantage (this calculation assumes a spinnaker is not flown on a beam reach, only on a true downwind leg).

Annual avge windspeed (m/s) Annual avge windspeed (kts) Sailing hours	6.5 12.6 10	All courses TOTAL Distance (nm)
ketch mk1 46' shortmast	100%	51
sloop mk1 51' tallmast	102%	52
sloop mk1 46' shortmast	100%	51
sloop mk2 49' bowsprit	103%	52
ketch mk2	-	-
sloop mk1 46' shortmast + bowsprit	101%	51
sloop mk1 51' tallmast + bowsprit	103%	52
sloop mk1 51' tallmast + shortboom	101%	51
Spinnaker		**yes**

The availability of a spinnaker is most important for boats that anticipate doing long downwind passages. As an alternative the use of solent rig could be considered, as has been employed by some Corbins, e.g. #49, “Hanna” (see photos below) or #108, “Neige d’Ete” which has the advantage of perhaps being more practical for shorthanded crew to manage safely and effectively.

Some owners report that they use very large genoas to a similar effect, but not directly downwind.

Lastly a study was carried out into how critical additional weight (displacement) is. This assumed an extra 1,000 kg loaded centrally in the boat, increasing the displacement from 14t to 15t. In short, the speed differences are very small, a slight deficit of speed ~ 0,1 Knots usually up to 0,2 Knots at the worst (beam to downwind, light winds). Upwind by breeeze (wind > 16 Knots), the 15 t is bit more powerful (due to the more upright stance) with a slight speed increase together with 1° to 1,5° less heel angle.

In combination the daily miles run study suggests that :

- Other considerations should be the primary determinant of which Corbin 39 anyone should purchase, as all the models have similar overall sailing performances;
- A spinnaker (or equivalent) may be worth considering, especially for long downwind passages;

From the VPP study we can also say of the unmodified mk1 cutters:

- Weather helm issue when it occurs could be mitigated by reefing a bit early without significant loss of speed, e.g. from a VPP simulation when upwind : a 0,9 reefing (meaning a 81% sail surface, commonly known as a "first reef") from wind ~ 14 Knots with a loss of speed of ~ 0,1 Knots. Reefing should be done firstly by the Main surface reduction (to increase the so-called « Lead ») and then the reduced heel angle also contributes to reduce the weather helm effect. In less technical phrasing this could be said as "*weather helm really isn't an issue as you will ordinarily be reefing anyway at the windspeeds that would weather helm, and once you have reefed then you won't get weather helm.*"

3 What is a VPP, and which VPP were used

A Velocity Prediction Program (VPP) is a computer program that will predict the performance of a sailing yacht by balancing the wind forces and the water forces, i.e. the sail and hull forces. The wiki explanation is succinct,

> *VPPs are iterative programs which require educated guesses of initial parameters to begin operating. Generally VPPs are composed of two mechanisms, a boat model and a solution algorithm.*
>
> *Initial guesses of parameters including boat speed (Vs), heel angle (Φ), number of reefs and sail flatness are input into the boat model. Using these input parameters the solution algorithm calculates the difference between the propulsive force of the sails and the resistive force of the hull. It also calculates the righting moment created by the hull and the operational heel angle.*
>
> *Since the propulsive force and the resistive force are not likely to be equal on the first iteration, the solution algorithm has the responsibility of adjusting the input parameters and balancing the forces until it produces the maximum possible speed at each true wind angle.*
>
> https://en.wikipedia.org/wiki/Velocity_prediction_program

In the previous studies there was a theoretical analysis of the weather helm issue based on the various sailplans definitions also needed as input data for the VPPs. Then building the computer hull form model and carrying out the static stability analysis generated most of the remaining required information such as the restoring moment and the wetted surface for the various heel angles, the various ratios used for the residuary drag estimation, etc ...

In the VPP studies that were carried out here the same conditions were assumed as for the static stability analysis, i.e. representative of a Corbin 39 at a cruising displacement of 14,000 kg (30,865 lbs). The mast heights, boom lengths, and sail triangle areas for the various Corbin 39 models are the same as were set out in the weather helm analysis unless otherwise noted. It does not make a difference to the VPP whether a Corbin 39 is aft cockpit or centre cockpit as the hull is always the same, and the mast/spars/etc are always as stated.

The mk2 ketch was not studied. We have not been able to locate sufficiently definitive data regarding the mizzen mast and mizzen sail to do the computation, however by inspecting the mk1 results for the mk1 'shortmast cutter' vs the mk1 'shortmast ketch' we can be fairly confident the mk2 ketch would perform very similarly to the mk2 cutter.

VPPs are iteration programs that work around a series of calculations in nested loops until they get a balanced result where the result becomes almost unchanged with every successive iteration. It is a 3 degrees of freedom programme (x , y, roll) where balanced result means 3 equalities : thrust = drag ; heeling moment = restoring moment ; aero side force = hydro side force. The last equality is actually embedded in the computation of the hydro induced drag. The two first equalities are the object of the iterations on boat speed and heel angle : with these two input data, an iteration consists of calculation the apparent wind force and direction, of assessment of the aero fore and side forces, the corresponding heeling moment, the restoring moment, the hull drag components, and then check the equalities. Then (because most of these things depend on each other) use the result from the first iteration to recalculate the second iteration, then the third, and so on until the solutions converge to become almost unchanging. This is computationally intensive and so they do not perform these calculations from first principles, instead they use a set of results that are calculated in other programs as their starting point. So (for example) the righting moment curves will be generated within the stability assessment program and then entered into the VPP. The VPP then moves up and down the curve, but does not generate new righting moment curves 'on the fly'.

In the initial part of the study three different VPPs were used to generate an initial set of performance predictions. These were then compared with each other and with the performance results from owners, and some tuning of the VPP models took place. Two of the VPPs are commercial proprietary software and so one cannot inspect the hidden inner workings of the software. The third VPP is not commercial and is written by Jean-Francois Masset so we can inspect the inner workings and make improvements to the calculation engine if we think it desirable. A side-effect of this study is that it is possible to validate Jean-Francois Masset's VPP against the two proprietary VPPs as giving very credible results. We cannot of course say whether it is in aggregate 'better' or 'worse' than either or both of the two proprietary VPPs as we do not have exhaustive real-world test data gathered from sailing the boats in controlled conditions. Ultimately all three VPPs converged to a very close correspondence.

A little bit of information about two of the VPPs is given below. The third VPP is a piece of professional proprietary software which we had access to, but we are unable to give the name, however we can confirm that the results correspond well with everything in these study reports.

US-VPP

The Velocity Prediction Program (VPP) used by ORR was developed in the mid-1990's s as a refinement of the Massachusetts Institute of Technology (MIT)/Pratt Institute project that was the foundation of the IMS. Since its inception, the VPP has been heavily modified as the result of annual updates reflecting the latest technology and scientific research. The rule relies on measurements of all the speed affecting variables required to competently predict reliable handicaps. See https://www.ussailing.org/competition/offshore/orr/ The version used was the 1990 USVPP which does not have options for a Code O or an asymmetric spinnaker, or for staysails or multiple jibs.

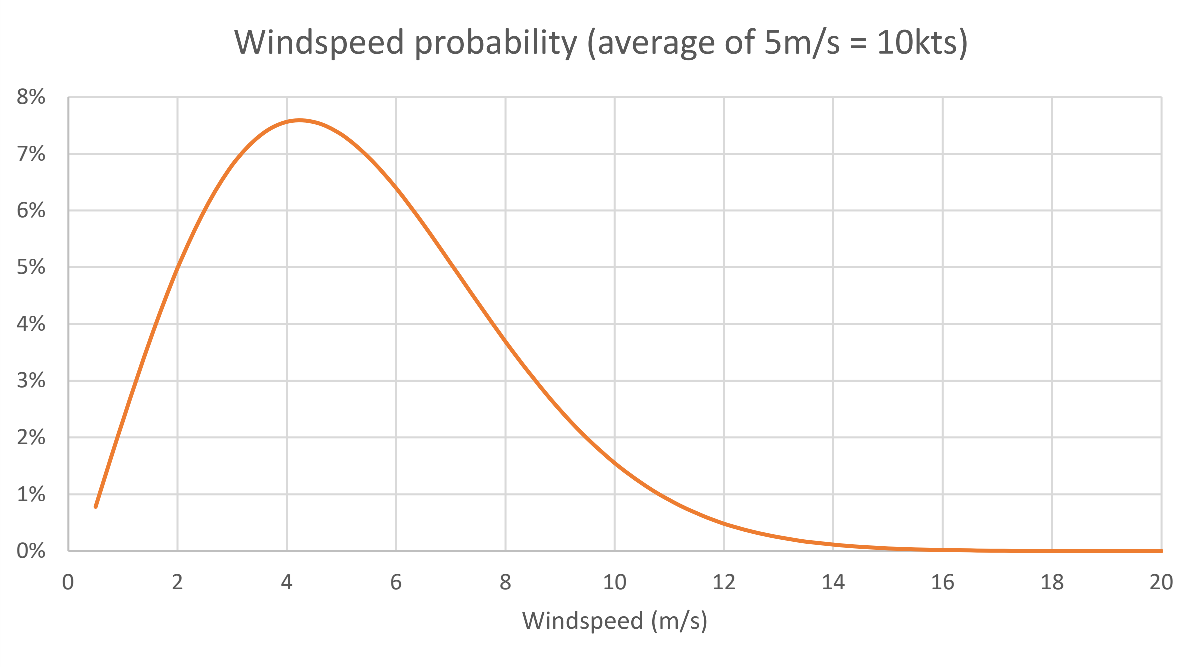
SA-VPP

Developed by retired naval architect Jean-Francois Masset is the Spreadsheet Application VPP, named SA-VPP, using the OpenOffice spreadsheet tool including standard mathematical and conditional formulations. Some of the nested loops run as automated iterations using standard spreadsheet solvers. The drawback is that iteration is a manual process on Speed and Heel angle up to equalities : thrust = drag and righting moment = heeling moment. Upwind, you have the extra complexity of the search of an optimum for twa and Flat to maximise the VMG, meaning 2 extra loops of iteration in upwind condition. The advantage is that the user can directly access the 'engine'. Before making SA-VPP public here is still work to clean the spreadsheet file, to make a user-friendly interface and a User Guide with diagrams. In due course this will be available at the Boatdesign software forum (https://www.boatdesign.net/forums/design-software/).

If you want to read more about VPP workings then "**Principles of Yacht Design**" by R. Larsson & E. Eliasson has a good introduction. For further insight read the "**ORC VPP Documentation**" which sets out how the ORC's own VPP works and how the racing yacht handicaps are calculated. It is available on the ORC website (https://orc.org/) and you can read editions for 2013, 2016, and 2019 to see how things have evolved.

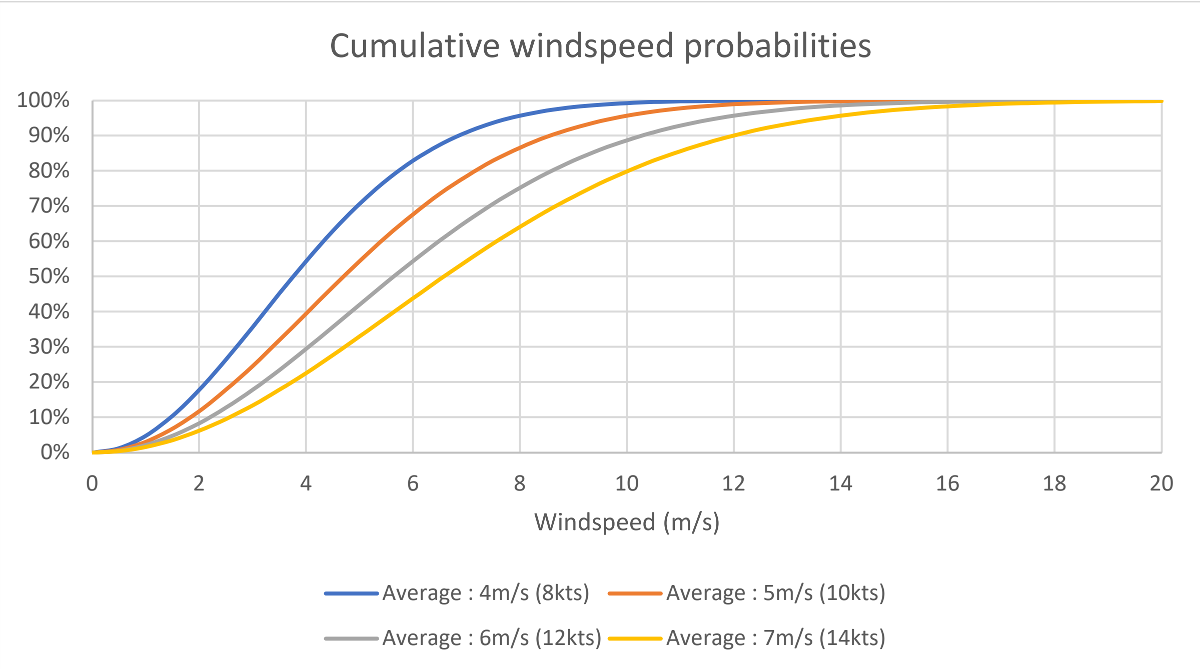
4 Windspeed distributions and performance comparison

At most locations in the world the wind is more likely to blow at some speeds than at other speeds. We can plot the probability of the wind being of any given speed on a graph such as the one below. Typically we will observe that the probability distribution is skewed towards the lower windspeeds than the higher windspeeds, such as in this example.



By making lots of observations around the world we can assess typical shapes of windspeed probability distributions. In this study we assume a particular reference shape that is used in the wind energy industry (a Rayleigh distribution with a shape factor of 2). Each actual location in the world will be slightly different than this but it is good enough for our purposes.

If we plot the cumulative probability distribution for some typical average windspeeds we can look at the same thing a different way, so for example we can see that the probability of the wind exceeding 20 m/s (40 knots) is very small, but becomes more likely as the average windspeed of a location increases.



When meteorologists gather windspeed data they reference it to a height of 10-metres above ground (or sea) level, which is quite a useful height to use for our yachting information purposes without needing adjustment. A typical fairly windy seaside town (such as Weymouth in the UK, where the 2012 sailing Olympics were held) will have an annual average of maybe 6.5 m/s (13 knots).

For our purposes we are interested in comparing the sailing performance of the different Corbin models to understand to what extent it might be relevant in typical use. The VPPs have calculated performance at windspeeds of 8-knots , 14-knots, and 20-knots. We can divide up the windspeed into ranges (known as 'bins' in the wind energy industry) with the bins being centred on the windspeeds for which we have VPP results. We can then calculate the probability that a Corbin sailing at that location would experience winds of each wind strength, such as in this example for a location with an annual average of 5.0 m/s (10 knots).

Average = 5.0 m/s			
Bin avge m/s	Bin range m/s	Bin bottom m/s	Bin top m/s
1.3	0 - 2.6	0.0	2.6
4.1	2.6 - 5.7	2.6	5.7
7.2	5.7 - 8.7	5.7	8.7
10.3	8.7 - 11.8	8.7	11.8
16.2	11.8 - 20.6	11.8	20.6

Average = 9.7 kts			
Bin avge kts	Bin range kts	Bin bottom kts	Bin top kts
2.5	0 - 5	0	5
8	5 - 11	5	11
14	11 - 17	11	17
20	17 - 23	17	23
31.5	23 - 40	23	40

Cum probability to bin top %	Bin probability %
18%	18%
61%	44%
90%	28%
98%	9%
100%	2%
	100%

As a simplification we assume that in winds of less than 5-knots or of greater than 23-knots sailing will not be taking place. Of course it may still go on, but either the number of miles run will be very little if becalmed, or the amount of time will hopefully be very small if in a storm.

The next simplification is to assume that when sailing the time will be divided equally between beating to windward, beam reaching, or running downwind. This can either be thought of as sailing a triangular course with a constant wind direction, or as sailing a straight course with a varying wind direction.

Then we take the sailing performance as generated by SA-VPP for each Corbin model, and calculate the number of miles sailed through the water. For easy comparison the numbers shown are for one sailing day of 10-hours, but it is of course representative of the range of windspeed conditions that would more likely be encountered over a longer period such as several months.

The outcome is shown below for locations with annual average windspeeds of 4, 5, 6, 7 and 8 m/s. To begin with it is assumed that no use is made of a spinnaker.

Comparing the results it is marked how insignificant is the performance difference between the various Corbin models. When all is said and done the skill and ability of each individual crew is likely to be a far greater performance determinant than which model of Corbin is selected.

Annual avge windspeed (m/s)	4.0	All courses
Annual avge windspeed (kts)	7.8	TOTAL
Sailing hours	10	Distance (nm)
ketch mk1 46' shortmast	100%	39
sloop mk1 51' tallmast	103%	40
sloop mk1 46' shortmast	100%	39
sloop mk2 49' bowsprit	104%	40
ketch mk2	-	-
sloop mk1 46' shortmast + bowsprit	101%	39
sloop mk1 51' tallmast + bowsprit	104%	40
sloop mk1 51' tallmast + shortboom	101%	39
Spinnaker		**no**

Days sailing	1	(days)
Day duration	10	(hours/day)
Sailing hours	10	(hours)

Annual avge windspeed (m/s)	4.0
Annual avge windspeed (kts)	7.8

Windspeed bin probabilities			Assumption
Bin avge kts	Bin range kts	Bin probability %	
3	0 - 5	26%	not sailing
8	5 - 11	51%	sailing
14	11 - 17	20%	sailing
20	17 - 23	3%	sailing
32	23 - 40	0%	not sailing
		100%	

Course probability	33%	33%	33%

Windspeed = 8 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)	Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
ketch mk1 46' shortmast	4.81	5.73	3.81	8	10	6	24
sloop mk1 51' tallmast	4.98	5.91	3.91	8	10	7	25
sloop mk1 46' shortmast	4.81	5.73	3.81	8	10	6	24
sloop mk2 49' bowsprit	4.98	6.01	3.99	8	10	7	25
ketch mk2							
sloop mk1 46' shortmast + bowsprit	4.90	5.82	3.87	8	10	7	25
sloop mk1 51' tallmast + bowsprit	5.03	6.01	3.99	9	10	7	26
sloop mk1 51' tallmast + shortboom	5.02	5.77	3.81	9	10	6	25

Windspeed = 14 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)	Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
ketch mk1 46' shortmast	5.96	7.27	5.77	4	5	4	13
sloop mk1 51' tallmast	6.02	7.38	5.92	4	5	4	13
sloop mk1 46' shortmast	5.87	7.27	5.79	4	5	4	12
sloop mk2 49' bowsprit	5.99	7.44	6.01	4	5	4	13
ketch mk2							
sloop mk1 46' shortmast + bowsprit	5.94	7.33	5.86	4	5	4	13
sloop mk1 51' tallmast + bowsprit	6.02	7.44	6.01	4	5	4	13
sloop mk1 51' tallmast + shortboom	6.04	7.29	5.78	4	5	4	13

Windspeed = 20 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)	Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
ketch mk1 46' shortmast	6.45	8.01	7.08	1	1	1	2
sloop mk1 51' tallmast	6.46	8.09	7.19	1	1	1	2
sloop mk1 46' shortmast	6.33	8.01	7.10	1	1	1	2
sloop mk2 49' bowsprit	6.42	8.13	7.27	1	1	1	2
ketch mk2							
sloop mk1 46' shortmast + bowsprit	6.43	8.06	7.15	1	1	1	2
sloop mk1 51' tallmast + bowsprit	6.44	8.14	7.26	1	1	1	2
sloop mk1 51' tallmast + shortboom	6.48	8.03	7.09	1	1	1	2

Corbin 39 performance for a location with an annual average of 4 m/s (7.8 kts)

Annual avge windspeed (m/s)	5.0	All courses
Annual avge windspeed (kts)	9.7	TOTAL
Sailing hours	10	Distance (nm)
ketch mk1 46' shortmast	100%	45
sloop mk1 51' tallmast	102%	46
sloop mk1 46' shortmast	100%	45
sloop mk2 49' bowsprit	103%	46
ketch mk2	-	-
sloop mk1 46' shortmast + bowsprit	101%	46
sloop mk1 51' tallmast + bowsprit	103%	47
sloop mk1 51' tallmast + shortboom	101%	46
Spinnaker		**no**

Days sailing	1	(days)
Day duration	10	(hours/day)
Sailing hours	10	(hours)

Annual avge windspeed (m/s)	5.0
Annual avge windspeed (kts)	9.7

Windspeed bin probabilities			Assumption
Bin avge kts	Bin range kts	Bin probability %	
3	0 - 5	18%	not sailing
8	5 - 11	44%	sailing
14	11 - 17	28%	sailing
20	17 - 23	9%	sailing
32	23 - 40	2%	not sailing
		100%	

Course probability	33%	33%	33%

Windspeed = 8 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)	Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
ketch mk1 46' shortmast	4.81	5.73	3.81	7	8	6	21
sloop mk1 51' tallmast	4.98	5.91	3.91	7	9	6	21
sloop mk1 46' shortmast	4.81	5.73	3.81	7	8	6	21
sloop mk2 49' bowsprit	4.98	6.01	3.99	7	9	6	22
ketch mk2							
sloop mk1 46' shortmast + bowsprit	4.90	5.82	3.87	7	8	6	21
sloop mk1 51' tallmast + bowsprit	5.03	6.01	3.99	7	9	6	22
sloop mk1 51' tallmast + shortboom	5.02	5.77	3.81	7	8	6	21

Windspeed = 14 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)	Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
ketch mk1 46' shortmast	5.96	7.27	5.77	6	7	5	18
sloop mk1 51' tallmast	6.02	7.38	5.92	6	7	6	18
sloop mk1 46' shortmast	5.87	7.27	5.79	6	7	5	18
sloop mk2 49' bowsprit	5.99	7.44	6.01	6	7	6	18
ketch mk2							
sloop mk1 46' shortmast + bowsprit	5.94	7.33	5.86	6	7	6	18
sloop mk1 51' tallmast + bowsprit	6.02	7.44	6.01	6	7	6	18
sloop mk1 51' tallmast + shortboom	6.04	7.29	5.78	6	7	5	18

Windspeed = 20 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)	Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
ketch mk1 46' shortmast	6.45	8.01	7.08	2	2	2	6
sloop mk1 51' tallmast	6.46	8.09	7.19	2	2	2	6
sloop mk1 46' shortmast	6.33	8.01	7.10	2	2	2	6
sloop mk2 49' bowsprit	6.42	8.13	7.27	2	2	2	6
ketch mk2							
sloop mk1 46' shortmast + bowsprit	6.43	8.06	7.15	2	2	2	6
sloop mk1 51' tallmast + bowsprit	6.44	8.14	7.26	2	2	2	6
sloop mk1 51' tallmast + shortboom	6.48	8.03	7.09	2	2	2	6

Corbin 39 performance for a location with an annual average of 5 m/s (9.7 kts)

Annual avge windspeed (m/s)	6.0	All courses
Annual avge windspeed (kts)	11.7	TOTAL
Sailing hours	10	Distance (nm)
ketch mk1 46' shortmast	100%	47
sloop mk1 51' tallmast	102%	48
sloop mk1 46' shortmast	100%	47
sloop mk2 49' bowsprit	103%	49
ketch mk2	-	-
sloop mk1 46' shortmast + bowsprit	101%	48
sloop mk1 51' tallmast + bowsprit	103%	49
sloop mk1 51' tallmast + shortboom	101%	48
Spinnaker		**no**

Days sailing	1	(days)
Day duration	10	(hours/day)
Sailing hours	10	(hours)

Annual avge windspeed (m/s)	6.0
Annual avge windspeed (kts)	11.7

Windspeed bin probabilities			Assumption
Bin avge kts	Bin range kts	Bin probability %	
3	0 - 5	13%	not sailing
8	5 - 11	36%	sailing
14	11 - 17	31%	sailing
20	17 - 23	15%	sailing
32	23 - 40	6%	not sailing
		100%	

Course probability	33%	33%	33%

Windspeed = 8 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)
ketch mk1 46' shortmast	4.81	5.73	3.81
sloop mk1 51' tallmast	4.98	5.91	3.91
sloop mk1 46' shortmast	4.81	5.73	3.81
sloop mk2 49' bowsprit	4.98	6.01	3.99
ketch mk2			
sloop mk1 46' shortmast + bowsprit	4.90	5.82	3.87
sloop mk1 51' tallmast + bowsprit	5.03	6.01	3.99
sloop mk1 51' tallmast + shortboom	5.02	5.77	3.81

Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
6	7	5	17
6	7	5	18
6	7	5	17
6	7	5	18
6	7	5	17
6	7	5	18
6	7	5	17

Windspeed = 14 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)
ketch mk1 46' shortmast	5.96	7.27	5.77
sloop mk1 51' tallmast	6.02	7.38	5.92
sloop mk1 46' shortmast	5.87	7.27	5.79
sloop mk2 49' bowsprit	5.99	7.44	6.01
ketch mk2			
sloop mk1 46' shortmast + bowsprit	5.94	7.33	5.86
sloop mk1 51' tallmast + bowsprit	6.02	7.44	6.01
sloop mk1 51' tallmast + shortboom	6.04	7.29	5.78

Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
6	8	6	20
6	8	6	20
6	8	6	20
6	8	6	20
6	8	6	20
6	8	6	20
6	8	6	20

Windspeed = 20 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)
ketch mk1 46' shortmast	6.45	8.01	7.08
sloop mk1 51' tallmast	6.46	8.09	7.19
sloop mk1 46' shortmast	6.33	8.01	7.10
sloop mk2 49' bowsprit	6.42	8.13	7.27
ketch mk2			
sloop mk1 46' shortmast + bowsprit	6.43	8.06	7.15
sloop mk1 51' tallmast + bowsprit	6.44	8.14	7.26
sloop mk1 51' tallmast + shortboom	6.48	8.03	7.09

Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
3	4	4	11
3	4	4	11
3	4	4	11
3	4	4	11
3	4	4	11
3	4	4	11
3	4	4	11

Corbin 39 performance for a location with an annual average of 6 m/s (11.7 kts)

Annual avge windspeed (m/s)	7.0	All courses
Annual avge windspeed (kts)	13.6	TOTAL
Sailing hours	10	Distance (nm)
ketch mk1 46' shortmast	100%	47
sloop mk1 51' tallmast	102%	48
sloop mk1 46' shortmast	100%	47
sloop mk2 49' bowsprit	103%	48
ketch mk2	-	-
sloop mk1 46' shortmast + bowsprit	101%	47
sloop mk1 51' tallmast + bowsprit	103%	48
sloop mk1 51' tallmast + shortboom	101%	47
Spinnaker		**no**

Days sailing	1	(days)
Day duration	10	(hours/day)
Sailing hours	10	(hours)

Annual avge windspeed (m/s)	7.0
Annual avge windspeed (kts)	13.6

Windspeed bin probabilities			Assumption
Bin avge	Bin range	Bin probability	
kts	kts	%	
3	0 - 5	10%	not sailing
8	5 - 11	29%	sailing
14	11 - 17	30%	sailing
20	17 - 23	19%	sailing
32	23 - 40	12%	not sailing
		100%	

Course probability	33%	33%	33%

Windspeed = 8 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)
ketch mk1 46' shortmast	4.81	5.73	3.81
sloop mk1 51' tallmast	4.98	5.91	3.91
sloop mk1 46' shortmast	4.81	5.73	3.81
sloop mk2 49' bowsprit	4.98	6.01	3.99
ketch mk2			
sloop mk1 46' shortmast + bowsprit	4.90	5.82	3.87
sloop mk1 51' tallmast + bowsprit	5.03	6.01	3.99
sloop mk1 51' tallmast + shortboom	5.02	5.77	3.81

Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
5	6	4	14
5	6	4	14
5	6	4	14
5	6	4	14
5	6	4	14
5	6	4	14
5	6	4	14

Windspeed = 14 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)
ketch mk1 46' shortmast	5.96	7.27	5.77
sloop mk1 51' tallmast	6.02	7.38	5.92
sloop mk1 46' shortmast	5.87	7.27	5.79
sloop mk2 49' bowsprit	5.99	7.44	6.01
ketch mk2			
sloop mk1 46' shortmast + bowsprit	5.94	7.33	5.86
sloop mk1 51' tallmast + bowsprit	6.02	7.44	6.01
sloop mk1 51' tallmast + shortboom	6.04	7.29	5.78

Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
6	7	6	19
6	7	6	19
6	7	6	19
6	7	6	20
6	7	6	19
6	7	6	20
6	7	6	19

Windspeed = 20 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)
ketch mk1 46' shortmast	6.45	8.01	7.08
sloop mk1 51' tallmast	6.46	8.09	7.19
sloop mk1 46' shortmast	6.33	8.01	7.10
sloop mk2 49' bowsprit	6.42	8.13	7.27
ketch mk2			
sloop mk1 46' shortmast + bowsprit	6.43	8.06	7.15
sloop mk1 51' tallmast + bowsprit	6.44	8.14	7.26
sloop mk1 51' tallmast + shortboom	6.48	8.03	7.09

Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
4	5	5	14
4	5	5	14
4	5	5	14
4	5	5	14
4	5	5	14
4	5	5	14
4	5	5	14

Corbin 39 performance for a location with an annual average of 7 m/s (13.6 kts)

Annual avge windspeed (m/s)	8.0	All courses
Annual avge windspeed (kts)	15.6	TOTAL
Sailing hours	10	Distance (nm)
ketch mk1 46' shortmast	100%	44
sloop mk1 51' tallmast	102%	45
sloop mk1 46' shortmast	100%	44
sloop mk2 49' bowsprit	102%	45
ketch mk2	-	-
sloop mk1 46' shortmast + bowsprit	101%	45
sloop mk1 51' tallmast + bowsprit	103%	45
sloop mk1 51' tallmast + shortboom	101%	45
Spinnaker		no

Days sailing	1	(days)
Day duration	10	(hours/day)
Sailing hours	10	(hours)

Annual avge windspeed (m/s)	8.0
Annual avge windspeed (kts)	15.6

Windspeed bin probabilities			Assumption
Bin avge kts	Bin range kts	Bin probability %	
3	0 - 5	7%	not sailing
8	5 - 11	24%	sailing
14	11 - 17	28%	sailing
20	17 - 23	21%	sailing
32	23 - 40	19%	not sailing
		99%	

Course probability	33%	33%	33%

Windspeed = 8 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)	Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
ketch mk1 46' shortmast	4.81	5.73	3.81	4	5	3	11
sloop mk1 51' tallmast	4.98	5.91	3.91	4	5	3	12
sloop mk1 46' shortmast	4.81	5.73	3.81	4	5	3	11
sloop mk2 49' bowsprit	4.98	6.01	3.99	4	5	3	12
ketch mk2							
sloop mk1 46' shortmast + bowsprit	4.90	5.82	3.87	4	5	3	11
sloop mk1 51' tallmast + bowsprit	5.03	6.01	3.99	4	5	3	12
sloop mk1 51' tallmast + shortboom	5.02	5.77	3.81	4	5	3	11

Windspeed = 14 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)	Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
ketch mk1 46' shortmast	5.96	7.27	5.77	6	7	5	18
sloop mk1 51' tallmast	6.02	7.38	5.92	6	7	5	18
sloop mk1 46' shortmast	5.87	7.27	5.79	5	7	5	18
sloop mk2 49' bowsprit	5.99	7.44	6.01	6	7	6	18
ketch mk2							
sloop mk1 46' shortmast + bowsprit	5.94	7.33	5.86	5	7	5	18
sloop mk1 51' tallmast + bowsprit	6.02	7.44	6.01	6	7	6	18
sloop mk1 51' tallmast + shortboom	6.04	7.29	5.78	6	7	5	18

Windspeed = 20 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)	Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
ketch mk1 46' shortmast	6.45	8.01	7.08	5	6	5	15
sloop mk1 51' tallmast	6.46	8.09	7.19	5	6	5	16
sloop mk1 46' shortmast	6.33	8.01	7.10	5	6	5	15
sloop mk2 49' bowsprit	6.42	8.13	7.27	5	6	5	16
ketch mk2							
sloop mk1 46' shortmast + bowsprit	6.43	8.06	7.15	5	6	5	15
sloop mk1 51' tallmast + bowsprit	6.44	8.14	7.26	5	6	5	16
sloop mk1 51' tallmast + shortboom	6.48	8.03	7.09	5	6	5	15

Corbin 39 performance for a location with an annual average of 8 m/s (15.6 kts)

To compare the performance with a spinnaker the same exercise was carried out, but with a boat speed increase downwind of 1.5 knots at 8 knots and 14 knots of wind. For the 20 knots wind the speed increase would ordinarily be approximately 1.1 knots, but since the windspeed bin range is from 17-23 knots only 0.25 knots of hull speed was allocated as it was assumed the spinnaker would be doused at approximately 18-knots.

Annual avge windspeed (m/s)	6.0	All courses
Annual avge windspeed (kts)	11.7	TOTAL
Sailing hours	10	Distance (nm)
ketch mk1 46' shortmast	100%	51
sloop mk1 51' tallmast	102%	52
sloop mk1 46' shortmast	100%	51
sloop mk2 49' bowsprit	103%	52.3
ketch mk2	-	-
sloop mk1 46' shortmast + bowsprit	101%	51
sloop mk1 51' tallmast + bowsprit	103%	52
sloop mk1 51' tallmast + shortboom	101%	51
Spinnaker		yes

Days sailing	1	(days)
Day duration	10	(hours/day)
Sailing hours	10	(hours)

Annual avge windspeed (m/s)	6.0
Annual avge windspeed (kts)	11.7

Windspeed bin probabilities			Assumption
Bin avge kts	Bin range kts	Bin probability %	
3	0 - 5	13%	not sailing
8	5 - 11	36%	sailing
14	11 - 17	31%	sailing
20	17 - 23	15%	sailing
32	23 - 40	6%	not sailing
		100%	

Course probability	33%	33%	33%

Windspeed = 8 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)	Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
ketch mk1 46' shortmast	4.81	5.73	5.31	6	7	6	19
sloop mk1 51' tallmast	4.98	5.91	5.41	6	7	6	19
sloop mk1 46' shortmast	4.81	5.73	5.31	6	7	6	19
sloop mk2 49' bowsprit	4.98	6.01	5.49	6	7	7	20
ketch mk2							
sloop mk1 46' shortmast + bowsprit	4.90	5.82	5.37	6	7	6	19
sloop mk1 51' tallmast + bowsprit	5.03	6.01	5.49	6	7	7	20
sloop mk1 51' tallmast + shortboom	5.02	5.77	5.31	6	7	6	19

Windspeed = 14 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)	Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
ketch mk1 46' shortmast	5.96	7.27	7.27	6	8	8	21
sloop mk1 51' tallmast	6.02	7.38	7.42	6	8	8	22
sloop mk1 46' shortmast	5.87	7.27	7.29	6	8	8	21
sloop mk2 49' bowsprit	5.99	7.44	7.51	6	8	8	22
ketch mk2							
sloop mk1 46' shortmast + bowsprit	5.94	7.33	7.36	6	8	8	21
sloop mk1 51' tallmast + bowsprit	6.02	7.44	7.51	6	8	8	22
sloop mk1 51' tallmast + shortboom	6.04	7.29	7.28	6	8	8	21

Windspeed = 20 kts	Upwind Twa 47 Speed (kts)	Beam Twa 90 Speed (kts)	Downwind Twa 140 Speed (kts)	Upwind Twa 47 Distance (nm)	Beam Twa 90 Distance (nm)	Downwind Twa 140 Distance (nm)	All courses - Distance (nm)
ketch mk1 46' shortmast	6.45	8.01	7.33	3	4	4	11
sloop mk1 51' tallmast	6.46	8.09	7.44	3	4	4	11
sloop mk1 46' shortmast	6.33	8.01	7.35	3	4	4	11
sloop mk2 49' bowsprit	6.42	8.13	7.52	3	4	4	11
ketch mk2							
sloop mk1 46' shortmast + bowsprit	6.43	8.06	7.40	3	4	4	11
sloop mk1 51' tallmast + bowsprit	6.44	8.14	7.51	3	4	4	11
sloop mk1 51' tallmast + shortboom	6.48	8.03	7.34	3	4	4	11

Corbin 39 performance for a location with an annual average of 6 m/s (11.7 kts) with a spinnaker

Annual avge windspeed (m/s)	6.0	All courses
Annual avge windspeed (kts)	11.7	TOTAL
Sailing hours	10	Distance (nm)
ketch mk1 46' shortmast	100%	47.5
sloop mk1 51' tallmast	102%	48.4
sloop mk1 46' shortmast	100%	47.4
sloop mk2 49' bowsprit	103%	48.8
ketch mk2	-	-
sloop mk1 46' shortmast + bowsprit	101%	48.0
sloop mk1 51' tallmast + bowsprit	103%	48.9
sloop mk1 51' tallmast + shortboom	101%	47.9
Spinnaker		no

Annual avge windspeed (m/s)	6.0	All courses
Annual avge windspeed (kts)	11.7	TOTAL
Sailing hours	10	Distance (nm)
ketch mk1 46' shortmast	100%	50.9
sloop mk1 51' tallmast	102%	51.9
sloop mk1 46' shortmast	100%	50.8
sloop mk2 49' bowsprit	103%	52.3
ketch mk2	-	-
sloop mk1 46' shortmast + bowsprit	101%	51.4
sloop mk1 51' tallmast + bowsprit	103%	52.4
sloop mk1 51' tallmast + shortboom	101%	51.4
Spinnaker		yes

Detail of above comparing with and without spinnaker

5 Performance reports from owners

Early on in the study some upwind speeds (i.e. when beating to windward) were proposed to the owners via the Corbin 39 Association. The speeds were proposed on the basis of initial VPP analysis and were as follows.

> *Wind force 2 (4 to 6 Knts) >> Speed 3,9 to 4,6 Knots ?*
>
> *Wind force 3 (7 to 10 Knts) >> Speed 5,3 to 5,9 Knots ?*
>
> *Wind force 4 (11 to 16 Knts) >> Speed 6,1 to 6,5 Knots ?*
>
> *Wind force 5 (17 Knts to 21 Knts) >> Speed 6,6 to 6,7 Knots ? (with a necessary sail reduction to 80% at Wind 18 Knots)*

*(**Note:** the actual VPPs were subsequently tuned, partly to reflect the owner responses below, and partly as a result of investigating other parameters. Therefore the VPP early results as reminded here above are not the same as are in the remainder of this report)*

Responses were obtained as follows:

1. Response for #97, “Grace” which is a mk1 double-spreader tallmast with no bowsprit : The 3 blade folding Maxprop gives me +.5 knots over my previous fixed three blades, under sail. My numbers are very close to the above at force 4 and above but a little slower at the lower winds. My foresail is only a 110 high Yankee cut roller hanked 30 year old- my main is new with three reef points - first reef is used if there will be anything above force 3 that day. Grace’s main is way overpowered but manageable once you understand her. The folding prop (Maxprop) was a very helpful improvement.

2. Response for #61, “Cosmic Debris”, which is a mk1 double-spreader tallmast with a bowsprit : I have actually never had a working knot meter on my boat so it's difficult to say. Relying only on SOG and and sailing in reasonably calm sea states I would those speeds are probably fairly accurate. We have reached hull speed in 15kn wind while beating but favourable current would likely be a factor.

3. Response for #143, “Sputnik III”, which is a mk2 double-spreader tallmast with a bowsprit : That's more or less ok, but depending of the sea state. With the short waves against my course I needed to use genoa + jib + mainsail and I was able to make about 80% of those values. Especially with wind force 5 or more the effect of the short sea is to slow the boat when sailing upwind.

4. Response for #107, ”Full Circle, which is a mk1 shortmast single spreader with no bowsprit. “Full Circle” would have speeds on the lower ends of those ranges. Our boat has the Genoa track on the cap rail which results in less than ideal sheeting angle. In an ideal world they would be mounted along the pilot house on side deck.

5. Response for #073, “Jakatar”, mk1, 50’ shortmast single spreader, no bowsprit
   Main: 34 m2

   High cut genoa: 48 m2

   Boomed staysail: 12 m2

   I worked out the speeds to the best of my memory. I found that the [initially suggested speeds are] somewhat optimistic at low wind speeds; can’t imagine doing 3.9 knots in 4 knots of wind in any wind direction. Corbins need a bit of wind on a close reach.

Note: I've done 8.5+ knots but that's in extreme conditions (never on a close reach), maybe also helped by waves.

Close Reach

Wind force 2 (4 to 6 Knts) >> Speed 2 to 3 Knots

Wind force 3 (7 to 10 Knts) >> Speed 3.5 to 4.5 Knots

Wind force 4 (11 to 16 Knts) >> Speed 5 to 5.5 Knots

Wind force 5 (17 Knts to 21 Knts) >> Speed 6 to 7 Knots

Beam Reach

Wind force 2 (4 to 6 Knts) >> Speed 2 to 3 Knots

Wind force 3 (7 to 10 Knts) >> Speed 3.5 to 5 Knots

Wind force 4 (11 to 16 Knts) >> Speed 5.5 to 6.5 Knots

Wind force 5 (17 Knts to 21 Knts) >> Speed 6.5 to 7.5 Knots

Broad Reach

Wind force 2 (4 to 6 Knts) >> Speed 1 to 2.5 Knots

Wind force 3 (7 to 10 Knts) >> Speed 3 to 4.5 Knots

Wind force 4 (11 to 16 Knts) >> Speed 5 to 6 Knots

Wind force 5 (17 Knts to 21 Knts) >> Speed 6.5 to 7.5 Knots

6. Response for #xxx, "Abenaki", mk1, 50' shortmast single spreader, no bowsprit : The proposed numbers sound about right. They like more wind to get them going. I have had 8knts waterspeed with 20kts of wind, close hauled. More typically 7kts. I have a Bruntons folding prop which I think is worth 0.8 kts. Beam reach and running downwind in 15kts for 6kts waterspeed average.

7. Response for #83, "Ramble On". So, short mast Mk I cutter with heavy dacron sails (8oz dacron, minimum), sailing with a Yankee cut job (not sure of fore-triangle % but not huge) a full main, no reefs, and no inner foresail (winds were typically too light to justify), as background for your query, I think the following represents my recollection of windward performance: Force 2 resulted in 3.5-4 knots (as measured by a reasonably calibrated SR Mariner knotmetre); Force 3 resulted in 4-5.5 knots; Force 4 resulted in 5.5-6.25 knots; Force 5 resulted in 6.25-7 knots. We typically didn't sail in winds about force 5 on the Great Lakes.

8. Response for #123, "Bockra", mk2 doublespreader with bowsprit: approx 8kts on a beam reach in F3-F4.

6 Spinnaker Sizes

The Corbin plans did not originally have spinnaker dimensions in them. Therefore the following information was gathered for spinnakers as an input into deciding upon what size to model.

SAILRITE

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From Sailrite at https://www.sailrite.com/Corbin-39-Sail-Data?fbclid=IwAR35J23pF_5twllxrD8Z5KvFNnEq9wHmQ2-2JgAoHo_CPBFnkAJ89fHNn9o I get

Asymmetrical Spinnaker
Luff 46.35*ft
Foot 27.97*ft
Leech 42.64*ft

Symmetrical Spinnaker
Foot 30.51*ft
Stay 46.35*ft

COSMIC DEBRIS

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Response for #61, “Cosmic Debris”, which is a mk1 double-spreader tallmast with a bowsprit

asymmetric = 43.5 X 45 X 28.5 feet. (measuring along each side). This was cut down from a larger spinnaker off another yacht.

QUOTED CRUISING CHUTE for #123, “BOCKRA”

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For a mk2 cutter with the 49’ double-spreader mast with the 3’ bowsprit I have been quoted an (asymmetrical) cruising chute with an ISP = 15.54m, an STL = 5.58m, and an area = 84.04m2.

The actual sizes used in the models are given in the VPP reports below.

7 Detailed VPP results

The detailed SA-VPP and USVPP results fall into 3 documents, « VPP issue and results», « VPP with spi » and « VPP with Disp 15t » all of which are attached (for download alongside this covering note on the Corbin 39 website):

- **« VPP issue and results »** : is the core document explaining the process and the input data (assuming the 14 t displacement configuration), giving the results upwind, beam reaching and downwind (without spinnaker) for wind up to 20 Knots.
- **« VPP with spi »** : an additionnal document giving results with a spinnaker up and comparison with spinnaker down
- **« VPP with Disp 15 t »** : an additionnal document giving results when the displacement is 15 t, and comparison with 14 t results

Once again we in the Corbin community owe an enormous debt of gratitude to Jean-Francois Masset and Alain Lebeau for their fantastic volunteer support, so willingly given.