

Handicapping Calculations - How Are They Done?

Handicapping is performed as two distinct types – boat type or class based handicapping and personal performance handicapping. The class based handicapping is a comparison of different types of boats while performance handicapping is a comparison of the performance of the skipper.

Class based handicapping uses an external data source as the reference for the handicap factors. These factors are applied to the race results to give handicap results.

Personal performance handicapping develops the handicap factors based on the racing results for each competitor. The developed factors are then applied to the results to give handicap results.

To aid the discussion of the application and development of handicaps, an example of a race and series with 7 competitors, boats A to G, will be used. The handicap factors used for this example fleet are typical of the catamaran fleet at CYC.

Class Based Handicapping

The class based handicap system used for 'off the beach classes' is known as a Yardstick (YS). In Australia the Yardstick is set and administered by Yachting Victoria and is therefore known as the Victorian Yardstick – VYS. The VYS factors are based on mixed fleet racing results sent to Yachting Victoria from throughout Australia. These results are used to compare classes and set the VYS factors. The VYS factors are set for each rig configuration for each class of boat (as long as data is available).

The Yardstick is set as a value scaled to 100. The time taken to complete a race course – the Elapsed Time (ET) - is then multiplied by 100 and divided by the Yardstick (YS) to give the Yardstick Corrected Time (YS Cor'd T).

As an equation this is:-

$$YS \text{ Cor'd } T = ET \times \frac{100}{VYS}$$

A Yardstick less than 100 will increase the Elapsed Time (ET) to the Yardstick Corrected Time (YS Cor'd T). A Yardstick greater than 100 will decrease the Elapsed Time (ET) to the Yardstick Corrected Time (YS Cor'd T).

This Yardstick Corrected Time is then a comparison of the time taken to complete the race course if all competitors were on identical boats with a VYS of 100. The winner of the race is then the competitor with the lowest Yardstick Corrected Time.

Table 1 lists a single race result for the example fleet. The VYS factor is shown for each boat along with the Elapsed Time taken to sail the race. The Yardstick Corrected Time is then calculated using the above formula. The placing on Yardstick is then awarded, with the lowest Yardstick Corrected Time being awarded 1st place.

Table 1 – Yardstick Handicap Result

Boat	YS	ET	YS Cor'd T	Place
A	81.5	57:51	1:10:59	4
B	72.0	48:46	1:07:44	2
C	72.0	56:01	1:17:48	7
D	72.0	54:05	1:15:07	6
E	72.0	49:08	1:08:14	3
F	81.5	57:55	1:11:04	5
G	79.5	48:26	1:00:55	1

The effect of the Yardstick correction can be seen by comparing boats D and F. Boat D had a lower elapsed time for the race than boat F, but after Yardstick correction boat F had a lower Yardstick Corrected Time due to a higher VYS factor.

Personal Performance Handicapping

A Personal Performance Handicap is a factor comparing the performance of each skipper in a particular fleet. It is attempting to make the finishing time of all boats in a fleet identical based on their average performance. The winner on handicap is the competitor who sailed the greatest amount better than their average.

The Personal Performance Handicap (HC) is similar to the Yardstick factor in that a multiplier is used to give a corrected time. The Performance Handicap factor (HC) is set directly as a multiplying factor and not scaled like the VYS factor. The value of the Handicap factor is a number around 1.0.

The Performance Handicap (HC) is applied to the YS Corrected Time (YS Cor'd T). The Yardstick correction will have already removed the effect of different classes of boat.

The Handicap Corrected Time (HC Cor'd T) is then the Yardstick Corrected Time (YS Cor'd T) multiplied by the Performance Handicap (HC).

As an equation this is:-

$$HC \text{ Cor'd } T = YS \text{ Cor'd } T \times HC$$

Since it is used to multiply time directly, a Handicap less than 1.0 will reduce the Yardstick Corrected time when applied. A handicap greater than 1.0 will increase the time.

Table 2 shows the Performance Handicapping of the example fleet. The Yardstick Corrected Time is taken from the previous section and the listed Performance Handicap factors applied to generate the Handicap Corrected time. The placing on Handicap is awarded in Handicap Corrected Time order, with the lowest Handicap Corrected Time being awarded 1st place.

Table 2 – Performance Handicap Result

Boat	YS Cor'd T (h:mm:ss)	HC	HC Cor'd T (h:mm:ss)	Place
A	1:10:59	0.957	1:07:56	3
B	1:07:44	1.007	1:08:12	4
C	1:17:48	1.012	1:18:44	7
D	1:15:07	1.028	1:17:13	6
E	1:08:14	0.957	1:05:18	1
F	1:11:04	0.965	1:08:35	5
G	1:00:55	1.103	1:07:12	2

How is the Performance Handicap factor (HC) arrived at?

The Performance Handicap (HC) is derived from the results of racing for the fleet in question. It is developed in two stages of calculation carried out on the results for each race. The first stage calculates the Back Calculated Handicap (BCHC) to compare and equalise each competitor's result. The second stage finds the average performance for each competitor.

Back Calculated Handicap (BCHC) and Clamped Back Calculated Handicap (CBCH)

The Yardstick correction is applied to generate the Yardstick Corrected Time (YS Cor'd T). This is used as the basis for the remainder of the calculations.

The Handicap being used for each competitor for the race being processed – the Allocated Handicap (AHC) – is applied to the Yardstick Corrected Time (YS Cor'd T) to give the Handicap Corrected Time (HC Cor'd T) for each competitor for the race. This is the calculation in the previous section (refer to Table 2).

The AHC for this race is the result of the Performance Handicap calculations after the previous race.

A reference boat is then selected from the results to carryout a comparison and equalisation of the competitors. The competitor selected is defined by the handicapping system being used. Reference literature (TopYacht etc) suggests that the competitor that finished 45% of the way down the finishers on handicap is the appropriate competitor to use as the reference boat. For example, if there were 12 finishers for the race, 45% of 12 = 5.4, therefore the 5th place boat would be selected as the reference.

Selecting a reference boat based on position in the fleet has the advantage of not being tied to a particular boat which may not be present in some races. Also the finishing order of the boats is not relevant. Using a mid position is based on there being a similar spread of results for the fleet in each race.

Having selected the reference boat, a calculation is performed for each competitor to determine what handicap would have been needed for that competitor to have the same Handicap Corrected Time (HC Cor'd T) as the selected reference boat. This is the Back Calculated Handicap (BCHC) for each competitor.

As an equation this is:-

$$BCHC = \frac{HC\ Cor'd\ T_{ref\ boat}}{YS\ Cor'd\ T}$$

The reference boat Back Calculated Handicap will be the same as the Allocated Handicap for that boat for that race.

Looking at the seven boats in the example fleet, the reference boat would be at 45% of the 7 places – 45% x 7 = 3.15 – that is place 3. The boat that finished 3rd on Handicap Corrected Time would be the reference boat for this race. In the example fleet this is Boat A, as shown in Table 2. The handicap correct time for Boat A is 1:07:56.

Using the Yardstick Corrected Time for each competitor and the Handicap Corrected Time of Boat A, the Back Calculated Handicap for each competitor is calculated, as shown in table 3. Note that the reference boat does not have a Back Calculated Handicap as this is the same as the Allocated Handicap for this race.

Table 3 – Back Calculated Handicap

Boat	YS Cor'd T (h:mm:ss)	AHC	BCHC
A	1:10:59	0.957	
B	1:07:44	1.007	1.003
C	1:17:48	1.012	0.873
D	1:15:07	1.028	0.904
E	1:08:14	0.957	0.995
F	1:11:04	0.965	0.956
G	1:00:55	1.103	1.115

Boats C and D have performed well below their Allocated Handicap while the other competitors are near to their handicaps.

Limiting is then applied to the Back Calculated Handicap (BCHC) to ensure the performance is not an abnormal result for that competitor.

Literature (Top Yacht discussion papers) suggests that a sailor will vary their results around their average performance. The normal spread of results is within 4% of their average. Results outside of this are generally due to some abnormal event that occurred during that particular race (e.g. capsize, missed start, broken start etc). The limit of +/- 4% is being used as suggested.

Therefore, if the Back Calculated Handicap (BCHC) is outside +/- 4% of the Allocated Handicap (AHC), then the 4% limit value is used as the Clamped Back Calculated Handicap (CBCH).

As an equation this is:-

$$CBCH = \frac{1.04 \times AHC}{0.96 \times AHC} \left| \frac{HC \text{ Cor'd } T_{ref \text{ boat}}}{YS \text{ Cor'd } T} \right|$$

This limiting prevents radical fluctuations in the handicap due to one off abnormal performances.

Table 4 shows the limiting applied to the example fleet. The table shows the Allocated Handicap for the race, the +/- 4% limits from the Allocated Handicap, the Back Calculated Handicap as calculated in Table 3, and the Clamped Back Calculated Handicap that would be used for the next stage of the calculations. Boat A's CBCH is the same as the AHC for this race since it was the reference boat.

Table 4 – Clamped Back Calculated Handicap

Boat	AHC	AHC - 4%	AHC + 4%	BCHC	CBCH
A	0.957	0.919	0.995		0.957
B	1.007	0.967	1.047	1.003	1.003
C	1.012	0.972	1.052	0.873	0.972
D	1.028	0.987	1.069	0.904	0.987
E	0.957	0.919	0.995	0.995	0.995
F	0.965	0.926	1.004	0.956	0.956
G	1.103	1.059	1.147	1.115	1.115

The performance of boats C and D being well below their Allocated Handicap due to some abnormal event has resulted in the lower limit of 4% below the Allocated Handicap being set as the Clamped Back Calculated Handicap for these competitors. For the remainder of the competitors, the Clamped Back Calculated Handicap is the same as the Back Calculated Handicap as they fall within the limits.

Average Performance

Having obtained the Clamped Back Calculated Handicap (CBCH) for each competitor for each race, the handicap for each competitor for the next race is the average of their last 'N' Clamped Back Calculated Handicaps. The number of Clamped Back Calculated Handicaps used, 'N', is defined in the handicap system selected.

The literature suggests that a good value for N is 4 race weekends. This will cover a range of conditions and performances. It is not excessively long to stop the handicaps moving as results improve or decline, but not so short that there is large fluctuation in the average. For this reason, eight (8) races have been selected as the value for the number of results to be used in the averaging. This is due to the fact that we generally have two races each race day.

Therefore, the Allocated Handicap (AHC) for the next race for each competitor is the average of the last eight (8) Clamped Back Calculated Handicaps (CBCHs) for each competitor.

Until a competitor has completed eight races, the averaging uses the initial Allocated Handicap for each result short of the eight needed for the average calculation.

Returning to the example fleet, Table 5 shows the Clamped Back Calculated Handicaps obtained for each boat over 12 races. These are calculated from the results of each race using the previous calculation procedure. The reference boat for each race would be different depending on performance and therefore finishing position. A blank value for a boat in a particular race is where the boat did not compete or finish in that race. Since no result is available no Back Calculated Handicap can be generated.

Table 5 – Average Performance Handicap

Boat	Initial AHC	Race 1	Race 2	Race 3	Race 4	Race 5	Race 6	Race 7
A	1.002	0.944	0.962	0.976	0.956			
B	1.017	1.054	1.000	0.995		1.018	1.030	0.980
C	0.989	0.984	1.019		1.018			
D	1.040	1.040		1.051	1.028			
E	0.988	0.993	0.922			0.971		
F								
G						1.104	1.073	1.112

Boat	Race 8	Race 9	Race 10	Race 11	Race 12	Ave Last 8
A	0.945	0.991	0.952	0.927	0.957	0.958
B			0.973	1.008	1.003	1.001
C	1.016	1.008	1.012	1.049	0.972	1.010
D	0.998	0.995	1.070	1.005	0.987	1.022
E				0.932	0.995	0.972
F		0.970		0.931	0.956	0.963
G	1.089	1.063		1.144	1.115	1.101

In the situation of Boat A, where more than 8 CBCHs are available, the last 8 are averaged. In the case of Boat E where only 5 CBCHs are available, boat E's initial AHC of 0.988 is used for 3 results to make up the 8 CBCHs required for the average. The average of the last 8 Back Calculated Handicaps would then become the Allocated Handicap for the next race to be run.

If no result was recorded for a boat in race 12, and therefore no Back Calculated Handicap calculated, the average of the last 8 BCHs would not change. The allocated handicap to be used would not be modified from race 11 to race 12.

As the handicap is a comparison of boats in a given fleet it is only relevant to that fleet. You can't move this handicap to another club with a different fleet of boats.