

## NATIONAL HANDICAP FOR CRUISERS (NHC)

### Results Software Calculations



The following is intended to give club handicap officers and sailing secretaries etc an overview of the calculations that the approved software's use in order to score NHC races and calculate the handicap number to be used in the next race. This document can also be used by software developers that wish to add an NHC plug in to their programme (if you are a developer looking to implement an NHC plugin you are strongly encouraged to contact the RYA technical department [technical@rya.org.uk](mailto:technical@rya.org.uk))

#### **Calculating race results**

The approved software's will calculate results for any race (club or regatta) as follows:

$$C = E \times \text{NHC\#}$$

Where;

C = The corrected time to the nearest second

E = The elapsed time to the nearest second (where a boat finished/ took part in a race and has an elapsed time)

NHC# = The handicap number used in that race expressed as a Time Correction Factor (TCF)

An example is shown in the table below.

Boat Name	Elapsed Time (E )	NHC Handicap number	Corrected time	Position	Points
Boat 4	3448	0.964	3324	1	1
Boat 3	3548	0.939	3332	2	2
Boat 1	3527	0.966	3407	3	3
Boat 2	4610	0.819	3776	4	4
Boat 5	0	0.983	0	DNC	6

[NB unless specified the Racing Rules Appendix A is applied for other scoring issues such as DNC, Times may be in either seconds (as above) or in hh:mm:ss]

### Adjusting handicaps – Club Series

The adjustment calculations for a club series use known principles. For every race that a boat completes an achieved handicap is calculated. This achieved handicap is the handicap that if rescored, all boats would score equal 1<sup>st</sup>. A percentage of this achieved handicap is then applied to a boats current handicap to give the handicap to be used for the next race. If a boat has not taken part in a specific race it will receive no adjustment and it will carry forward its current handicap to the next race.

The achieved handicap for each boat in a race is calculated as follows:

The sum of the Handicaps used by all the boats that took part in the race divided by the sum of the adjustment scales from boats that took part in the race, multiplied by the individual adjustment scales of boats that took part in the race.

The adjustment scale for each boat is calculated as 100 divided by the elapsed time.

Expressed mathematically as:

$$TCFr = (\sum TCF / \sum AS) \times AS$$

Where:

TCFr = Achieved handicap

TCF=Handicap used

AS = Adjustment scale (100/E)

E= Elapsed Time

The achieved handicap is then compared to the handicap that was used for that race to establish if the boat over or under achieved their handicap. The handicap to be used in the next race is then calculated by adding a percentage of the achieved handicap and a percentage of the used handicap together to make up the handicap for the next race. This is slightly different dependant for under or over performance. It is expressed mathematically as:

For over performance;  $TCFn = (TCF \times 0.7) + (TCFr \times 0.3)$

For under performance;  $TCFn = (TCF \times 0.85) + (TCFr \times 0.15)$

Where:

TCFn = The Handicap to be used in the next race

TCF = The Handicap used in the race being analysed

TCFr = The Achieved Handicap in the race being analysed

An example is shown below:

Boat Name	Elapsed Time (E )	NHC Handicap number	Adjustment Scale	TCFr
Boat 4	3448	0.964	0.02900232	0.997
Boat 3	3548	0.939	0.028184893	0.969
Boat 1	3527	0.966	0.028352708	0.975
Boat 2	4610	0.819	0.021691974	0.746
Boat 5	0	0.983	0	0
Sum of TCF	3.688	Sum of Adjustment Scale	0.107231895	

[Individual race analysis]

Boat Name	Elapsed Time (E )	NHC Handicap number	TCFr	TCFn
Boat 4	3448	0.964	0.997	0.974
Boat 3	3548	0.939	0.969	0.948
Boat 1	3527	0.966	0.975	0.969
Boat 2	4610	0.819	0.746	0.808
Boat 5	0	0.983	0	0.983

[Calculation of handicaps to be used in the next race]

In a club series if no boat finishes a race it is disregarded for the sake of analysis and the last calculated handicap numbers still stand as being used in the next race.

At the end of a club series the numbers being used will be relatively accurate for the group of boats that have taken part in the series, however they will have “drifted” from the base numbers and in some cases this drift could be large. Accordingly any boat joining the next series with its base number will not be competitive and will either find it impossible to win or win really easily. To address this, the final TCF’s are “realigned” against the base number for each boat. The calculation for the realignment process is shown mathematically as:

$$CN = (\sum BN / \sum EH) \times EH$$

Where:

CN = The realigned club number

BN = Base number

EH = Ending handicap number from a club series.

An example is shown below;

Boat Name	Final Club Number	Base Number	Realigned <u>Club Number</u>
Boat 1	0.966	0.821	0.906
Boat 2	0.819	0.770	0.768
Boat 3	0.939	0.890	0.881
Boat 4	0.964	0.922	0.904
Boat 5	0.983	0.977	0.922

[Realignment at the end of a club series]

These realigned handicaps are then used as the starting club number in the next club series.

### Adjusting Handicaps – Regatta Series

For every race an achieved handicap is calculated exactly as for a Club series. After each race a percentage of the difference between the used and achieved handicap is applied to the used handicap to give the handicap to be used in the following race.

Because all boats start on their base number and because a regatta is a short series, all boats are treated equally for the first race and have a relatively large adjustment applied to move quickly towards corrected handicaps. This is shown mathematically as:

$$TCFn = ((TCFr - TCF) \times 0.6) + TCF$$

Where:

TCFn = The handicap to be used in the next race

TCFr = The achieved handicap

TCF = The used handicap in the race being analysed

In the second and all subsequent races the adjustments are reactive to over and under performance similar to the club series. This is shown mathematically as

$$\text{For over performance } TCFn = ((TCFr - TCF) \times 0.6) + TCF$$

$$\text{For underperformance } TCFn = ((TCFr - TCF) \times 0.5) + TCF$$

Where:

TCFn = The handicap to be used in the next race

TCFr = The achieved handicap

TCF = The used handicap in the race being analysed

Along with the race by race analysis clamping levels are applied to the adjustments to prevent the handicaps at any time drifting too far away from the base numbers. These are set so that at any time

a boats handicap cannot be greater than 110% of its base number or less than 90% of its base number.

In a regatta series if a boat does not compete or is unable to finish a race it also has its handicap adjusted to keep its handicap for the next race current with the rest of the boats. For the purpose of calculating an achieved handicap for these boats they are given an artificial elapsed time of either the corrected time equal to the average of the first three boats corrected times or the corrected time of the median boat.

For this purpose the median boat is the boat that finishes exactly in the middle of the fleet. i.e. a fleet that has 9 finishers the median boat is the boat that scored 5<sup>th</sup>. If there is no median boat the corrected time to be allocated is the average of the two median boats. i.e. in a fleet of 10 the corrected time to be allocated is the average of the corrected times for the boats that scored 5<sup>th</sup> and 6<sup>th</sup>.

This is displayed mathematically as:

For boats with the scoring abbreviations DNC/ DNS;  $EB = ((C1:C3)/3)/TCF$

For boats with the scoring abbreviations DNF;  $EB = CM/TCF$

Where:

EB = Back calculated Elapsed time

C1:C3 = Sum of corrected times for the boats placed 1<sup>st</sup> to 3<sup>rd</sup> in that race (if 3 or less boats finished the race and have a corrected time then the sum of all corrected time is used i.e. If only 2 boats finish, DNC boats get the corrected time of the average of the 2 boats that finish i.e.  $((C1+C2)/2)$ . If only 1 boat finishes the DNC boats get the corrected time of the winner.)

CM = The corrected time of the median boat

TCF = The handicap the boat would have used had they sailed in that race.

In a regatta series if no boat finishes a race it is disregarded for the sake of analysis and the last calculated handicap numbers still stand as being used in the next race.