HalSail FAQ

What is the detailed mathematical explanation of NHC?

The RYA's National Handicap scheme for Cruisers was introduced in 2013. It is a progressive handicap scheme, in the sense that it adjusts the handicap given to each boat based on the results of previous races. A boat that does well will be penalised in subsequent races and a boat that does badly will be helped. If crews perform consistently and the conditions are the same, all the boats' results converge after a number of races.

It relies on an algorithm that is built into scoring programs. This explanation refers to the May 2015 version and has been written by Peter Hopford of HAL's Race Results for the benefit of any user of the scheme.

Definitions

H_0	The base handicap for a boat (NHC base number) as published by the RYA. It is calculated from a small number of measurements such as length, beam, weight and sail area. Note that Hal's Race Results and HalSail both assume that the base handicap is the first one in the Boat Register.
H_1	The handicap given to a boat in any particular race.
T_e	The elapsed time of a boat in a race (rounded to the nearest second).
T_c	The corrected time of a boat (rounded to the nearest second). • $T_c = T_e H_1$ As in other handicap systems, the positions in a race are given in order of corrected times.
H_a	Handicap achieved by a boat in a race. • $H_a = \mathbf{\Sigma} H_1 / T_e \mathbf{\Sigma}(1/T_e)$ where **Σ** indicates the sum over all the boats finishing the race. If all boats had been given this handicap at the start they would have tied for equal first place.
H_p	The provisional handicap for the next race before realignment takes place.
μ_{tc}	The mean (average) corrected time (T_c) across all the boats in a race.
σ_{tc}	The standard deviation of T_c across all the boats in a race.
Extreme Performer	A boat whose T_c differs from the mean by more than one standard deviation. This can be either • an extremely fast performer where $T_c < \mu_{tc} - \sigma_{tc}$ • or an extremely slow performer where $T_c > \mu_{tc} + \sigma_{tc}$

α	The blend of the existing handicap H_1 and the achieved handicap H_a to be used to calculate the new provisional handicap H_p for non-extreme performers. (Set to 0.3 in NHC 2015.)
T_t	The elapsed time that would put a boat on the threshold of being an extreme performer.
H_2	The realigned handicap actually to be used in the next race.

Provisional new handicaps for non-extreme performers

The algorithm calculates the provisional handicaps for non-extreme performers as

- $H_p = (1-\alpha)H_1 + \alpha H_a$

Provisional new handicaps for extreme performers

If it used the same formula for extreme performers the change in handicap would be very large and might not reflect the boat's true potential. If, for instance, a boat were very slow because it suffered gear failure, it would be unfair on the other boats to give it a huge reduction in handicap for the next race. If a boat finished just before the wind died delaying the remaining boats, it would be unfair to give it a huge increase in handicap for the next race. So the change of handicap is limited to that the boat would have had if its corrected time were one standard deviation away from the mean.

First the algorithm works out the elapsed time for a boat that would put it on the threshold of being an extreme performer

- $T_t = (\mu_{tc} - \sigma_{tc})/H_1$ for an extremely fast performer
- $T_t = (\mu_{tc} + \sigma_{tc})/H_1$ for an extremely slow performer

Now the provisional handicaps are worked out as for non-extreme performers but substituting T_t for the elapsed time

- $H_p = (1-\alpha)H_1 + \alpha(\mathbf{\Sigma}H_1 / T_t \mathbf{\Sigma}(1/T_e))$

Provisional new handicaps for other boats

Boats that did not take part in the race, or boats that took part but did not receive a finish time, have a provisional handicap that is the same as their starting handicap in the race.

- $H_p = H_1$

A boat that joins in for the first time ever starts on its base number H_0.

Realignment to base numbers

The final step is realignment. This is done to ensure that the average handicap of a fleet does not drift away from the base numbers after many races. Realignment does not alter the relative handicaps of the boats in a fleet, it moves the whole fleet up or down together so that

- $\mathbf{\Sigma}H_2 = \mathbf{\Sigma}H_0$

Note that realignment applies to all boats, so even if a boat did not take part in a race (DNC) it will be realigned, which is likely to result in a change of handicap.

Final handicaps for the next race

- $H_2 = H_p(\mathbf{\Sigma}H_0 / \mathbf{\Sigma}H_p)$

rounded to 3 decimal places.

That is all there is to it. Simple really!