

PHRF NS

Performance Handicapping Manual

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1.0 PRINCIPLES OF HANDICAPPING

1.1 Introduction

For as long as yachts of different designs have raced together, skippers have searched for a fair method of handicapping. We will all be happier in our appreciation of handicapping if we begin by accepting the impossibility of achieving a perfect system. So many variables affect the speed of yachts that no formula can accurately predict, nor any assessment of race results accurately measure, their performance under all conditions that may arise.

Bearing in mind that good races are won by seconds, the order of accuracy we seek in a handicapping system is extreme. To be correct within ten seconds, say, in a three hour race, we would need to estimate relative speeds, and apply corrections, to an accuracy of better than 1 in 1000. In fact, we cannot hope to be better than 1 in 100, on average, and conditions in some races will inevitably cause larger errors. Hence there will always be grounds for complaint. Indeed it has been suggested that the ideal handicapping system would be one that caused every competitor to grumble equally.

The best that we can aim to do is to approximate conditions that would exist in one-design racing in average local weather, in order to provide enjoyable, albeit not completely fair racing.

There is an important principle embodied in this aim, which is often misunderstood. In one-design racing, all yachts are of the same design and thus have the same potential speed. However, they will not all be equally well maintained; their sails will not be of the same quality, and the ability of their skippers and crews will vary widely. All the major handicapping systems similarly seek to equalize the potential performance of yacht designs, but not the individual performance of each yacht and her crew. In a properly handicapped race, the best maintained and best sailed yacht should always win, as in one-design racing.

For special purposes, to encourage newcomers to internal Club racing, for example, a golf-like handicap based on an individual's performance may be desired. We shall see in Section 4.5 that simple modifications can be made to do this, but the major handicapping systems all aim to allow the best crew to win.

It is important to appreciate that handicapping involves two distinct but related steps:

1. Rating the potential speed of a yacht,
2. Correcting her elapsed time.

1.2 Rating

In principle, there are two methods of rating the potential speed of a yacht:

1. Measurement rating, according to some formula or rule,
2. Performance rating, according to the results of races.

Measurement rating was the traditional method, both for restricted class racing and for handicap racing, particularly in the ocean racing fleets. The main reason that measurement rating was favoured for most prestigious events is that rating judgment plays no part. A yacht's rating is uniquely determined by measurements that can (in theory) be taken as precisely as needed by the formula. For everyday racing, however, measurement rating has two disadvantages. First, the complexity of today's formulae demands many measurements and frequent updating, thus incurring a significant expense. Second, no formula can be fair to all possible designs, and a clever designer will be able to "beat the rule" by designing a yacht that will sail faster than the formula claims it should. Thus there is always the risk of finding oneself the owner of an obsolete yacht, despite ameliorating effect of age allowances and periodic revisions of the rule.

Although originally intended to rate all designs of yachts equitably, a measurement rule inevitably causes a particular style of yacht to evolve, as designers learn features that best exploit the rule. This is not a handicapping problem, but there is no guarantee that such development will lead to a style of yacht that is desirable except for racing under that particular rule.

Historically, there have always been one or two prestigious measurement rules in vogue, together with a wide variety of simpler local rating methods, less costly to owners. Because the simpler measurement rules have usually proved disappointing, local methods have increasingly turned to performance rating.

The first performance rating method to gain wide acceptance outside its local area of origin was the Portsmouth Number system, but with its growth came a lack of local control and delays in updating the numbers. To meet local needs in the US, with the rapid expansion of racing-cruiser designs coming on the market in the 1970s, a number of performance handicap racing Fleets (PHRF) evolved. As described in Chapter 2, the rating concept is common, but each Fleet has its own Handicap Committee, evaluating local race results and updating the handicaps periodically.

Today there are over 60 Fleets in US-PHRF, all operating independently but following agreed guidelines. The great advantage of this "federated" approach is that each Fleet has the guidance of the accumulated experience of all other Fleets. The complete listing of handicaps published annually by US-PHRF, with amendments circulated to member Fleets as they report them, is undoubtedly the most comprehensive database for keel-boat handicapping available.

It is important to appreciate, however, that PHRF is a concept rather than one specific method. In detail, each Fleet publishes its own rules and procedures, developed to suit the local racing scene. In this manual, principles followed by all Fleets are described in Section 2, and procedures are specified in Sections 3 and 4 for one particular Fleet, that of PHRF-NS.

1.3 Time Correction

There are two ways of applying ratings to the elapsed time of a yacht to obtain her corrected time:

- 1 **Time-on-time correction**, using "time correction factors",
- 2 **Time-on-distance correction**, using "time allowances".

These are fundamentally different and will not yield the same corrected times (unless the scratch yacht happens to sail the race at one particular speed). Either can be applied to any method of rating but most systems present us with either a time allowance (TA) or a time correction factor (TCF), suggesting that the rating method is tied to one or the other.

In the case of PHRF, $TA = Rating$, because the ratings are stated directly as time allowances in seconds per mile. They are, nevertheless, ratings and there is no reason why a corresponding TCF cannot be used for time-on-time correction in PHRF.

Time-on-time correction is the easier of the two to apply. We simply multiply the elapsed time of each yacht by its TCF to obtain the corrected time. Time-on-distance correction requires us to know the length of the course sailed. We first multiply the TA for each yacht by the course length in nautical miles, and then subtract the resulting total allowance from each yacht's elapsed time to obtain the corrected time.

This dependence on course length introduces an additional source of error in the time-on-distance method. Course length and actual distance sailed through the water will differ significantly, depending on the proportion of windward legs and on currents in tidal waters.

Controversy abounds as to which is the more accurate method of time correction, and will continue to do so, because the real answer is that neither of them is accurate, except under the very special set of circumstances when both produce the same result. Clubs and regatta officials are encouraged to experiment with both methods - and perhaps with combinations of the two - to determine which best suits the type of races they run and the prevailing local conditions. There is no need to follow tradition slavishly.

2.0 PERFORMANCE HANDICAP RACING FLEETS (PHRF)

2.1 Background

PHRF is a loosely federated system of regional organizations, each of which has its own constitution, regulations and procedures, but all working within the same principles and guidelines. A Committee of the United States Sailing Association (USSA), referred to as US-PHRF, lays down these guidelines but otherwise serves only as a promotional centre of communications, not as a decision-making body. Each regional organization, referred to as a "Fleet", has its own Handicap Committee responsible for establishing the handicaps used in its region. Hence there can be significant differences in PHRF ratings from Fleet to Fleet. The following sections describe the common principles and guidelines followed by all PHRF Fleets. Further details on US Sailing PHRF should be sought from the US Sailing Association, PO Box 1260, 15 Maritime Drive, Portsmouth, RI 02871-0907 (401) 683-0800. An annual list of PHRF handicaps covering all Fleets is available for purchase at that address.

PHRF NS is a contributing member of US-PHRF.

2.2 US PHRF Committee

The United States Performance Handicap Racing Fleet Committee (USPHRF) is a technical rule committee of US SAILING that promotes performance handicap racing for monohull and multihull sailing yachts applying the PHRF® rule. The Committee researches, develops, and distributes guidelines for performance handicapping using systematically applied empirical methodology to determine estimates of speed potential. The Committee maintains a database of critical dimensions for production boats and a database of handicaps assigned by local and regional fleets associated with USPHRF. It publishes these data, periodic bulletins, and handicapping guidelines that are mailed to member fleets associated with US SAILING. Three subcommittees have special tasks. The Executive Subcommittee deals with management and evaluates application of the rule. The Technical Subcommittee updates the procedures and methodology for performance handicapping. The National Appeal Subcommittee hears appeals of handicaps forwarded from associated local and regional fleets.

www.ussailing.org/phrf

2.3 Principles of Performance Rating

PHRF ratings are yacht performance handicaps. They are based on the speed potential of the yacht, determined as far as possible on observations of previous racing experience.

It is the intent of PHRF handicapping that any well equipped, well maintained, and well sailed yacht has a good chance of winning, and that any boat that wins a race is indeed well- equipped, well-maintained, and well-sailed. Handicaps are adjusted as needed on the basis of the yacht's performance so that each equally well sailed yacht has an equal opportunity to win. This is fundamental.

PHRF ratings are not intended to reflect skippers' and crews' capability. Ratings are not adjusted to encourage an inexperienced or careless skipper, and conversely, no rating adjustment is made to penalize proficiency and preparation. Intensity of competition and the influx of new and aggressive sailors require each skipper to maintain consistently high performance in order to place well.

Doing well in a race, therefore, requires the exercise of skill, ability, and teamwork. Consistently poor performance, sloppy maintenance, or deliberately holding back will not result in a more favorable handicap. Conversely, if a skipper and crew sail the boat well and consistently place high, this will not, by itself, lead to a handicap that is less favorable than that of the actual performance potential of the boat. Assuring that the handicap is based on the performance potential of the boat, rather than sailing skill, is an important factor in preserving high morale and wholesome competition within the Fleet.

Well-designed and well-constructed yachts will not be made obsolete by newer designs under PHRF. As faster designs appear, they are handicapped accordingly. One of the major attractions of the PHRF system is that older yachts can race competitively with the latest designs.

PHRF discourages "rule beating". If a skipper modifies his yacht, PHRF will attempt to compensate for the new potential speed. The use of taller masts, longer spinnaker poles, extra ballast, gutted interiors or other modifications intended to increase speed will be taken into account by the rating assigned.

PHRF assumes that a yacht is equipped and tuned to race. It does not attempt to rate a yacht which differs from others in its class in that it is out of balance, has old sails, or has unusual windage (as from a dinghy on davits). However, if the basic hull and rig differ from others in its class, it will, of course be rated uniquely.

Because headsail size has so much influence on speed, PHRF uses this factor to adjust handicaps. Yachts are rated for having large or small headsails, an LP of 153 %J being the dividing line in most Fleets. Once a yacht is rated with a large headsail, this rating must be used, even though wind conditions may preclude use of the sail. A skipper is not allowed to have his yacht re-rated frequently by choosing a headsail to suit race conditions.

2.4 PHRF Base Ratings

PHRF ratings are expressed directly as time-on-distance allowances measured in seconds per nautical mile, to be deducted from elapsed times to produce corrected times. A higher PHRF rating indicates a slower boat.

Most Fleets in North America recognize 6 sec/mile as the smallest increment of time-on-distance performance that can be assessed reliably, but use increments of 3 sec/mile in making adjustments for minor changes of equipment and sail size.

The "base ratings" which appear in nationally published lists apply to yachts for which the following "standard configuration" applies:

- (1) The spinnaker pole/whisker pole length is equal to "J"
- (2) The spinnaker maximum width is equal to 180% of "J"
- (3) The spinnaker maximum length is equal to .95 times the square root of ("I" squared + "J" squared)
- (4) The genoa "LP" maximum is equal to 150% of "J"
- (5) The yacht is in racing condition
- (6) The yacht has a folding or feathering propeller, a two bladed fixed propeller in an aperture, or a retractable outboard motor.
- (7) Hull and appendages are unmodified.

Adjustments made for deviations from standard configuration vary from Fleet to Fleet, because they are based on local racing experience. Each Fleet publishes its own list of adjustments.

2.5 Non-Spinnaker Rating

At the outset it is important to remember that each NSYA boat will be assigned only one Race Rating. That rating will be based on the boat's full declared inventory, including any declared spinnakers, and will be used during NSYA open regattas

If any boat wishes to enter a regatta using a Non-Spinnaker Rating (Non-Spinnaker Rating = Race Rating plus the applicable adjustment as shown in the summary table in Section 3.11) in place of a Race Rating that boat must enter the regatta in a Non-Spinnaker class assuming that the Race Committee has made provision for a Non-Spinnaker class. In the event the regatta does not have a Non-Spinnaker class the boat must then enter the regatta using its Race Rating unless the Race Committee, at its sole discretion, allows the boat to enter a Mixed Class using its Non Spinnaker rating. Owners who wish to pursue this possibility should contact the Race Committee well in advance to request approval. Approval of such requests is at the sole discretion of the race committee.

Race Committees are encouraged to approve Non-Spinnaker rating adjustment applications to race in a Non-Spinnaker class or in a Mixed Class. Race Committees are also encouraged to specify that any assigned rating will apply for the duration of the regatta and must be requested prior to the start of the regatta.

3.0 PHRF-NS FLEET PROCEDURES

3.1 PHRF NS Handicap Committee

The PHRF NS Handicap Committee is governed by the Board of Directors of the Nova Scotia Yachting Association (NSYA). The Chairman of the PHRF NS Handicap Committee is a member of the NSYA Board and is appointed by the NSYA Board on an annual basis.

The members of the PHRF-NS Handicap Committee are selected by the member clubs of the NSYA. Each member club is entitled to appoint one member (one vote) to the PHRF NS Handicap Committee. Each member club follows its internal procedures to select its representative.

3.2 NSYA Yacht Database

The Nova Scotia Yachting Association maintains a database of all PHRF rated boats in Nova Scotia. The PHRF NS Handicap Committee administers the content of the database. See Section 3.4 for more information on the NSYA Yacht Database.

3.3 PHRF NS Rating request

NSYA will accept yacht data that is submitted on paper using the PHRF NS Yacht Data Sheet found on the web at www.nsyans.ca. Additionally, PHRF NS will accept data that is submitted through the web using the online yacht data entry tool found on the same web site.

3.4 PHRF NS Base Ratings

Section 2 identified the basic principles for establishing the base rating for a yacht or class that is new to the Fleet. This Section will build on those principles and describe the tools, process, and guidelines that the PHRF NS Handicap Committee uses when dealing with base ratings.

To establish an initial base rating, when considering changing a base rating, and when addressing any written appeals of a base rating, the PHRF NS Handicap Committee will consider the following data, publications, and information:

- Results from races deemed suitable for handicapping by the local Race Committee or the local Club Handicapper
- Declared inventory as presented by the owner.
- Any change to the “measurements” of the yacht
- Established PHRF NS ratings for similar yachts.
- Skipper Effect
- Published measurement and performance data for similar yachts;
 - US Sailing, PHRF Handicaps
 - US Sailing, PHRF Rig Dimensions
 - US Sailing, IMS Master File
 - US Sailing, Performance Characteristics Profiles for the North American IMS Fleet.
- Critical comparison to similar sized and type boats with existing PHRF NS rating

3.4.1 Suitable Race Results

Race results will be reviewed giving careful consideration to the following:

- Wind conditions.
 - Was the wind reasonably steady?
 - Did all yachts sail in similar wind conditions?
- Suitability of the course.
 - Was there a reasonable mix of up-wind, down-wind, and off-wind legs?
- Were there enough yachts in the race to make the results statistically relevant?
- Was the yacht in racing condition?
- Was there sufficient and competent crew on board?
- Was the handicap spread across the Fleet within reasonable limits?
- How does the spread in corrected times compare with what one would expect from a “one design” fleet of the same size?

3.4.2 Declared Inventory

The NSYA Yacht Database will be reviewed to examine the declared inventory for the subject yacht.

- Is the yacht as-built or modified?
- If the yacht has been modified, what modifications have been declared?
- What are the declared sizes of the various sails carried on the yacht?.

Yacht owners are encouraged to visit the NSYA web site to verify that the data entry for their yacht is correct. Any discrepancies should be promptly reported to NSYA at nsya@sportnovascotia.ca

3.4.3 Measurement Change

It is the intention of the PHRF-NS Handicap Committee to handicap boats using the yacht's as-built configuration as a reference. The Handicap Committee will adjust the handicaps of boats that have been altered from their as-built configuration to completely compensate for any expected speed change, either positive or negative. Yacht owners are responsible to promptly report any measurement and sail inventory changes to the Handicap Committee.

As a minimum, the following changes shall be reported:

- Spinnaker/whisker pole length greater than J
- Spinnaker width (SMG) greater than 1.8 times J
- Spinnaker height greater than .95 times the square root of (I squared plus J squared).
- Rig height (I) changes
- Boom length (E) changes
- Rig cross section/weight changes
- Rig staying changes
- Sail measurement changes (P, E, SMW, SL, and LP)
- Keel/ballast weight changes
- Keel/rudder camber changes
- Keel/rudder chord changes
- Keel/rudder depth changes
- Propeller type/size/blade count/location changes
- Hull canoe body changes
- Changes to internal ballast

- Interior modifications including but not limited to the removal of significant fixed component(s), i.e. inboard engine, galley range, refrigeration unit, marine head, inside panels or floors, safety equipment, etc.
- Bow thrusters
- In-mast furling

3.4.4 Similar PHRF-NS Yachts

The existing PHRF NS Fleet will be examined to determine if there is an identical or similar yacht that has already been assigned a handicap.

3.4.5 Published Data for Similar Yachts.

The PHRF NS Handicap Committee has access to several authoritative publications that address the relative potential speed of various yachts (see Section 3.4). Some, like the annual US Sailing PHRF Handicaps book, are based on the assessment of various member fleet handicapping committees throughout north America. Others present empirical measurement data and may also present an associated time on distance handicap number (seconds/mile). The PHRF NS Handicap Committee will periodically review the available publications and services, and will update its library as required.

3.5 The Ethics of Reporting Changes

Assigning performance handicaps to racing yachts based on owners' declarations of configuration and inventory is strongly rooted in the premise that yacht owners are gentlemen and ladies of character.

The PHRF NS Handicap Committee will assign a handicap based, in part, on the declared inventory and configuration of the yacht. Unless the Committee is advised to the contrary, it will assume that the yacht is configured as it came from the factory. While it is not the intention of the PHRF NS Handicap Committee to discourage yacht owners from making performance enhancing changes to their yachts, the Committee does expect that owners will promptly and accurately report any such changes to PHRF NS at nsya@sportnovascotia.ca

Common sense and reason must be applied when determining what constitutes a change that should be reported. Upgrading your rope clutches or relocating your genoa tracks will be considered "tuning". Changing the aspect ratio of your keel or replacing your rig with carbon fibre will be considered "modifications". If you are in doubt then report the change to your club handicapper or the PHRF NS Handicap Committee.

The PHRF NS Handicap Committee is not responsible to examine the Fleet looking for unreported modifications or undeclared inventory. Its role is to act as an impartial body for the purpose of assessing and quantifying the impact of any reported change on the potential performance of the yacht. In the event that a competitor suspects that a competing yacht has undeclared inventory, or that the yacht has been modified, it is up to that competitor to protest the offending yacht under the applicable Sailing Instructions.

3.6 Rating Reviews

The PHRF NS guideline for determining if a yacht's handicap should be reviewed. It is important to note that exceeding the threshold only triggers a review; it does not necessarily mean that the handicap should be adjusted. The review will give full consideration to the items identified in Section 3.4.

When contemplating a rating change the Committee will give consideration to the "Skipper//Crew Effect" as described in Section 3.7. The Committee will also make an effort to eliminate any distortion of the data that may be generated by exceptional results. For greater clarity; if a yacht demonstrates extraordinary performance in a regatta or series of races, those results will be examined in the context of the yacht's recent performance over a large number of races. Exceptions abound in yacht racing, but consistency is the essence of sound handicapping.

When changing established ratings, the Committee will generally not exceed 6 sec/mile at any one time. Some lag in reaching a proper figure is better than the oscillations that can result from trying to precisely match current performance. Of course this normal limit does not apply to Provisional ratings that should be brought into line regardless of the amount of change needed.

3.7 The Skipper/Crew Effect

When considering changing the handicap of a yacht type based on recorded performance, careful consideration to the Skipper/Crew Effect will be given.

A major problem in all performance handicapping is separating differences due to the true speed potential of yacht designs from those resulting from the skill of skippers and crews. When a Fleet has only one or two yachts of a particular type, judgement becomes especially difficult.

We can gain a good idea of the size of the skipper/crew effect from typical results of one-design races. Analyses reported by US-PHRF suggest that the average results of a 10-yacht race are distributed with the winner sailing about 15 sec/mile faster than middle finishers, the last yacht similarly slower. If the class includes a champion of national status, s/he can be expected to sail about 25 sec/mile faster than middle finishers. These figures vary with the number of starters. With 5 yachts a difference of 10 sec/mile, and with 15 yachts 20 sec/mile, would be typical for the winner. The extra skill of a champion is likely to show less change; he will sail more consistently 10-15 sec/mile faster than the typical club winner.

We should expect to see variations like these among yachts properly handicapped for speed potential. If we try to "straighten the line", as application of a constant threshold would do, we will be handicapping winning skippers unduly and giving the rear-guard an unwarranted boost.

Clearly, these numbers are only representative; particular race conditions can produce wide variations in the skipper effect. No simple rule can be suggested, but the PHRF NS Handicap Committee will guard against rating revisions that would compress corrected times more closely than the spread of times to be expected in one-design racing.

3.8 Provisional Ratings

When assigning an initial rating to a type of yacht new to the Fleet, the initial rating will be clearly identified as "provisional", to be reviewed as soon as valid race results provide significant evidence. The rating will remain provisional until the committee is satisfied that the yacht has reached its potential or that the potential of the yacht is clearly understood. The NSYA Handicap Committee will carefully review a provisional rating after 10 valid races have been recorded.

3.9 Rating Appeals

The Committee will only consider written appeals.

Appeals may be of two kinds:

- 1/ An owner may appeal the handicap assigned to their yacht
- 2/ An owner may appeal the handicap assigned to a competitor's yacht.

The appellant should work with their club handicapper in an effort to resolve the issue without involving the NSYA Handicap Committee. If the issue cannot be resolved at the club level, then the appellant must submit their appeal to the PHRF NS Handicap Committee using the prescribed form found on the NSYA web site (see Attachment 2). All information requested by the form must be provided before the appeal will be heard. The Handicap Committee will provide a decision on any rating appeal within 60 days of the appeal being received.

A fee of \$50.00 will be charged for each appeal. If the appeal is granted then the appellant will receive a refund of \$50.00. If the appeal is denied then NSYA will donate the \$50.00 appeal fee to the junior sailing program of the appellant's yacht club.

Challenges to rating facts, as opposed to rating assignments, should be handled by protests under the Sailing Instructions. For example, if a yacht is suspected of sailing with a headsail larger than she has declared, another competitor should protest. Presumably, the Race or Protest Committee would immediately call for the sail to be measured. The facts found in such protests should be reported to the Handicap Committee.

3.10 Sail Measurement

In most Fleets, measurement is only required as a result of a protest, but voluntary measurement can sometimes prevent potential arguments and is simple to do.

An official measurer is not needed and an accuracy of an inch will suffice. The following notes cover likely rig measurements.

The definitions and rules presented in ISAF Equipment Rules of Sailing for 2009 - 2012 shall be used to determine sail areas.

3.10.1 Definitions:

The following definitions are provided as a general guide only. **Where a conflict exists between the definitions presented in this manual and those presented in the ISAF Equipment Rules of Sailing for 2009 - 2012, the definitions presentess in the ISAF publication shall apply.**

"I". The Foretriangle height measured along the foreside of the mast from the main deck "datum" to the top of the jib halyard sheave.
NOTE: The height of the deck used as datum for "I" shall be taken as 4% of beam above the shear line abreast of the mast. For flush deck boats i.e. TANZER 22-26, CAL 28 and MORG 27 whose cabin extends athwartships to the shear line, use the stripe along the hull which represents the shear line.

"H". Same as "I" but measured to top of spinnaker sheave, if same as "I" this measurement is not necessary.

"J". Distance is measured from the foreside of the mast to the point where forestay attaches to deck or bowsprit, in a direction level with the waterline.

"P". Luff length of mainsail from tack to head.

"E". Foot length of mainsail along boom from tack to clew of sail. In the event the clew of the mainsail is carried below the top of the boom where it intersects the mast (Boom Droop), measure the "E" along the slope of the mainsail.

"MGM." Mainsail Mid-Girth Measurement, the points of measurement are determined:

1. By folding the head of the sail to the tack and marking the midpoint of the Luff.
2. By folding the head of the sail to the clew and marking the midpoint of the Leach.

"MGM" is the measured distance between the Luff and Leach marks.

"MGU." Mainsail Upper-Girth Measurement, the points of measurement are determined by folding the head of the sail to the Mid-Girth measurement points and marking the three-quarter points for the Luff and Leach. "MGU" is the measured distance between the resulting Luff and Leach marks.

"HB." Headboard. Measure the maximum fore and aft dimension from the Luff of the mainsail to the aft edge of the Leach at the widest part of the Headboard.

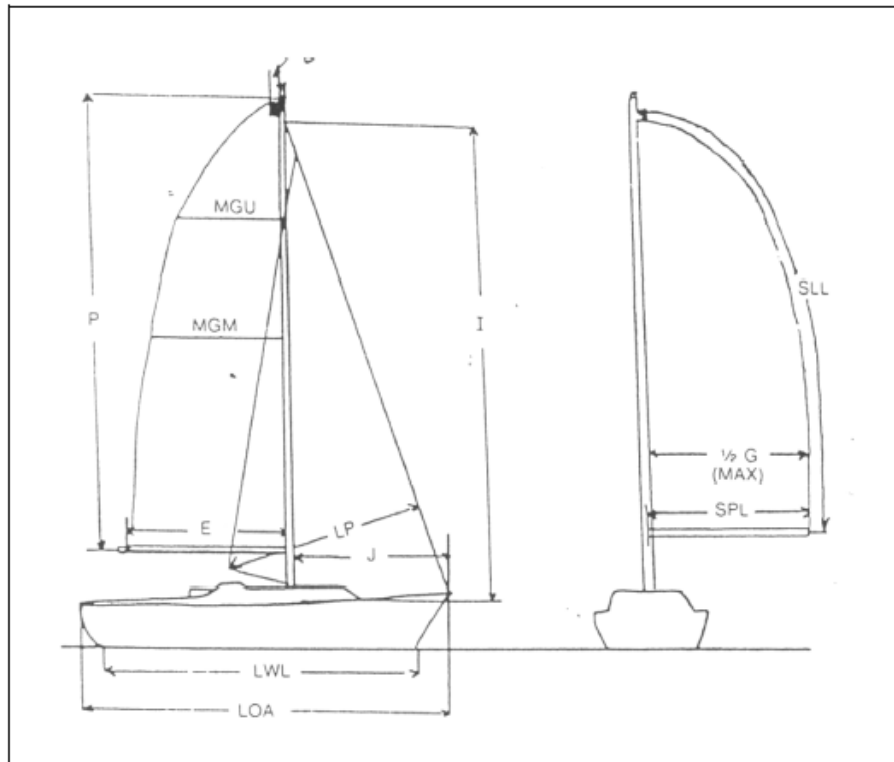
"LP." LP is the distance from the clew of the jib to the luff line of the jib in a direction to cross the luff at 90°. If in doubt about clew location, project the leach and foot to the point of intersection.

"LLJ." Luff Length Jib is the measurement from the Tack to the Head of the Jib. If in doubt about the Tack and Head location, project the Luff, Foot or Leach to the point of intersection.

"LLS." Luff Length Spinnaker is the greatest length of Spinnaker Luff and Leach measured around the edges of the sail.

"G." Is the Girth of the spinnaker. This is the maximum width of the spinnaker measured from Luff to Luff with the spinnaker stretched flat; measured parallel to the Foot. (Same as SMW in IOR)

"SPL." Spinnaker/whisker Pole Length. The length of the Spinnaker/whisker Pole, when in its fitting on the mast, and set in a horizontal position athwartship, measured from the centre line of the yacht to the extreme outboard end of the pole and fittings used when the Spinnaker is set.



NOTE: Greater detail on the rules associated with equipment measurement can be found in the ISAF publication entitled “Equipment Rules of Sailing for 2005 - 2008”. Those rules can be found by following the link below:

<http://www.sailing.org/technical/ERS2005-2008.pdf>

Figure 3

3.11 Adjustments

3.11.1 Recreational Adjustment

This adjustment only applies to boats with a limited sail inventory as described below:

+6

- above deck jib roller furling,
- no laminate sails/ woven material only (e.g.dacron) sails only,
- no exotic sail materials (such as kevlar, spectra, technora, etc.).

- a maximum of:
 - One nylon spinnaker
 - One jib with $L_p > 110\%$
 - One jib with $L_p \leq 110\%$
 - One mainsail

Working roller furling with sail attached to swivel and above deck drum is required. If the drum is below deck, the credit will be halved. The roller furling headsail is not to be disconnected from the swivel above the drum. Boats that come with

built in roller furling are not eligible for this credit. In cases where the intent of this adjustment is not honored, the credit will be denied. The credit may also be reduced on performance boats to 3 seconds per mile. Special racing roller furling sails are not allowed. As a rule of thumb, the foot skirt should not exceed 3 percent of the foot length in depth. If the boat is cutter rigged, the staysail must also be roller furling and be capable of being used upwind.

This same credit applies to boats racing without a spinnaker provided they declare and use sails as described above.

Since all modifications cannot possibly be anticipated, other changes will be considered on a case by case basis. Obvious attempts to take advantage of perceived loopholes may result in loss of credit

3.11.2 Mainsail Luff Roller Furling

With no battens or no positive roach	+6
With battens and/or a positive roach	+3

3.11.3 Asymmetrical Spinnaker

If part of standard boat configuration	0
If only spinnaker on boat and flown from bow without pole or sprit. If the spinnaker is tacked to the bow, you must put "None" in the spinnaker pole length box on the application. This credit is lost if the spinnaker is used with a pole.	+9
If sprit added to conventional boat	+9 minus 3 per 10% J or fraction increase

SL = average of SLU and SLE (Does not apply to boats where this spinnaker is standard.

Maximum width = 1.8 x JC (Does not apply to boats where this spinnaker is standard. Sport boats are handicapped with the largest class spinnaker.

Minimum mid girth, mid leech to closest luff point = .75 x max width

Boats that have an asymmetric spinnaker as standard will be handicapped in the class configuration. Variations from the class standard will have a handicap adjustment. In general, the credits are intended to assist true cruising boats.

For some day-boats the base configuration assumes an asymmetric tacked to the bow. These boats will not get additional credit.

Attempts by race boats to exploit these provisions may result in reduction or denial of the credit.

3.11.4 Schedule of Adjustments for Other Than IB or OB

If the base rating for the boat includes an outboard and that outboard is removed from the boat the adjustment will be -6

If the base rating for the boat includes an inboard and the inboard is removed from the boat the adjustment will be -12.

If the base rating for the boat includes an outboard and that outboard is replaced with an inboard the adjustment will be +6

If the base rating for the boat includes an inboard and that inboard is replaced with an outboard the adjustment will be -6

3.11.5 Rig Related Adjustments

A. Rig Height Adjustment (Both I and P increased)

0.5% to 3%	-3
3.01% to 5%	-6
5.01% to 7%	-9
7.01% to 9%	-12
9.01% to 11%	-15
11.01% to 13%	-18
13.01% to 15%	-21

B. Boom Length Adjustment

0.5% to 10%	-3
10.01% to 20%	-6

C. Reduction in rig measurements

It is not intended to give credit for minor reductions in sail area. Therefore a credit will be not assigned unless a significant reduction is made. An example would be that you would have to reduce the boom length (mainsail foot) by at least 5% to get a credit.

D. Carbon Rig Adjustment

In cases where the base boat has an aluminum mast, changing to a carbon mast will result in a handicap charge of between 3 and 6 seconds per mile, depending on the relative section of the aluminum mast. The Committee will review any adjustment associated with changing to a carbon boom on a case-by –case basis.

E. Exotic Standing Rigging Adjustment

A boat with shrouds and/or headstay made of something other than wire or stainless steel rod, such as PBO, will normally incur a handicap adjustment unless all boats of that class have such rigging. Backstays are excluded from this adjustment. This will be considered on a case by case basis.

3.11.6 Notice of Change of Inventory

Owners may declare a change in inventory by advising NSYA in writing, through an email, or preferably by using the NSYA Data Sheet available on the NSYA web site. An owner may change his declared inventory no more than once a year, and never during a regatta or race week. Any change in rating arising from a declared change in inventory will only take effect seven (7) days after NSYA receives the notice of change.

NSYA ASPN – PHRF Handicap Adjustments	
	Adjustment
1. Oversized headsail, over 170% J	-9
2. Oversized headsail, up to and including 170% J (Note 1)	-6
3. Standard headsail, up to and including 155% J (Note 1)	0
4. Undersized headsail, up to and including 110% J; fractional rig (Note 1)	+6
5. Undersized headsail, up to and including 110% J; masthead rig (Note 1)	+12
6. Masthead yachts with no spinnaker declared or in a non-spinnaker class with the largest declared headsail having an LP > 110% and an LP 135% or less will be assigned a 6 sec/mile LP adjustment	+6
7. Mainsail exceeds IMS MGUL or MGML by up to 20%	-6
8. Mainsail exceeds IMS MGUL or MGML by up to 40%	-12
9. Mainsail exceeds IMS MGUL or MGML by 40% or more	-18
10. Mainsail exceeds one design class rule MGUL or MGML by up to 20%	-6
11. Mainsail exceeds one design class rule MGUL or MGML by up to 40%	-12
12. Mainsail exceeds one design class rule MGUL or MGML by 40% or more	-18
13. Oversized spinnaker, 201% J and over	-12
14. Oversized spinnaker, up to and including 200% J	-6
15. Standard spinnaker, up to and including 180% J	0
16. No spinnaker, fractional rig	+12
17. No spinnaker, mast-head rig	+18
18. If $0.5 * (\text{luff length} + \text{leach length}) > 0.95 * \sqrt{(I^2 + J^2)}$ there is a penalty of + 2 points for each 5% excess or part thereof. Note: Sprit boats will be handicapped in the configuration declared by the owner.	-6 (for each 5%)
19. Standard boat includes a spinnaker pole with an overall length = J. Poles longer than J will be subject to penalty as per 20. JSP=Spin Pole length. If JSP exceeds J and/or SMW (Spinnaker Max Width) exceeds 1.8*J then the penalty is -6 sec/mile for every 10% excess or fraction thereof.	-6 for each 10%
20. Asymmetric spinnaker if only spin on boat and if flown from bow	+9
21. Add sprit to conventional boat	+9 minus 3 per 10% J or fraction increase
22. Inboard engine in an outboard class	+6
23. 2 bladed fixed prop on an exposed shaft.	+6
24. 3 bladed fixed prop on an exposed shaft.	+12
25. 2 bladed fixed prop in aperture	0
26. Remove outboard	-6
27. Remove inboard	-12
28. Replace outboard with inboard	+6

29. Replace inboard with outboard	-6
30. 3 bladed fixed prop in aperture	+6
31. Recreational Adjustment (see 3.11.1)	+6

3.12 Calculating and Analysing Median Back Calculated Rating (MBCR)

The PHRF NS Handicap Committee will use the performance of the median boat as a reference for determining the relative performance of boats in a race. The process is based on the assumption that the median boat sails to its rating. Boats finishing with a corrected time less than that of the median boat will be deemed to have sailed faster than their rating, and boats finishing with a corrected time greater than the median boat will be deemed to have sailed slower than their rating.

The rating in sec/mile that each boat in the race would have required in order to finish with the same corrected time as the median boat will be calculated

First, we need to pick out the “median corrected time”. This is the corrected time of the yacht finishing in the middle of the fleet when ordered by corrected times. With an even number of finishers, we pick the first of the middle two finishers. For example, in races with 9 or 10 finishers, the yacht finishing 5th on corrected time would have the median corrected time.

The Median Back Corrected Rating (MBCR) of the median boat will be equal to its assigned rating in sec/mile.

The MBCR of those boats with a corrected time less than that of the median boat will be smaller (less sec/mile) than their PHRF NS rating.

The MBCR of those boats with a corrected time greater than that of the median boat will be larger (more sec/mile) than their PHRF NS rating.

The difference between a boat’s PHRF NS rating and its MBCR will be one measure of its relative performance. These rating differences will be brought to the meetings of the PHRF NS Handicap Committee.

3.13 Scoring races using PHRF

NSYA yacht clubs are encouraged to ease the burden of scoring races by using suitable scoring software such as Sailwave www.sailwave.com

3.14 PHRF NS Handicap Committee

Because of the need for judgement in deciding which race results are valid for handicap assessment, the active and regular participation of individual Clubs is most important. Each NSYA yacht club appoints one member to the PHRF NS Handicap Committee, but Clubs are asked to name alternative members. Both the Handicappers and their deputies are encouraged to attend all meetings so that continuity of Club participation is assured.

Most Committee discussions eventually reach a consensus but if a vote is needed, each Club has one vote and the Chairman may cast a deciding vote. The NSYA Executive Director acts as secretary of the Committee, his attendance facilitating the prompt updating of the NSYA Yacht Database at www.nsy.ns.ca.

During the first meeting of each year, normally held in January, a firm schedule of meeting dates is agreed to, so that Clubs can plan their attendance well in advance. Meeting dates are chosen to allow the committee to address current issues, to assign handicaps to new yachts, and to review race results. The total number of meetings to be held during a given year will vary depending on the agenda that the Committee establishes for itself. At a minimum five meetings will be held; two meetings during the winter months to address procedural issues, two meetings during the racing season to review race results, and one annual review.

To encourage attendance by Clubs outside the Halifax-Dartmouth area, the NSYA is prepared to cover travel expenses for Clubs more than 25 km away from the Club hosting a meeting. AYC, BBYC, DYC, RNSYS, SMSC, and SYC are regular hosts. One meeting a year is usually held at a South Shore club.

3.15 PHRF Revision Process

Club Handicappers bring to meetings MBCRs calculated for all valid races held since the previous meeting. When a significant difference between a boat's MBCR and its PHRF rating is consistently maintained over several races by the best performing yacht of a class, a PHRF rating revision is discussed for that class (or type) of yacht.

A "significant difference" is usually taken to be 12 sec/mile averaged over at least 3 races, and after making allowance for Skipper/Crew Effect.

When averaging MBCRs over 3 races, say, the mean can be unduly biased by a single extraordinary result. Such results should be excluded from the average and discussed separately; they probably result from some chance event. Only the yacht with the fastest MBCR in a particular class need be considered; it is the best performing yacht that establishes the speed potential of the design.

An inevitable shortcoming of performance handicapping is the implicit assumption that the best performing yachts in each class have reached a comparable level of tuning and skill. Obviously this is not true, particularly when there is only one yacht in a class, which may well be owned by a novice. Despite allowances for the skipper effect and other judgements based on the Committee's knowledge of the people and yachts involved, a tendency to favour the inexperienced owner of a one-off yacht will remain. This is, however, in the right direction for encouraging fun and enjoyment.

Only in exceptional circumstances will a revision of more than 6 sec/mile be decided on the basis of one set of race results. If it is, the evidence supporting this special revision is recorded in the minutes. Reasons for revisions of one point are minuted only if the evidence comes from a source other than local race results, or if that revision takes the yacht type more than 3 points away from the PHRF mean. Provisional handicaps are excepted.

This caution against movements larger than one point may cause temporary frustration. However, experience shows this to be less disruptive than the oscillations that can result from reacting too precisely to short-term trends.

If a Club Handicapper happens to be the owner of a yacht in a class being discussed by the committee, s/he excludes themselves from that discussion, unless asked for specific evidence by the Chairman.

3.16 Provisional and Inactive ratings

When the Committee first assigns a rating to a new class of yacht, that rating is designated "Provisional" in the database. This indicates that the Committee has not yet established the performance of that class relative to other classes in the Fleet, and serves as an indicator that the number may be inaccurate.

Since any Race Committee has the right to refuse entry to any yacht, it may be superfluous to point out that a Club need not accept yachts with Provisional ratings for open regattas. The Handicap Committee would prefer to see Clubs

accept them, unless a prestigious trophy is at stake, simply because regattas afford the best opportunity for good performance data. What is important, however, is that each Club determines what its policy will be, and publishes a clear statement in the Notice of Race. A similar policy statement should be made regarding yachts not registered in the NSYA Yacht Database.

The normal practice of limiting revisions to one point at a time does not apply to Provisional ratings. The Committee simply does its best to bring the rating in line whenever race results become available, and the "Provisional" notation is not removed until the Committee is satisfied with the extent of the data on which the rating is based.

At the last meeting of each year, classes that sailed fewer than three races during the season are transferred to an "inactive" list. All inactive ratings are checked against PHRF data, and any class rated more than 12 sec/mile away from the PHRF mean for that type are either revised or the reason for not doing so is minuted, to explain the discrepancy.

Inactive ratings are treated the same way as Provisional ratings. When the Committee learns that an inactive yacht has started to race regularly, its rating will be designated as Provisional, to be reviewed as soon as results become available.

3.17 NSYA Yacht Database

All revisions made by the PHRF NS Handicap Committee are entered into the NSYA Yacht Database. The database is available to all by following the links on the NSYA web site at www.nsyans.ca. Yacht owners, the NSYA Handicap Committee, and the NSYA Executive Director, work together to keep the database current.

Once a boat is rated and entered into the system a certificate is automatically generated and e-mailed to the owner.

Attachments

- 1/ Crew Sizes
- 2/ Handicap Appeal Form
- 3/ Skipper Effect
- 4/ PHRF – ToT Conversion Table

Attachment 1 Crew Sizes

PRHR NS has no desire to limit the number of crew sailing on any yacht. However, Race Committees of prestigious events should be aware that the relative performance handicap numbers provided in this manual have been derived from the results of races sailed with normal crew sizes. They may wish to control the possibility of a yacht gaining unfair stability by embarking abnormal "movable ballast". For their guidance only, when writing an appropriate Sailing Instruction, the following table suggests the maximum crew size considered applicable to these performance handicap numbers based on 160 lb adults.

LOA, feet	Max crew		LOA, feet	Max crew
Below 20	4		39, 39	11
20, 21, 22	5		40, 41	12
23, 24, 25	6		42, 43	13
26, 27, 28	7		44, 45	14
29, 30, 31	8		46, 47	15
32, 33, 34	9		48, 49	16
35, 36, 37	10		50 and up	17

Attachment 2 Handicap Appeal form (see following pages)

PHRF NS Rating Appeal Form

Appellant's name

Appellant's Street Address

Appellant's City/Town, Postal Code

Appellants Telephone Number

Appellant's Email Address

Appellants Signature

Club Handicapper' Signature

The above signature attests and acknowledges that the relevant sections of the PHRF NS Handicapping Manual have been read and understood, the appellants boat has not been modified since the date the handicap under appeal was last assigned, and that the appellant agrees to abide by the decision of the hearing committee for a period of no less than two years from the date of decision.

<i>Yacht Handicap Data</i>	
<i>Yacht name</i>	
<i>Type/Class</i>	
<i>Manufacturer and hull date</i>	
<i>Sail Number</i>	
<i>Current Base Handicap</i>	
<i>Current Adjusted Handicap</i>	

<i>Bottom Preparation</i>	
<i>When was bottom last treated?</i>	
<i>What type of bottom paint is applied?</i>	
<i>How is the bottom paint applied?</i>	
<i>How often is the bottom cleaned?</i>	
<i>How is the bottom cleaned?</i>	

<i>Sail Inventory</i>					
<i>Sail</i>	<i>Sail Maker</i>	<i>Material</i>	<i>Ozs.</i>	<i>Condition</i>	<i>Age (months)</i>
<i>Main</i>					
<i>1st Genoa; LP%=</i>					
<i>2nd Genoa; LP%=</i>					
<i>3rd Genoa; LP%=</i>					
<i>1st Spinnaker; SMG%=</i>					
<i>2nd Spinnaker; SMG%=</i>					
<i>3 Spinnaker SMG%=</i>					
<i>Other</i>					
<i>Other</i>					

<i>Skipper and Crew Experience</i>	
<i>Number of years racing experience for the skipper/owner</i>	
<i>Number of persons in the racing crew including the skipper/owner</i>	
<i>Number of crew members racing with the skipper/owner more than 50% of the time</i>	
<i>How many years experience do you have racing the boat in question?</i>	

Races and Performance

Briefly describe the number and type of PHRF races sailed annually.

<i>Results for the last five races with the best finishes</i>						
<i>Race Name</i>	<i>Handicap</i>	<i>Number of starters</i>	<i>Handicap Spread</i>	<i>Corrected finish position</i>	<i>MBCR</i>	<i>Rating required to be first in class</i>

How many races did you finish this season? _____ How many races did you finish last season? _____
 What percentage of the time did you finish in the top third of your class? _____
 What percentage of the time did you finish in the middle third of your class? _____
 What percentage of the time did you finish in the bottom third of your class? _____

<i>Boats that regularly beat the appellant's boat on corrected time</i>					
<i>Class/Type</i>	<i>Handicap</i>	<i>Class/Type</i>	<i>Handicap</i>	<i>Class/Type</i>	<i>Handicap</i>
1		4		7	
2		5		8	
3		6		9	

<i>Boats beat or sailed equal to on corrected time</i>					
<i>Class/Type</i>	<i>Handicap</i>	<i>Class/Type</i>	<i>Handicap</i>	<i>Class/Type</i>	<i>Handicap</i>
1		4		7	
2		5		8	
3		6		9	

Boats the appellant considers incorrectly handicapped

<i>Class/Type</i>	<i>Handicap</i>	<i>Class/Type</i>	<i>Handicap</i>	<i>Class/Type</i>	<i>Handicap</i>
1		4		7	
2		5		8	
3		6		9	

The appellant may add in addition to this page with no more than five (5) double spaced typewritten pages of continued or other relevant information.

Other relevant information

Attachment 3; Skipper Effect

An analysis of One Design races was undertaken in an effort to validate the assertion that first place finishers in a properly handicapped race should sail from 15 sec/mile to 25 sec/mile faster than the median boat.

Data from fifty-seven races sailed during the 2001 and 2002 Key West Race Weeks were gathered from public web sites. Data from the flowing fleets were used:

- 1D35
- Farr 40
- J/29
- J/80
- J/105
- Melges 24
- Mumm 30

For each race the difference in seconds/mile between the first place boat and the median boat was calculated.

Figure 1 shows the results with the x-axis showing the number of boats in the race, and the y axis showing the difference in sec/mile between the first place boat and the median boat. Each data point represents a race.

The continuous line represents a smoothing of the data using a mathematical procedure (least squares fit; polynomial) for finding the best-fitting curve for a given set of points.

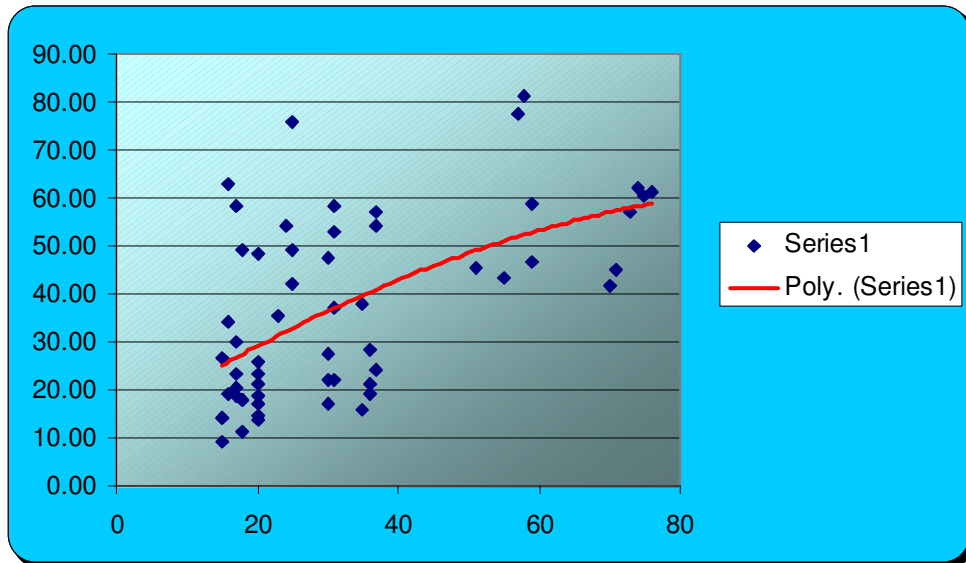


Figure 1

The data were further analyzed by taking the average difference in speed for fleets of various sizes. Data from Figure 1 above were grouped into the following fleet sizes:

- 15
- 17
- 20
- 25
- 30
- 35
- 60

Figure 2 represents the results of the analysis. Once again the number of boats in the race is shown on the x-axis, and the speed difference in sec/mile between the first place boat and the median boat is shown on the y-axis. The seven data points represent the average difference in speed between the lead boat and the mean boat for the respective fleet sizes. The smooth line through the data represents a mathematically generated best fitting curve.

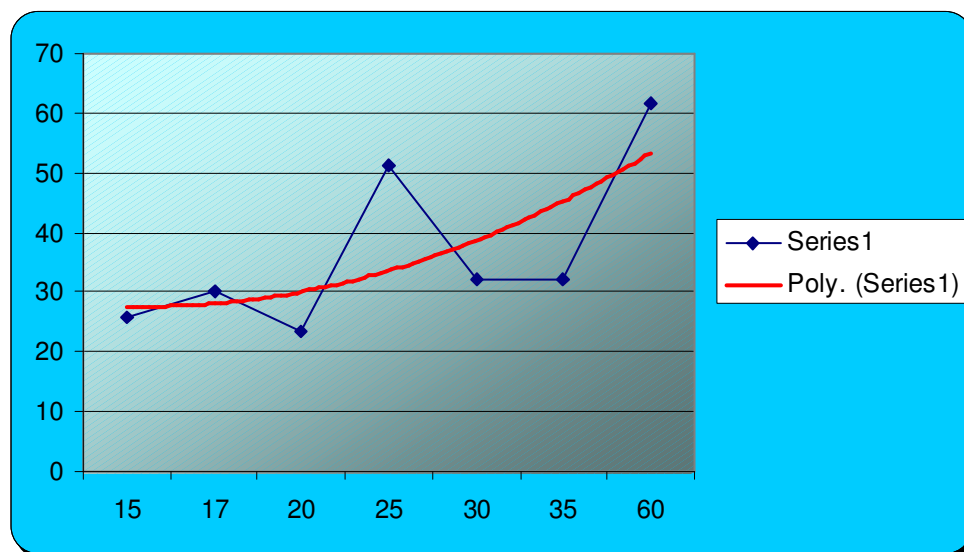


Figure 2

An examination of the smoothed curves in both Figure 1 and Figure 2 suggests that in a fleet of 15 boats we should expect the first place boat to sail the course 25 sec/mile faster than the median boat. In a fleet of 25 boats we should expect to see a difference of 35 sec/mile. As the size of the fleet grows, so should the difference in speed between the lead boat and the median boat.

Handicappers should be aware that the above analysis is intended to be a general guideline only. The results from Key West clearly indicate that the difference in speed between the lead boat and the balance of the fleet varies widely from race to race. However, the results also clearly indicate that within a one-design fleet, where the only differentiators are the skipper/crew and the condition of the boat, there will be a significant difference in speed within the fleet.

This analysis serves to support the assertion made by Michael Ames in the 1993 edition of the NSYA Performance Handicapping Manual.

Jan 24, 2005
mpp

Attachment 4; PHRF – ToT Conversion Table

NOTE: The conversion table presented on the following page is based setting on A to 695 and B to 525 in the formula:

ToT Correction Factor = $A/(B + PHRF)$.

Race Committees are encouraged to change either or both factors to suit local sailing conditions and fleet make up.

PHRF	ToT		PHRF	ToT		PHRF	ToT		PHRF	ToT		PHRF	ToT		PHRF	ToT
21	1.27		71	1.17		121	1.08		171	1.00		221	93.2		271	0.87
22	1.27		72	1.16		122	1.07		172	1.00		222	93.0		272	0.87
23	1.27		73	1.16		123	1.07		173	1.00		223	92.9		273	0.87
24	1.27		74	1.16		124	1.07		174	0.99		224	92.8		274	0.87
25	1.26		75	1.16		125	1.07		175	0.99		225	92.7		275	0.87
26	1.26		76	1.16		126	1.07		176	0.99		226	92.5		276	0.87
27	1.26		77	1.15		127	1.07		177	0.99		227	92.4		277	0.87
28	1.26		78	1.15		128	1.06		178	0.99		228	92.3		278	0.87
29	1.25		79	1.15		129	1.06		179	0.99		229	92.2		279	0.86
30	1.25		80	1.15		130	1.06		180	0.99		230	92.1		280	0.86
31	1.25		81	1.15		131	1.06		181	0.98		231	91.9		281	0.86
32	1.25		82	1.14		132	1.06		182	0.98		232	91.8		282	0.86
33	1.25		83	1.14		133	1.06		183	0.98		233	91.7		283	0.86
34	1.24		84	1.14		134	1.05		184	0.98		234	91.6		284	0.86
35	1.24		85	1.14		135	1.05		185	0.98		235	91.4		285	0.86
36	1.24		86	1.14		136	1.05		186	0.98		236	91.3		286	0.86
37	1.24		87	1.14		137	1.05		187	0.98		237	91.2		287	0.86
38	1.23		88	1.13		138	1.05		188	0.97		238	91.1		288	0.85
39	1.23		89	1.13		139	1.05		189	0.97		239	91.0		289	0.85
40	1.23		90	1.13		140	1.05		190	0.97		240	90.8		290	0.85
41	1.23		91	1.13		141	1.04		191	0.97		241	90.7		291	0.85
42	1.23		92	1.13		142	1.04		192	0.97		242	90.6		292	0.85
43	1.22		93	1.12		143	1.04		193	0.97		243	90.5		293	0.85
44	1.22		94	1.12		144	1.04		194	0.97		244	90.4		294	0.85
45	1.22		95	1.12		145	1.04		195	0.97		245	90.3		295	0.85
46	1.22		96	1.12		146	1.04		196	0.96		246	90.1		296	0.85
47	1.22		97	1.12		147	1.03		197	0.96		247	90.0		297	0.85
48	1.21		98	1.12		148	1.03		198	0.96		248	89.9		298	0.84
49	1.21		99	1.11		149	1.03		199	0.96		249	89.8		299	0.84
50	1.21		100	1.11		150	1.03		200	0.96		250	89.7		300	0.84
51	1.21		101	1.11		151	1.03		201	0.96		251	89.6		301	0.84
52	1.20		102	1.11		152	1.03		202	0.96		252	89.4		302	0.84
53	1.20		103	1.11		153	1.03		203	0.95		253	89.3		303	0.84
54	1.20		104	1.10		154	1.02		204	0.95		254	89.2		304	0.84
55	1.20		105	1.10		155	1.02		205	0.95		255	89.1		305	0.84
56	1.20		106	1.10		156	1.02		206	0.95		256	89.0		306	0.84
57	1.19		107	1.10		157	1.02		207	0.95		257	88.9		307	0.84
58	1.19		108	1.10		158	1.02		208	0.95		258	88.8		308	0.83
59	1.19		109	1.10		159	1.02		209	0.95		259	88.6		309	0.83
60	1.19		110	1.09		160	1.01		210	0.95		260	88.5		310	0.83
61	1.19		111	1.09		161	1.01		211	0.94		261	88.4		311	0.83
62	1.18		112	1.09		162	1.01		212	0.94		262	88.3		312	0.83
63	1.18		113	1.09		163	1.01		213	0.94		263	88.2		313	0.83
64	1.18		114	1.09		164	1.01		214	0.94		264	88.1		314	0.83
65	1.18		115	1.09		165	1.01		215	0.94		265	88.0		315	0.83
66	1.18		116	1.08		166	1.01		216	0.94		266	87.9		316	0.83
67	1.17		117	1.08		167	1.00		217	0.94		267	87.8		317	0.83
68	1.17		118	1.08		168	1.00		218	0.94		268	87.6		318	0.82
69	1.17		119	1.08		169	1.00		219	0.93		269	87.5		319	0.82
70	1.17		120	1.08		170	1.00		220	0.93		270	87.4		320	0.82