Utilizing VPP based handicapping systems to determine a PHRF handicap

Dec. 9, 2015

Purpose of the paper:

The purpose of this paper is twofold; first to discuss how to utilize a Velocity Prediction Program (VPP) based handicapping system, such as ORR, ORC or IMS, to develop a PHRF handicap for the DRYA Handicapping area and second to utilize the method described to develop a DRYA PHRF handicap for Northern Spy, a DuFour 45E.

Background:

VPP based handicapping was developed in response to the inability of IOR to adequately handicap a wide range of boat designs. The first version of this system was the MHS and was developed with MIT and the Chicago Yacht Club. This evolved into the International Measurement System (IMS) that was fairly widely used in the US from the mid 1980s until the early 2000s. The IMS VPP was "open source" and designers were able to optimize designs to take advantage of the VPP's shortcomings. (All VPPs have shortcomings – this is why technical groups continue to try and improve the VPP). IMS lost favor in the US and was replaced by the ORR, which is a development of the original IMS handicapping system. ORR has been developed as a "closed source" system to minimize obsolesce due to designer optimization. The ORC, based in England, has continued to develop the IMS handicapping system and it is now named ORC and is treated as an "open source" system to encourage optimization.

See the appendix for details on the history of both the ORR and ORC handicapping systems. In current practice, ORR and ORC are competing rules serving different worldwide constituencies.

Technical and operational differences between ORC and ORR

Both ORC and ORR handicapping systems utilize the hull and rig measurements from the original IMS handicapping system, so a boat rated under one rule has all the measurements required to obtain a handicap under the other.

ORC encourages trial certificates and offers an owner or sail maker the capability to run trial certificates on his boat or others in the measurement database for a nominal fee of approximately $15 US. Since all boats ever measured for IMS, ORR or ORC are in the ORC database, it can be very useful to a group like the DRYA Handicappers trying to determine reasonable PHRF handicaps. The ORC database currently has 86,000 boats.

ORC has some drawbacks for the DRYA PHRF fleet due to some inaccurate components of the ORC VPP. The major shortcoming is the way ORC treats centerboard boats. ORC's VPP determines that centerboard boats are 15 to 20 sec/mile faster than empirical evidence would determine. This is a carryover shortcoming from the original IMS VPP. The ORC technical committee is aware of this issue, but isn't currently working on a solution for the 2016 season. Otherwise the ORC VPP is a very accurate tool for handicapping boats.

ORR has addressed the IMS / ORC shortcoming with respect to centerboards, but due to the Offshore Racing Association's (ORA) desire to limit optimization, trial certificates are priced at $150 US and are very limited. If a boat at one time had an ORR certificate, it is possible to get a copy of that certificate for study purposes for $25 US, but these certificates are only useful if the sails and rig measurements are current, otherwise it costs $150 to update the certificate. ORR currently has approximately 1500 boats in their database, with approximately 700 of those with current certificates.

The ORC handicaps are of most use to a PHRF group when a full certificate is available. Some of the Time on Time (ToT) handicaps are available on the USSailing website, but this data is not sufficient to do a reasonable analysis.

ORC and ORR certificates for Albacore are in the appendix.

Both ORR and OCC have several "course handicaps" and some VPP outputs. One must fully understand the content of a "course" handicap before attempting to utilize it for other handicapping purposes.

Methodology for utilizing VPP handicap Systems for determining PHRF Handicaps:

Time on Distance(ToD) vs Time on Time(ToT)

PHRF is a Time on Distance (ToD) handicapping system that determines one boat's speed relative to another's in seconds per mile. The system has an "arbitrary" zero point and the PHRF handicaps have no physical meaning.

Many race organizers have used the PHRF ToD handicaps to develop a Time on Time handicap by adding a constant to the PHRF ToD handicap to approximate a speed value in terms of sec/mile and then inverting this "speed" value and multiplying by a "Target boat's" speed in sec/mi to get a ratio. The boat's elapsed time is multiplied by this ration to determine her corrected time. The equation for DRYA is shown below:

$$ToT = \frac{650}{ToD\ PHRF + 557}$$

The ToT handicapping system results in a handicap that is essentially sec/hr of ET

This discussion will only focus on developing a ToD handicap using the various pieces of data available from either an ORR or ORC certificate.

Picking the best fit VPP speed prediction value to use for PHRF handicapping:

DRYA's objective in establishing PHRF handicaps is to fairly estimate the performance of a boat, relative to other boats in the fleet, while sailing a course consisting of 1/3 of the distance beating, 1/3 of the distance reaching and 1/3 of the distance running with wind speeds of 8-12 knots, centered around 10 knots.

Both ORC and ORR have the same formulas for determining a boat's speed from the VPP as follows:

Circular Random (ORC) and Closed Course (ORR):

This handicap determines a boat's predicted speed in sec/mi to sail around a round island. This comes reasonably close to the DRYA goal as 1/3 of the distance will be sailed with true wind angles of less than 60 degrees, 1/3 of the distance will be sailed with TWAs of 60 – 120 degrees and 1/3 of the distance will be sailed with TWAs of greater than 120 degrees. Both ORR and ORC have handicaps for this type of sailing at various wind speeds. (Note: both ORR and ORC use "wind speed averaging" which uses a distribution of wind speed about the nominal wind speed. For example a 10 kt CR would contain some amount of 8 kt and some amount of 12 kt calculated in)

General Purpose Handicap (GPH):

This handicap is a straight average of the CR 8 kt and CR 12Kt speeds in ORC. ORR 's GPH is slightly slower than the straight average of CC 8kt and CC 12 kt. (Note the GPH is not the same as the 10 kt CR/CC speed.) Because of wind speed averaging, this speed contains some wind speeds of 6 kts as well as some of 14 kts.

Windward Leeward (W/L):

This handicap determines a boat's predicted speed in sec/mi to sail a windward / leeward course with legs of identical distance. This handicap also uses wind speed averaging.

How the various VPP handicaps are evaluated with respect to PHRF:

The VPP handicap with the closest relationship to the DRYA's PHRF fleet needs to be determined before a boat or group of boats can have their PHRF handicaps predicted from the VPP speed prediction.

This is done by doing a linear regression of the relationship between the fleet's PHRF handicaps and the corresponding VPP speed predictions. I have used an optimizing tool in excel to find the best fit for a selection of course combinations.

The equation looks like this:

$$Predicted\ PHRF = (x * CR10 + y * GPH + z * WL12) - Constant$$

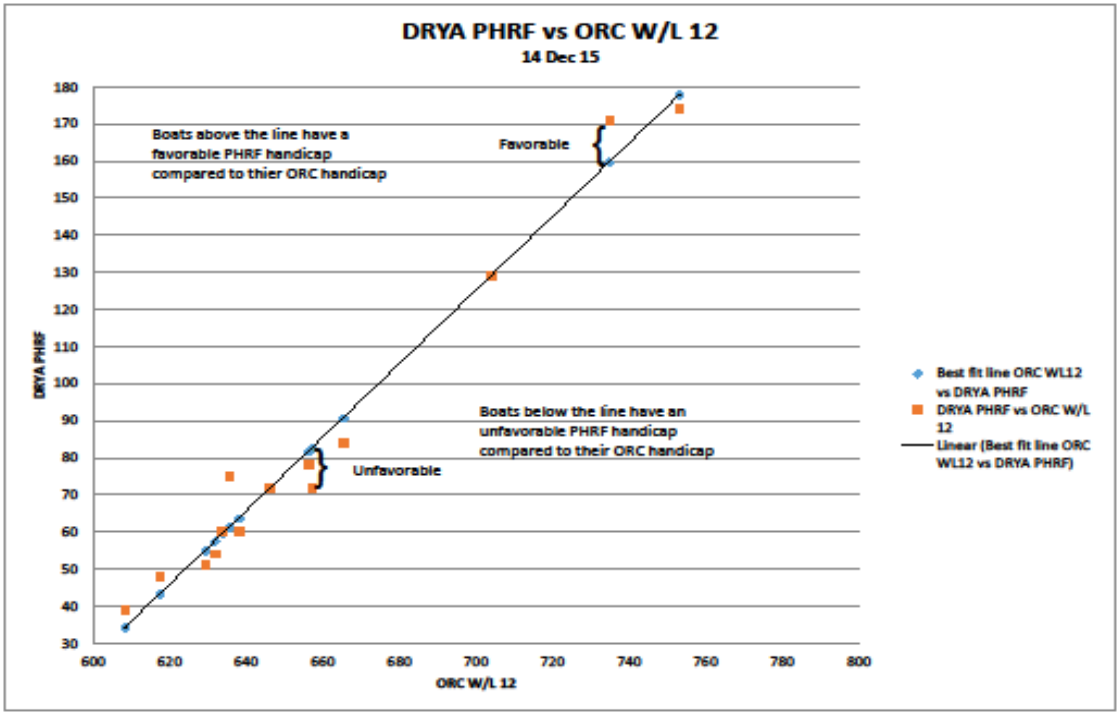
The best fit for ORR to DRYA PHRF is to use 0.90* CC 10 and 0.11 * W/L 12. While this is mathematically more precise, using only CC 10 gives a very good relationship and is more comprehensible to the average sailor.

The best fit for ORC to DRYA PHRF is to use 0.991 W/L 12. This is significantly better than either CR 10 or the GPH.

Each optimization has a specific constant.

Three example optimizations for ORC to DRYA PHRF are in spreadsheet form the appendix.

A plot of DRYA PHRF vs ORC W/L 12 with the best fit line is below:



How to use the best fit ORC or ORR handicaps to determine a DRYA PHRF handicap:

Once a VPP handicap is selected then there are two ways to determine a boat's PHRF handicap relative to her competitors:

Preferred Method:

The best method is to determine the difference between the boat under study and the boats that are near her in speed. Once the group of comparison boats is selected, the difference between the boats is determined using the best fit ORC VPP handicap. For Northern Spy the comparison would look like this:

Yacht	ORC W/L 12	DRYA PHRF	DuFour's PHRF from other boats
Epic	629.4	54	62.8
First 40.7	631.9	54	60.3
DuFour 45E	638.2	60	
Pet 43 – Blitz	633.9	60	64.3
Ben 36.7	656.4	78	59.8
J 35	657.2	72	53
NA 40	665.4	84	56.8

The average of the 6 handicaps is 59.5 which rounds up to 60.

Alternate Method:

The alternate method is to use the best fit line formula to calculate a specific boat's handicap. This is not a particularly accurate method as unless all the boats surrounding the boat under study are brought to the line together, the study boat will either be advantaged or disadvantaged by the line fit in that range of PHRF handicaps.

In the case of Northern Spy, the best fit line would predict a PHRF handicap for her of 64, however, the best fit line indicates that many of the boats in that handicap range would also have their handicaps increased by 3 to 4 seconds.

Conclusion:

The most accurate method to utilize VPP based handicaps to determine PHRF handicaps is to first determine which VPP handicap (or handicaps) is the best fit to the existing PHRF fleet, then use those handicap speeds to determine the speed differential from known boats in the same handicap range to calculate the study boat's PHRF handicap.

Appendix:

Brief history of the Offshore Racing Congress (From the ORC website)

"It is the spirit and intent of the rule to promote the racing of seaworthy offshore racing yachts of various designs, types and construction on a fair and equitable basis."

Thus began the introduction of the IOR Rule. It was an ambitious aim. For over a century yachting authorities on both sides of the Atlantic had tried to devise a rule that fairly equated yachts of different sizes and speeds.

Early Roots

The ancestor of modern rules was the Seawanhaka Rule of 1883. This evolved into the Universal Rule of Nathaniel Herreshoff which was in use before the First World War but was known and used only in the US. Similar developments were going on in England and the Boat Racing Association Rule of 1912 showed strong similarities to the rule ultimately adopted for the Fastnet Race by the Ocean Racing Club in the late 1920's. The International Rule, promulgated for the first time in 1907 by the newly formed IYRU was used at the times in Europe and Asia, and for the early Olympics at several level classes. The British used girth stations to determine length, while the American Rule used buttock length. In 1928 the Cruising Club of America used the British Rule with minor changes, but the use of this rule on both sides of the Atlantic was short-lived. In 1932 the CCA produced its own rule which tended to be type-forming, containing, as it did, a number of "base" dimensions, and penalties provided when differences from the base boat occurred. The measurement of stability was a novel thing in CCA promulgation.

Post-War divergence

When ocean racing resumed after the Second World War the rules tended to diverge, in that the CCA Rule was adapted from time to time to encourage owners to build the sort of dual-purpose cruiser/racer that the club thought desirable. The Royal Ocean Racing Club was less restrictive towards the development of the pure racing boat, such as "Myth of Malham." The CCA was adopted only in the US, while the RORC Rule had been adopted by many cruiser/racers. In the Med and a few other countries the RORC Rule was extended to smaller boats, and called the "C" Class.

But the demand for a truly International racing rule really started when some trophies and events were created on both sided of the Atlantic that encouraged international team participation. These included the Onion Patch series and later the SORC in the US, where the CCA was used, and the Admiral's Cup, where the RORC rule was used.

By 1961 it was clear that there were two very different rules, the RORC Rule for Europe and the Antipodes and the CCA Rule for North and South America. This situation was not to the liking of a number of European sailors who gathered in Bremen on 5 June 1961 at the suggestion of Rolf Schmidt of Germany.

Later the same year delegates from four countries met in London and decided to form the Offshore Rules Coordinating Committee. This committee worked throughout the 1960's and the original four countries (Germany, Great Britain, Sweden and the United States) were joined by Denmark, Norway, Finland, Holland, France, Italy, Australia, Canada and Belgium.

The ORCC was chaired throughout by Buster de Guingand. The Committee concentrated on trying to align the two rules in matters that were not of fundamental importance, such as the details of sail measurement.

Beginnings of an International Rule

In 1965 there were rumors that the 1968 Olympic Games might include an offshore racing class and in 1966 the International Yacht Racing Union asked the RORC and the CCA to try to frame one international rule. Both clubs agreed, and at the April 1967 meeting of the ORCC an International Technical Committee was established. Olin Stephens was the chairman and the other American representative was the designer Dick Carter. Europe was represented by Gustav Plym of Sweden and Ricas van de Stadt of Holland, and Paul Spens from England. The English measurers David Fayle and Robin Glover completed the committee.

Between April 1967 and November 1968 the committee met on a number of occasions and the ORCC considered the draft of a new International Offshore Rule at its November 1968 meeting in London. It was then unanimously agreed to recommend to all national authorities that the Rule should become operative in the 1969 season.

The set of measurements and the formulae for the length, the depths and the freeboards were taken mostly from the RORC Rule, and were finalized by Olin Stephens and Paul Spens. A Fortran program was written, using punched cards that in these early times had to be sent to a remote server. The USYRU was instrumental, with the help of MIT, in setting up this impressive software development, where the set of data entered could print out a certificate with a dot matrix printer of the times.

In parallel during 1968 and 1969 a Special Regulations Committee was established to carry out the same sort of process with special regulations of different countries to accompany the measurement rules, and set some standards for safety at sea on offshore racing yachts.

A constitution committee was also set up to prepare a constitution for a new Council - this council was to control the Rule and was to be formed with the sanction of IYRU.

Birth of ORC

On 1 November 1969 the Offshore Rules Coordinating Committee held its final meeting and approved the Constitution for the new Offshore Rating Council.

The Organization was revolving around the Rule and the computer program able to calculate the many measurements entered, with punched cards or tapes, and print the certificate on one or 2 pages. Any National Authority could make use of the program, paying a “levy” for every certificate issued.

The Council had from the beginning a close relationship with the IYRU, whose President, Beppe Croce, was a Council member until 1981. Even now the sitting ISAF President holds a seat in the ORC.

Initially there was some slight suspicion of the role of the new Council, and its somewhat limited function was denoted by calling it the "Offshore Rating Council."

By the mid-1970s the Council had shown that it had a secure place in the control of level rating as well as rated yachts and special regulations, so in 1976 the Council changed its title to "Offshore Racing Council." The development of a common international rule had taken thirteen meetings and eight years but all felt that the effort was well worthwhile. The rule that emerged was based upon the CCA approach to sail measurement and the RORC method of hull measurement. The biggest problem in 1969, as it is to the present day, is how to determine the vital L measurement under a system that is based on the use of girth stations.

For the next three years the Council met at least twice a year and the ITC even more often. The work of adding finishing touches to the rule took the Council to San Francisco, La Rochelle and Portofino. After 1975 the Council reduced the frequency of meetings to one a year in London each November.

Birth of IOR

The IOR arrived just in time to catch the boom in international racing represented by the growth of the Admiral's Cup, the Southern Cross and the Onion Patch series. The boom itself caused the serious problems that began to arise in rule management in the mid-seventies. Intense international competition and boat construction worldwide encouraged a bunch of amateur designers to do their trial, and eventually find their way to exploit the Rule to the full and so produce highly specialized racing boats very fast for their rating. This was unpopular particularly

in the United States where many owners favored the traditional compromise between cruiser and racer.

This policy was followed and was generally popular until the mid-1980's when another surge of development in technology of both design and materials took place.

The Rule gave excellent racing to the new "custom" designs and still accommodated the older yachts but the changes which would have been required to make traditional cruiser/racers truly competitive with this new generation of lighter yachts, so some Cruiser/Racer protected Divisions had to be created to ensure participation at the events, a policy that is continued with the current handicap rules.

David Edwards, Chairman of the Council from 1970 to 1978, and John Roome after him, made a great contribution in preserving a delicate balance between the interests, favoring generally rule changes to protect the existing fleet against early obsolescence, but keeping up a fair game at the top events. Rules were changed as loopholes were exploited, but discussions were often harsh.

In this period of two decades the system expanded and prospered worldwide, and with the advent of programmable calculators and later personal computers, the IOR program became a sort of exercise all designers and "expert" sailors of the times spent a lot of time doing. Many thousands of boats were measured in a complex way by expert measurers, and raced in many races all over the world at various levels, IOR being the only recognized system in use. The size of the fleets allowed the organization of individual Class championships, and very competitive International Level Class events.

To keep a limit on boat sizes, IOR has always maintained a "top" limit of 70 feet, even if the program and the formulae could give a rating to any size. This gave event organizers an workable benchmark limit for entries, and produced the concept of a Maxi class for boats rating at or about this limit. With large budgets and owner egos to match, the Maxi class soon became the focal point for design development and a suitable home for an emerging class of high-profile professional sailors.

The Maxi class later spurred the development of various sub-classes, such as the Mini-Maxi's, the Super Maxi's, and most recently the Mega Maxi's.

The IOR has been frozen in place with the 1993 version, but is still operational and usable for any race or certification renewal anytime - some IOR racing continues even now in Italy and Russia.

Advent of IMS

In 1985 the Council decided to adopt the Measurement Handicap System used in the US, renaming it the International Measurement System (IMS), as an alternative rule to accommodate traditional yachts, while continuing to manage IOR for the leading events and for the many other fleets which preferred to continue under that Rule.

In 1989, a policy of rule stability was adopted with respect to the IOR. This was strengthened in 1990 by removing the possibility of designing new yachts to the Mark III A formula, which had originally been introduced to promote dual-purpose boats. Also in 1989 certain "exotic" materials were banned for IMS yachts and smaller IOR yachts in order to keep costs down and reduce unrated performance advantage. By 1990, IMS had become well established in various countries - notably US, Netherlands, Finland, Germany and Australia - and thereafter continued to grow steadily throughout the world.

Level rating classes – the Ton Cups

The IOR Level Rating Classes (Ton Classes) were popular at the leading edge of IOR racing until keen racing owners gradually began to turn to IMS designs in the early nineties. Ton Classes had originated with Jean Peytel's idea to revive the old 6-Meter trophy, the One Ton Cup, for competition without time allowance between yachts rating 22 feet under the RORC Rule. The One Ton Class was followed in 1966 with the Half Ton Cup and the Quarter Ton Cup in 1967, both on the initiative of the Societe de Regates Rochelaises, and Pierre Chambonnet in particular.

In 1967 the Yacht Club Italiano started the Two Ton Cup and in 1974 the North American Yacht Racing Union presented the Jean Peytel trophy for the Three Quarter Ton Cup at 24.5 feet IOR rating. In 1973 the clubs that started the original Ton Cups generously presented the trophies and the right to administer the races to the ORC. In 1984 the Two Ton Class was discontinued and the maximum rating of the One Ton Class was raised to 30.55 feet. The One Ton Class became very popular at this new maximum rating and in 1990, following competitor demand, the Two Ton Class was re-introduced with a maximum rating of 35.05 feet.

ILC classes

Following a two-year development period in the early 1990's for a new Grand Prix Rule, the ORC inaugurated the International Level Class Rule (ILC Rule) based on levels defined using the International Measurement System (IMS). Under the ILC system, levels are set by "performance envelope" limits, i.e., performance limits at 3 points of sail in 3 wind velocities ensuring close class racing on all courses.

The first ILC World Championship was held for the ILC 40 in Denmark in 1995.

In the years immediately following, the rules for the full ILC family were developed, eventually including the ILC 25, 30, 40, 46 and ILC Maxi Classes. As the new classes emerged, they replaced the corresponding IOR Ton classes, with the last ORC World Championship under IOR being held in Quarter Tonners in 1996 and the 1 Ton Cup in Marseille in 1994. These classes eventually led to the adoption of more flexible forms of the level class format, e.g., the IMS 600 Class.

As the use of IMS in grand prix racing grew, it became necessary for Council to take steps to protect the fleet for which IMS had originally been developed by defining two divisions within IMS, the Cruiser/Racer Division and the Racing Division, the distinction being made on the basis the degree to which the features of a yacht's build, outfit and accommodation suited cruising considerations. The prescriptions for this were promulgated in 1993, and are now contained in the IMS Rule, and are accounted for in rating credit.

By the mid-1990's the popularity of the IMS had grown to the degree that the IOR was completely replaced, and by 1999 an IMS World Championship was introduced with scoring based on time allowances.

Advent of ORC Club

With the popularity of IMS came the inevitable pressure of competition at the highest level, resulting in the sense that a simplified version of IMS should be made available for the local racer at a modest cost. This concept was developed during 1997 and was introduced the following year under the name ORC Club.

The number of required measurements for ORC Club is reduced by the use of a system of calculated default measurements that replace measurements that would otherwise be required for a full IMS Certificate. The system made it possible to calculate ORC Club handicaps using the same Velocity Prediction Program as for the IMS, but without the burden of a complex and expensive measurement procedure.

A fundamental benefit for this concept is that ORC Club yachts could be raced and scored together with full IMS yachts and it is therefore not necessary for race committees who wish to adopt ORC Club racing to introduce a separate division; the Club-rated yachts could simply be mixed together with existing IMS yachts and race for the same prizes.

The popularity of ORC Club grew at such a pace that within four years the number of Club yachts surpassed IMS yachts. Countries with no previous IMS programs established Rating Offices for ORC Club and the system began to be taken up also for sportboat racing.

Safety and Offshore Special Regulations

Throughout this time work continued on the Offshore Special Regulations (OSR), the objective being to improve the safety equipment and so far as possible to standardize regulations in all countries. The 1979 Fastnet Race led to demands to strengthen the Regulations as well as to encourage increased stability in the yachts, and a special Council Meeting was held in Barcelona in 1980 to ratify these rule changes. There were also demands for a scantling rule to control the construction of hulls and spars.

A Guide was eventually produced by the American Bureau of Shipping in conjunction with the ITC, and plan approval was made mandatory for yachts built after 1 January 1986 racing in Categories 0 and 1, and other yachts racing Category 2.

The OSR are today used worldwide, occasionally modified for local racing, and are also used for many simplified rules such as IRC in France and the UK and PHRF in the US, but from 2001 they have passed under the jurisdiction of ISAF. The core of the current ISO standards also rely mostly on the requirements contained in the OSR.

Brief merger option with ISAF, renaming of ORC

In 1997 negotiations were initiated to agree a merger of ORC with the newly-renamed ISAF, and the following year the ORC office was moved to the ISAF headquarters in Southampton, where it remained until 2002 when the merger plans were abandoned, there being too large a gulf between administering to the interests the offshore constituency and those of one-design classes. At the AGM in 2001 in Lisbon the ORC was supposed to be ISAF's newly constituted Offshore Committee, but instead just the Special Regulations moved to within its jurisdiction.

With the success of ORC Club came additional countries administering ORC programs and to provide for broader representation, the eligibility for Members of Council was put on a new basis related to the number of certificates issued annually. The expanded Council was ultimately given a new name, the Offshore Racing Congress.

Recognition of growing interest in elite offshore racing led, in 2005, to the development and introduction of three new, grand prix, fixed-formula classes to be raced without handicap: the ORC's GP 26, GP 33 and GP 42, with design and building getting under way for the inaugural 2006 season. Thusfar, the GP 42's have enjoyed the best success of these classes, with 15 boats built from 2006-2010, and competitive class racing held in the 2007-2010 seasons in Europe, including two seasons in the Audi MedCup. While not having any organized class racing yet, GP 26's continue to attract build interest on four continents.

ORC International was started at the 2007 ORC Annual General Meeting in

Estoril. This represented the ITC's major overhaul and significant improvement to the ORC's VPP and rating system, with elimination of some of the poor typeforming qualities seen in the old system. IMS would now be a measurement protocol only, used for inputs to ORCi and ORC Club rating rules. All ORC Championships would henceforth be run under the ORCi rule.

At the urging of ISAF, merger discussions were started in Feb 2010 with RORC to form a new company to manage ORC and IRC rating systems as a single rule authority. These discussions are still ongoing.

In 2012 ORC agreed with US Sailing and the RORC Rating Office to help develop the concept of a Universal Measurement System (UMS) in which a "passport", or complete characterization of a boat's measurement profile, would be possible to enable use in any measurement rating system.

Also in 2012 ORC has agreed with the Offshore Racing Association in the US to help administer the new High Performance Rule (HPR) that is suited for modern high-performance designs. HPR will utilize measurement standards consistent with IMS and the new UMS.

Technical milestones in the rating system:

- 1970: first IOR program listing
- 1983: first PC program for IOR
- 1986: first PC IMS program
- 1990: crew weight and stability index formulations
- 1993: New Rr introduced, double Division Regulations, DBOS
- 1995: carbon masts and asymmetric sails allowed. ILC concept
- 1997: Dynamic Allowance
- 1998: new Windage model, defaults for ORC Club
- 2000: new Rr regression & L formulation
- 2003: propeller strut fixed
- 2006: new aero model
- 2007: ORC system, new program, new data format
- 2012: new Rr formulation

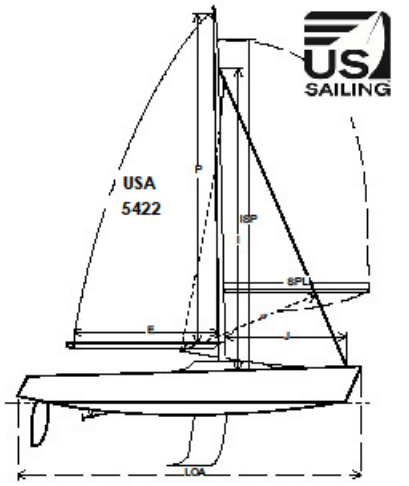
ORR (Offshore Rating Rule) (From the US Sailing Website)
In 2004 the Chicago Yacht Club, the Cruising Club of America, and the Transpacific Yacht Club collaborated to form the Offshore Racing Association (ORA). This organization is responsible for ORR and is convinced that a sophisticated (if not 'simple') VPP-driven handicapping system that is based on comprehensive physical measurement of the boat is the best way to reliably and accurately handicap a diverse fleet. ORA believes this rule is the best way of scientifically handicapping the US offshore racing fleet. The ORR is used by sailors who want to be able to race boats of the type that they themselves prefer to sail, rather than a boat type that is favored by a rating rule. An ORR objective is not to favor any single design characteristic over another and changes to the rule are made as needed if trends indicate specific boat characteristics are being favored. The Offshore Rating Rule (ORR) was first used in 2006.
The ORR is maintained as a "limited access rating system" in an effort to reduce aggressive optimization by those seeking competitive advantage. ORR's lineage goes all the way back to the access Pratt Project VPP, developed at the Massachusetts Institute of Technology in the 1970's, and it is a direct descendant of US Sailing's 'Americap' Rule. ORR is under continual development by a US-based technical team, with changes to its VPP based both on hard science (e.g. test tank, wind tunnel, and CFD studies) and on informed observation of real world performance. ORR performance predictions are based on direct measurement of rig and sails, and integrated values for wetted area, stability, beam at the waterline, effective sailing length, and sailing displacement, all data used is based on full hull and appendage shape definition. ORR is best known for its use in open water events such as the Newport Bermuda, Chicago Mackinac and Transpac races; its popularity in windward/leeward and short course racing has seen major growth. A recent count showed about 700 boats with active ORR certificates, all in North America. ORR is designed and managed by the ORA to fairly rate a very wide range of ages and types of well prepared, well-sailed boats from older designs to new high performance designs. -

2015 OFFSHORE RACING RULE CERTIFICATE™

ORR
OFFSHORE RACING RULE

US SAILING

YACHT NAME:	ALBACORE
SAIL NUMBER:	USA- 5422
ADDRESS:	Richard Marsh
ID: 1315038	32344 Mayfair Ln.
	Beverly Hills, MI 48025-2921 USA
Signature:	



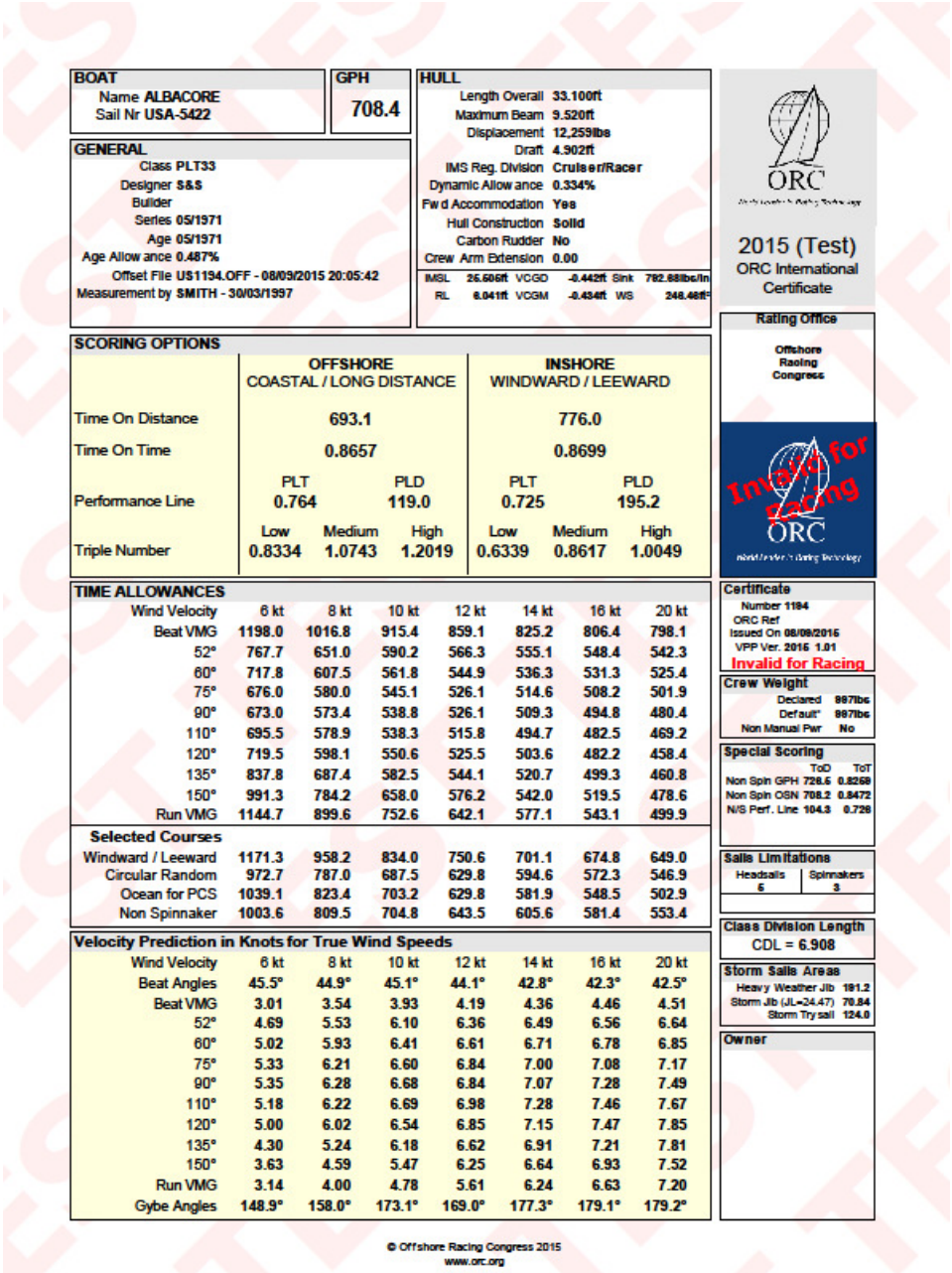
CERTIFICATE#:	US41297	AGE DATE:	5/1/1971
ISSUED DATE:	2/28/2015 1:37:30 PM		
YEAR VALID:	2012		
CLASS:	Pilot 33		
BUILDER:			
OFFSETS FILE:	US1194.OFF	ABS PLAN:	Not filed
MEASUREMENT:	MEASURER VERIFIED (Feet/Pounds)		
Freeboard Date:	6/14/1989		
Inclining Data:	6/14/1989		
RIG TYPE:	Sloop		
SPINNAKER TYPE:	Asym on a pole		
KEEL TYPE:	Fixed keel		
PROP INSTALL:	In aperture	PRD:	1.330
PROP TYPE:	Feathering 2 Blade	PBW:	0.000

LOA	33.10	DRAFT	4.925
Rated L	25.904	ECE	0.000
BMAX	9.55	Wet AREA	248.49
Stability Index	128.4	PIPA	0.1228
LPS	122.9	RMC	587.8
CREW	1300	VCGM	-0.460
Frbd Fwd M	3.900	RM2	614.3
Frbd Aft M	2.390	RM20	537.4
SG	1.000	RM40	431.6
SFFP	1.650	RM60	302.7
SAFP	31.400	RM90	180.0
DISP Meas	12493	MWT	0.0
Water Ballast	0	MCG	0.000

Genoa/Spinnakers		Mainsail/Mast Meas.		Mizzen Meas.	
J	11.920	IG	37.640	PY	0.000
LPGenoa	168 %	ISP	37.640	EY	0.000
FSP	0.120	GO	0.550	HBY	0.000
JL	0.000	MW	0.550	MGTY	0.00
JLE	0.000	P	42.530	MGUY	0.00
JR	0.000	E	16.670	MGMY	0.00
SPL	13.110	HB	0.400	MGLY	0.00
SL	37.86	MGT	3.29	MDT1Y	0.00
SMW	23.60	MGU	6.33	MDL1Y	0.00
SF	23.60	MGM	10.83	MDT2Y	0.00
ASL	37.49	MGL	14.44	MDL2Y	0.00
AMG	23.60	MDT1	0.38	TLY	0.00
ASF	23.60	MDL1	0.56	EB	0.00
A Genoa	397.2	MDT2	0.31	YSD	0.0
A Sym	745.4	MDL2	0.36	YSF	0.0
A Asym	737.5	TL	9.26	YSMG	0.0
		MSWgt	34.0	A Mizzen	0.0
		A Main	425.4		

TABLE OF RATINGS	Time-on-Time (TOT)	6kt	8kt	10kt	12kt	16kt	20kt	24kt
GPH: 733.3								
CLOSED COURSE:	0.751	906.9	753.2	674.5	630.0	586.8	566.6	556.9
WW 60%,LW 40%:	0.755	1234.6	1004.0	875.6	799.5	731.3	707.4	701.6
WW 50%, LW 50%:	0.761	1226.9	989.1	855.5	775.5	703.3	675.6	665.0
Bermuda Course:	0.803	1123.5	868.4	724.7	633.9	542.6	500.9	475.2
Ocean Non-Spin:	0.781	1152.2	890.8	744.4	651.8	559.2	516.7	490.3
Offshore Offwind:	0.766	1049.5	834.5	716.3	644.8	567.5	524.7	491.4

Chicago-Mackinac All-Purpose TOT	0.756	Puerto Vallarta TOT:	0.491	Acapulco	TOD	TOT
Chicago-Mackinac Offwind TOT	0.766	Cabo San Lucas TOD	654.1	WW/LW:	855.5	0.689
Pacific Cup TOD	598.8	Cabo San Lucas TOT:	0.557	Random:	733.3	0.689
San Francisco Bay TOT:	0.597			WW/LWS:	875.6	0.681
				StatFit:	719.8	0.690



BOAT
Name ALBACORE
Sail Nr USA-5422

GPH
708.4

GENERAL
Class PLT33
Designer S&S
Builder
Series 05/1971
Age 05/1971
Age Allow ance 0.487%
Offset File US1134.OFF - 08/09/2015 20:05:42
Measurement by SMITH - 30/03/1997

HULL

Length Overall	33.100ft
Maximum Beam	9.520ft
Displacement	12,259lbs
Draft	4.902ft
IMS Reg. Division	Cruiser/Racer
Dynamic Allow ance	0.334%
Fw d Accommodation	Yes
Hull Construction	Solid
Carbon Rudder	No
Crew Arm Extension	0.00

IMSL	25.606ft	VCGO	-0.442ft	Sink	782.68lbs/In
RL	6.041ft	VCGM	-0.434ft	WS	248.46ft²

ORC
2015 (Test)
ORC International Certificate

Rating Office
Offshore Racing Congress

Invalid for Racing
ORC

SCORING OPTIONS

	OFFSHORE COASTAL / LONG DISTANCE			INSHORE WINDWARD / LEEWARD		
Time On Distance	693.1			776.0		
Time On Time	0.8657			0.8699		
	PLT	PLD		PLT	PLD	
Performance Line	0.764	119.0		0.725	195.2	
	Low	Medium	High	Low	Medium	High
Triple Number	0.8334	1.0743	1.2019	0.6339	0.8617	1.0049

TIME ALLOWANCES

Wind Velocity	6 kt	8 kt	10 kt	12 kt	14 kt	16 kt	20 kt
Beat VMG	1198.0	1016.8	915.4	859.1	825.2	806.4	798.1
52°	767.7	651.0	590.2	566.3	555.1	548.4	542.3
60°	717.8	607.5	561.8	544.9	536.3	531.3	525.4
75°	676.0	580.0	545.1	526.1	514.6	508.2	501.9
90°	673.0	573.4	538.8	526.1	509.3	494.8	480.4
110°	695.5	578.9	538.3	515.8	494.7	482.5	469.2
120°	719.5	598.1	550.6	525.5	503.6	482.2	458.4
135°	837.8	687.4	582.5	544.1	520.7	499.3	460.8
150°	991.3	784.2	658.0	576.2	542.0	519.5	478.6
Run VMG	1144.7	899.6	752.6	642.1	577.1	543.1	499.9
Selected Courses							
Windward / Leeward	1171.3	958.2	834.0	750.6	701.1	674.8	649.0
Circular Random	972.7	787.0	687.5	629.8	594.6	572.3	546.9
Ocean for PCS	1039.1	823.4	703.2	629.8	581.9	548.5	502.9
Non Spinnaker	1003.6	809.5	704.8	643.5	605.6	581.4	553.4

Velocity Prediction in Knots for True Wind Speeds

Wind Velocity	6 kt	8 kt	10 kt	12 kt	14 kt	16 kt	20 kt
Beat Angles	45.5°	44.9°	45.1°	44.1°	42.8°	42.3°	42.5°
Beat VMG	3.01	3.54	3.93	4.19	4.36	4.46	4.51
52°	4.69	5.53	6.10	6.36	6.49	6.56	6.64
60°	5.02	5.93	6.41	6.61	6.71	6.78	6.85
75°	5.33	6.21	6.60	6.84	7.00	7.08	7.17
90°	5.35	6.28	6.68	6.84	7.07	7.28	7.49
110°	5.18	6.22	6.69	6.98	7.28	7.46	7.67
120°	5.00	6.02	6.54	6.85	7.15	7.47	7.85
135°	4.30	5.24	6.18	6.62	6.91	7.21	7.81
150°	3.63	4.59	5.47	6.25	6.64	6.93	7.52
Run VMG	3.14	4.00	4.78	5.61	6.24	6.63	7.20
Gybe Angles	148.9°	158.0°	173.1°	169.0°	177.3°	179.1°	179.2°

Certificate
Number 1184
ORC Ref
Issued On 08/09/2015
VPP Ver. 2015 1.01
Invalid for Racing

Crew Weight

Declared	897lbs
Default*	897lbs
Non Manual Pw r	No

Special Scoring

	ToD	ToT
Non Spin GPH	728.6	0.8268
Non Spin OSN	708.2	0.8472
N/S Perf. Line	104.3	0.728

Sails Limitations

Headsails	Spinnakers
6	3

Class Division Length
CDL = 6.908

Storm Sails Areas

Heavy Weather Jib	191.2
Storm Jib (JL=24.47)	70.84
Storm Trysail	124.0

Owner

Page 2 and 3 contain rig and sail dimensions but cannot be imported with MS Word. If you want the full PDF let me know.

Utilizing VPP based handicapping systems to determine a PHRF handicap

Dec. 9, 2015

03De15	RAM Optimizer with Blitz, Pend and Aff		Optimizer Factors		0	0	0.991464		Constant 569.0904				Based on W/L 12
ORR Cert #			ORC CR 10		GPH		W/L 12	DRYA PHRF	Predicted PHRF	Error		Error^2	ORC Yacht
												589.05	
42049	Natalie J	TP 52						-81					
41027	Details	SC 70						-66					
41113	Stripes	SC 70						-66					
41822	Vortices	J 145						-15					
42427	Not so Easy	Dehler 44 SQ						36					
	Skull Cracker	J 111	562.8		580.4		608.4	39	34	-5		23.85	Valentina
41210	Jahazi	J 120	569.3		587.4		617.6	48	43	-5		22.68	Euphoria
19933	Spirit	J44						30					
40083	Epic	Beneteau 42S7	580.2		597.9		629.4	51	55	4		15.30	Epic from Diana
	Das Boot	Beneteau First 40.7	584.1		602.2		631.9	54	57	3		11.67	Natural
	Northern Spy	DuFour 45E	587.5		607		638.2	60	64	4		13.41	N. Spy from Marias
	Blitz	Peterson 43	585		602.5		633.9	60	59	-1		0.36	Vagary aka Blitz
41283	Grizzly	Beneteau First 36.7	610.7		629.5		656.4	78	82	4		13.74	Kookaburra
42275	Alpha puppy	J-35	610.8		629.1		657.2	72	83	11		110.25	Jager
	Affirmed	Tripp 36	596.8		614.8		646.4	72	72	0		0.04	Eagle aka Affirmed
	Pendragon	Cont 43	587.8		605.3		635.7	75	61	-14		190.90	
	Fast Tango	NA 40	613.2		631.3		665.4	84	91	7		43.96	Assail
41264	Erica	T10						126					
41945	TFWB Relentless	J29 MH IB						117					
42463	Tequila	Exp 27						138					
19151	Kahuna	S2 9.1						132					
41639	Siochail	C&C 35 MK1	649.5		669		704.2	129	129	0		0.01	Rouge
41583	Karizmaddie	Cat 320 wk						171					
40852	Odyssey	Tart 34 - 10.5 E						171					
40502	Providence	Eric 35 Mk2						165					
		Yare	676.6		697.3		735	171	160	-11		129.14	Yare
41793	Donnybrook	Cat 34						171					
41297	Albacore (TC)	Pilot 33	689.7		710.6		753.2	174	178	4		13.55	Albacore
42501	Fly Buff	Declercq 36						213					
												589.05	
	Cynthia	morgan 41	628.8		648.5		679.6	132	105	-27			Terrapin

24Oct15 results

	CR 10	GPH	W/L 12	Constant	
1	0	0	0.991445	569.0773	589.05
2	1.104926	0	0	587.8093	737.44
3	0	1.077178	0	590.9827	729.76

Does not include Morgan 41 in optimization

Utilizing VPP based handicapping systems to determine a PHRF handicap

Dec. 9, 2015

03De15	RAM Optimizer with Blitz, Pend and Aff		Optimizer Factors 1.104926		0	0		Constant 387.8093			Based on Circular Random 10
ORR Cert #			ORC CR 10	GPH	W/L 12		DRYA PHRF	Predicted PHRF	Error	Error^2	ORC Yacht
										737.44	
42049	Natalie J	TP 52					-81				
41027	Details	SC 70					-66				
41113	Stripes	SC 70					-66				
41822	Vortices	J 145					-15				
42427	Not so Easy	Dehler 44 SQ					36				
	Skull Cracker	J 111	562.8	580.4	608.4		39	34	-5	24.57	Valentina
41210	Jahazi	J 120	569.3	587.4	617.6		48	41	-7	43.90	Euphoria
19933	Spirit	J44					30				
40083	Epic	Beneteau 42S7	580.2	597.9	629.4		51	53	2	3.15	Epic from Diana
	Das Boot	Beneteau First 40.7	584.1	602.2	631.9		54	58	4	12.80	Natural
	Northern Spy	DuFour 45E	587.5	607	638.2		60	61	1	1.78	N. Spy from Marias
	Blitz	Peterson 43	585	602.5	633.9		60	59	-1	2.04	Vagary aka Blitz
41283	Grizzly	Beneteau First 36.7	610.7	629.5	656.4		78	87	9	80.45	Kookaburra
42275	Alpha puppy	J-35	610.8	629.1	657.2		72	87	15	227.40	Jager
	Affirmed	Tripp 36	596.8	614.8	646.4		72	72	0	0.15	Eagle aka Affirmed
	Pendragon	Cont 43	587.8	605.3	635.7		75	62	-13	177.79	
	Fast Tango	NA 40	613.2	631.3	665.4		84	90	6	32.85	Assail
41264	Erica	T10					126				
41945	TFWB Relentless	J29 MH IB					117				
42463	Tequila	Exp 27					138				
19151	Kahuna	S2 9.1					132				
41639	Siochail	C&C 35 MK1	649.5	669	704.2		129	130	1	0.71	Rouge
41583	Karizmaddie	Cat 320 wk					171				
40852	Odyssey	Tart 34 - 10.5 E					171				
40502	Providence	Eric 35 Mk2					165				
		Yare	676.6	697.3	735		171	160	-11	123.80	Yare
41793	Donnybrook	Cat 34					171				
41297	Albacore (TC)	Pilot 33	689.7	710.6	753.2		174	174	0	0.07	Albacore
42501	Fly Buff	Declercq 36					213				
										737.44	
	Cynthia	morgan 41	628.8	648.5	679.6		132	107	-25		Terrapin

24Oct15 results

	CR 10	GPH	W/L 12	Constant	
1	0	0	0.991445	569.0773	589.05
2	1.104926	0	0	387.8093	737.44
3	0	1.077178	0	390.9827	729.76

Does not include Morgan 41 in optimization

Utilizing VPP based handicapping systems to determine a PHRF handicap

Dec. 9, 2015

03De15	RAM Optimizer with Blitz, Pend and Aff		Optimizer	Factors			Constant			Based on GPH	
				0	1.077178	0	590.9827				
ORR Cert #			ORC CR 10	GPH	W/L 12	DRYA PHRF	Predicted PHRF	Error	Error^2	ORC Yacht	
									729.76		
42049	Natalie J	TP 52				-81					
41027	Details	SC 70				-66					
41113	Stripes	SC 70				-66					
41822	Vortices	J 145				-15					
42427	Not so Easy	Dehler 44 SQ				36					
	Skull Cracker	J 111	562.8	580.4	608.4	39	34	-5	22.93	Valentina	
41210	Jahazi	J 120	569.3	587.4	617.6	48	42	-6	39.04	Euphoria	
19933	Spirit	J44				30					
40083	Epic	Beneteau 42S7	580.2	597.9	629.4	51	53	2	4.25	Epic from Diana	
	Das Boot	Beneteau First 40.7	584.1	602.2	631.9	54	58	4	13.65	Natural	
	Northern Spy	DuFour 45E	587.5	607	638.2	60	63	3	8.20	N. Spy from Marias	
	Blitz	Peterson 43	585	602.5	633.9	60	58	-2	3.93	Vagary aka Blitz	
41283	Grizzly	Beneteau First 36.7	610.7	629.5	656.4	78	87	9	82.83	Kookaburra	
42275	Alpha puppy	J-35	610.8	629.1	657.2	72	87	15	215.21	Jager	
	Affirmed	Tripp 36	596.8	614.8	646.4	72	71	-1	0.34	Eagle aka Affirmed	
	Pendragon	Cont 43	587.8	605.3	635.7	75	61	-14	195.07		
	Fast Tango	NA 40	613.2	631.3	665.4	84	89	5	25.40	Assail	
41264	Erica	T10				126					
41945	TFWB Relentless	J29 MH IB				117					
42463	Tequila	Exp 27				138					
19151	Kahuna	S2 9.1				132					
41639	Siochail	C&C 35 MK1	649.5	669	704.2	129	130	1	0.42	Rouge	
41583	Karizmaddie	Cat 320 wk				171					
40852	Odyssey	Tart 34 - 10.5 E				171					
40502	Providence	Eric 35 Mk2				165					
		Yare	676.6	697.3	735	171	160	-11	118.08	Yare	
41793	Donnybrook	Cat 34				171					
41297	Albacore (TC)	Pilot 33	689.7	710.6	753.2	174	174	0	0.21	Albacore	
42501	Fly Buff	Declercq 36				213					
									729.76		
	Cynthia	morgan 41	628.8	648.5	679.6	132	108	-24		Terrapin	

240ct15 results

	CR 10	GPH	W/L 12	Constant	
1	0	0	0.991445	569.0773	589.05
2	1.104926	0	0	587.8093	737.44
3	0	1.077178	0	590.9827	729.76

Does not include Morgan 41 in optimization